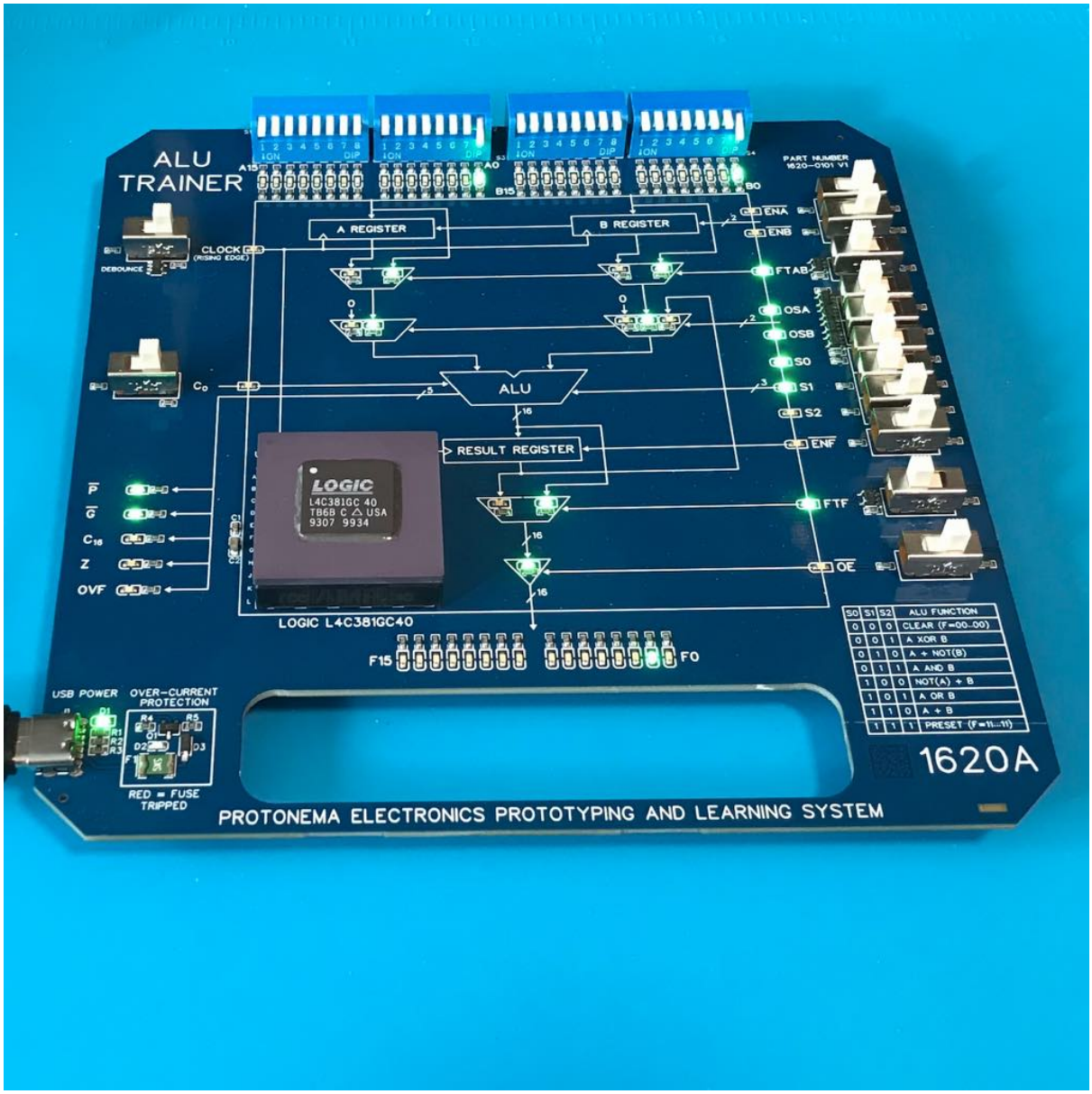
ALU Trainer

Assembly Instructions



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ABSTRACT: This document provides instructions on how to assemble and test a 1620A ALU Trainer. A complete bill of materials is included as an annex.

Suggestions and corrections should be directed to http://www.github.com/dslik/protonema/issues

Serial number: Assembly date: Assembled by:

USAGE

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Source location: https://github.com/dslik/protonema/

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Revision history

Table 1: Document Revisions

Version	Date	Change	Approver
1.0.0-draft.1	2023-09-30	Initial draft	D. Slik

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Part I

1620A Assembly Instructions

Section 1

Overview

This document describes the materials, processes, outcomes and verifications required to successfully assemble and test a 1620A ALU Trainer, a sub-component of the Protonema electronics prototyping and learning system.

A first-time reader should carefully review section 2 - prerequisites, and section 3 - preparation before beginning the assembly process.

This document serves both as instructions and as a record of the assembly of the product. When you finish each step in this document, sign your name (or apply your stamp) in the “Signature/Stamp” box on the right to provide a record of completion.

When things go wrong, this document provides guidance for common issues that have been encountered in the past. When this document does not provide guidance, please contact your quality management representative, who will help you fill out an exception report. These reports help improve process quality and product quality, and these reports are incorporated into future revisions of this document.

Always remember: If you are unable to successfully complete these instructions, that means the processes supporting you (including this document) have failed you. Our processes are built for your success, and by improving our processes, we help everyone succeed.

Section 2

Prerequisites

2.1 Required safety training

The following safety training units must be completed before assembling this product.

By signing (or applying your stamp) on the right, you indicate that you have completed the following training:

Table 2: Safety training

Item #	Description	Signature/Stamp
2.1.1	0402-8101 - Safety reporting policies and procedures training Key topics: Understanding policies and procedures around how to identify, contain and report a safety-related issue in the workplace, including damaged or malfunctioning equipment, leaks, spills, and other occupational hazards.	Stamp or sign here
2.1.2	0421-8101 - Material safety data sheets training Key topics: Understanding how to read material safety data sheets (MSDS) for materials you will be handling during product assembly, how they can affect your health and the health of the enviroment, how to safely handle and dispose of them, and what to do if there is a spill or accidential exposure.	Stamp or sign here
2.1.3	0422-8101 - Solder handling and disposal policies and procedures training Key topics: Understanding policies and procedures related to handling solder and solder paste, stencil cleaning, and solder disposal.	Stamp or sign here

2.2 Required skills training

The following skills training units must be completed before assembling this product.

By signing (or applying your stamp) on the right, you indicate that you have completed the following training:

Table 3: Skills training

Item #	Description	Signature/Stamp
2.2.1	0520-8101 - General components handling Key topics: Understanding of safe component handling, including reeled components, components in JEDEC trays, and loose components. Includes avoiding contamination, moisture control, and component inventory management.	Stamp or sign here
2.2.2	0522-8101 - IPC-A-610G - Acceptability of electronic assemblies Key topics: Covers visual acceptability requirements for electronic assemblies, including handling considerations, hardware installation, component placement, soldering, terminal connections, wiring, marking and cleanliness.	Stamp or sign here
2.2.3	0523-8101 - IPC-J-STD-001F - Soldered electrical connections Key topics: Covers soldering materials, general soldering and assembly requirements, wire and terminal connections, through-hole mounting, surface mounting of components, cleaning process requirements, PCB requirements, coatings and product assurance.	Stamp or sign here
2.2.4	0524-8101 - Electro-static discharge controls policies and procedures training Key topics: Understanding of ANSI/ESD S20.20 Electro-static discharge controls, ESD safety, the ESD control program, equipment and personnel grounding, EPAs, packaging and marking. Includes policies and procedures related to protecting equipment and components fromm electro-static discharge, clothing, protective equipment, material handling and labelling.	Stamp or sign here
2.2.5	0542-8101 - 5040-XTS reflow station Key topics: Safe and effective use of the 5040-XTS reflow station, including use of the pre-heater, the hot air system, and the soldering iron. Covers inspection and verification, cleaning, preferred settings and best practice techniques.	Stamp or sign here

Section 3

Preparation

3.1 Workspace

Before starting assembly, check out an assembly desk for a minimum of one hour. Units are assembled one at a time, with each unit taking 10 minutes.

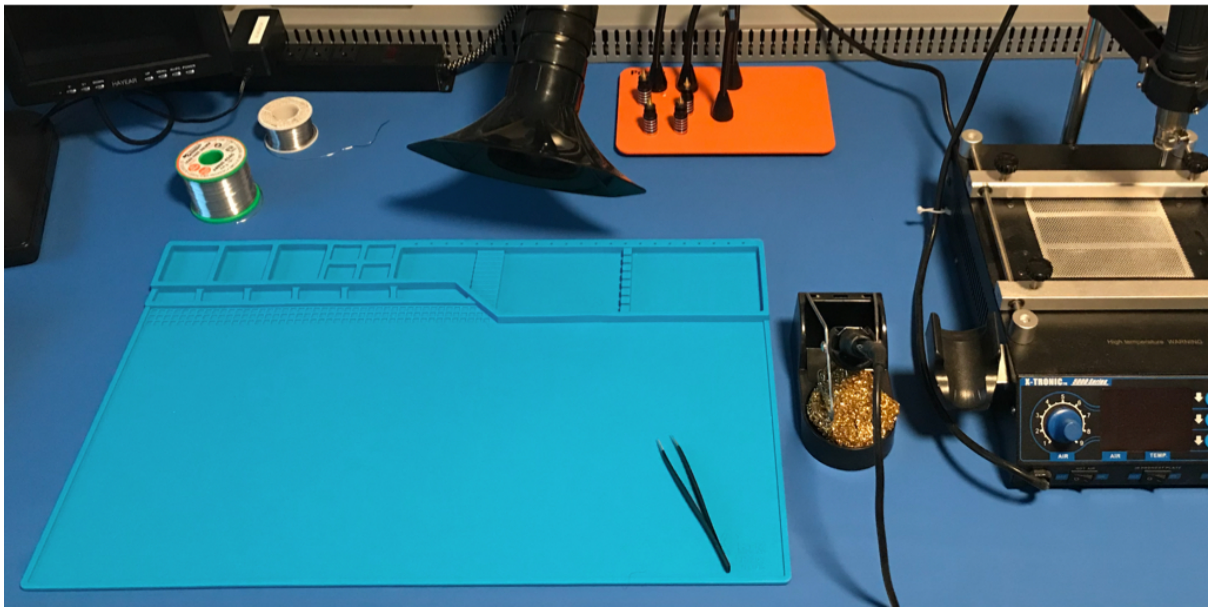


Fig. 1: Assembly Desk

Table 4: Prepare workspace

Step	Description	Signature/Stamp
3.1.1	Verify that the workspace has a clean assembly mat and anti-static mat, and that the cleaning record has been signed since last use.	Stamp or sign here

continues on next page

Table 4 – continued from previous page

Step	Description	Signature/Stamp
3.1.2	Verify that the HEPA fume extractor turns on, and that you can feel air suction from the nozzle.	Stamp or sign here
3.1.3	Verify that the 5040-XTS rework station soldering iron tip is not worn down. If it is worn down, obtain a new 900M-T-I tip from the stores department.	Stamp or sign here

3.2 Project consumables

Obtain each of the consumable items, as shown below, from the stores department:

Table 5: Assembly consumables

Item #	Description	Signature/Stamp
3.2.1	 Fig. 2: 1 pair ESD gloves If you prefer to use your own pair of ESD gloves, make sure they are tested before use.	Stamp or sign here
3.2.2	 Fig. 3: 1 spool MG Chemicals 4900 Lead Free No-Clean Wire Solder Sn96.2Ag2.8Cu0.4 (96.2%/2.8%/0.4%) 20 AWG	Stamp or sign here

3.3 Project tools

Obtain a tools container labelled “1XXX Assembly Tools” from the 1XXX section of the stores supply shelf. At your assembly desk, use Table 6 to verify that all the required tools are present.

If any required tools are missing, return all tools and the tools container to the stores department, and obtain another tools container.

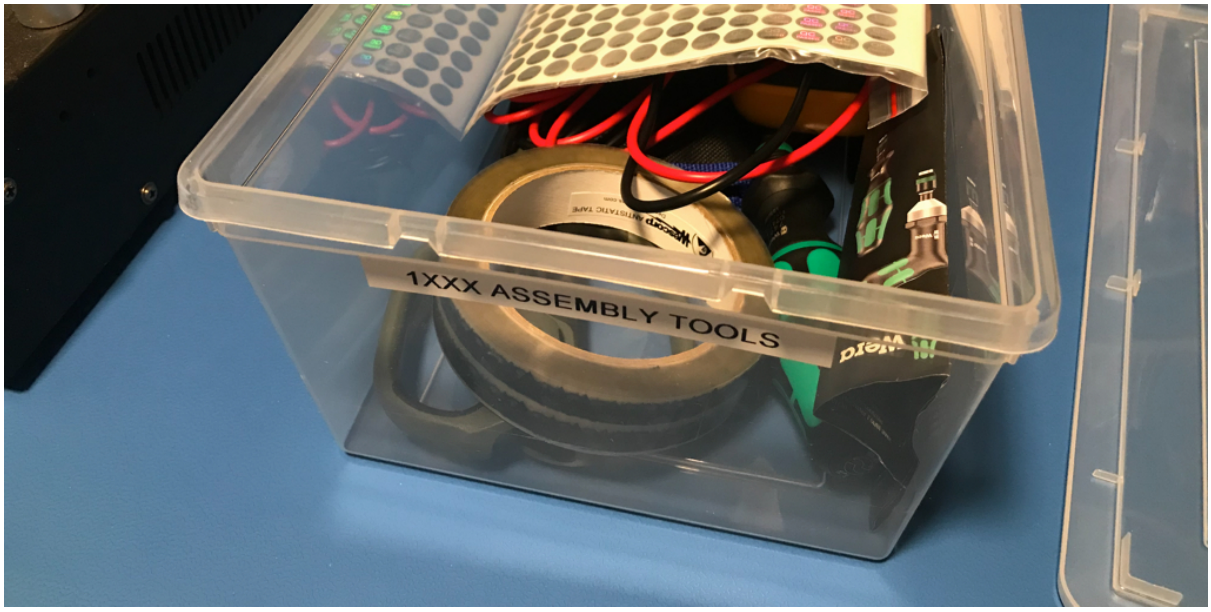


Fig. 4: Tools Container

Remove each of the following tools from the tools container, and place them on the anti-static mat of the assembly desk:

Table 6: Assembly tools

Item #	Description	Signature/Stamp
3.3.1	 Fig. 5: Hozan F-23 components tray	Stamp or sign here

continues on next page

Table 6 – continued from previous page

Item #	Description	Signature/Stamp
3.3.2	 Fig. 6: ESD tweezers	Stamp or sign here
3.3.3	 Fig. 7: Fine-tipped Sharpie marker	Stamp or sign here
3.3.4	 Fig. 8: Sissors	Stamp or sign here

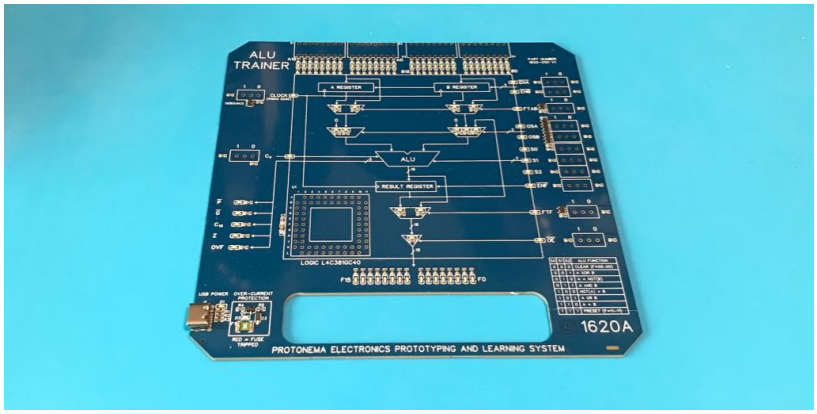
3.4 Parts preparation

3.4.1 PCBs and PCBAs

NOTICE: All PCBs and PCBAs must be handled with gloves to prevent marking with skin oils.

NOTICE: PCBs are removed from manufacturer packaging only when needed.

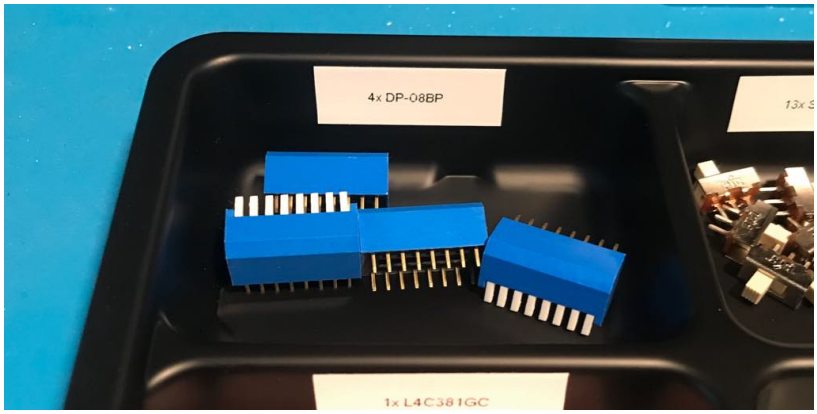
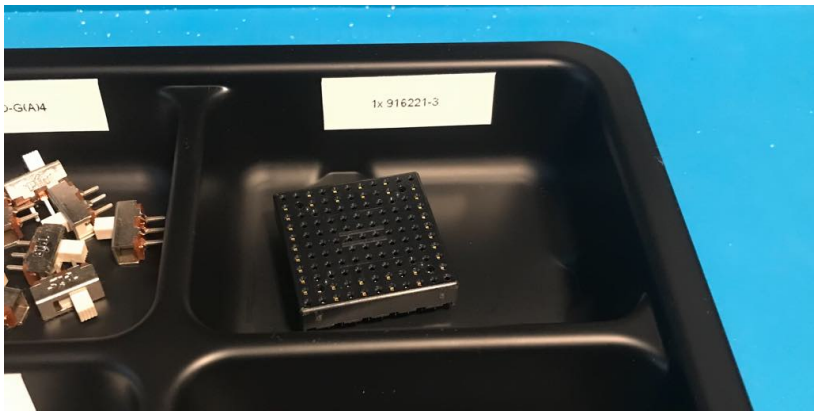
Table 7: PCBs and PCBAs

Item #	Description	Signature/Stamp
3.4.1.1	No marking required  Fig. 9: 1x 1620-0101 v1.0 - ALU Trainer PCB Assembly	Stamp or sign here

3.4.2 Loose components

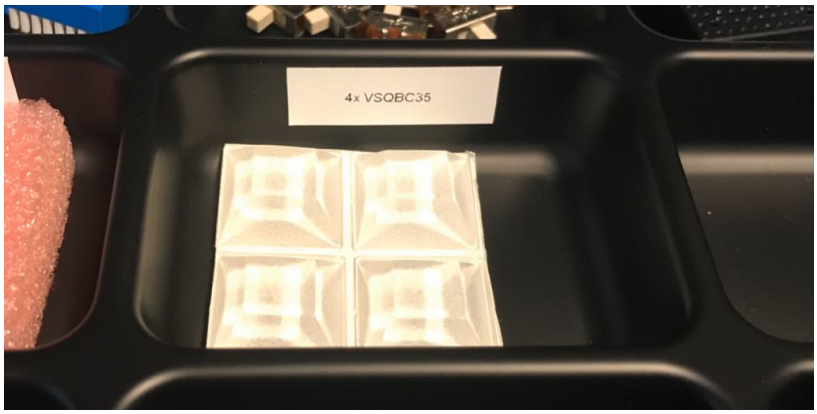
All loose components are stored on the shelf labelled “1XXX Components”. Take the components tray and obtain the following quanities of the folloiwng parts:

Table 8: Loose components

Item #	Description	Signature/Stamp
3.4.3.1	No marking required  Fig. 10: 4x DP-08BP - 8 Pin DIP switch	Stamp or sign here
3.4.3.2	No marking required  Fig. 11: 13x SS-12F60-G(A)4 - SPDT Switch	Stamp or sign here
3.4.3.3	No marking required  Fig. 12: 1x 916221-3 - PGA socket 11x11, 68 pin	Stamp or sign here

continues on next page

Table 8 – continued from previous page

Item #	Description	Signature/Stamp
3.4.3.4	No marking required  Fig. 13: 1x L4C3819GC - ALU IC	Stamp or sign here
3.4.3.5	No marking required  Fig. 14: 4x VSQBC35 - Clear rubber feet	Stamp or sign here

3.4.3 Packaging materials

All packaging materials are stored on the shelf labelled “1XXX Components”. Take the packaging box and obtain the following quanities of the folloiwng materials:

Table 9: Packaging materials

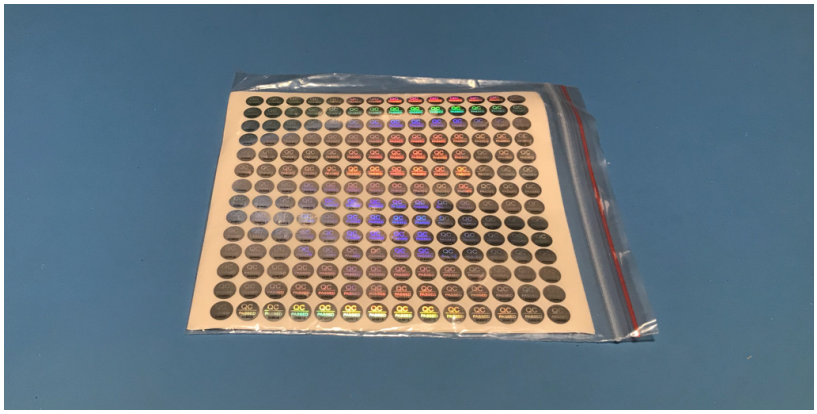
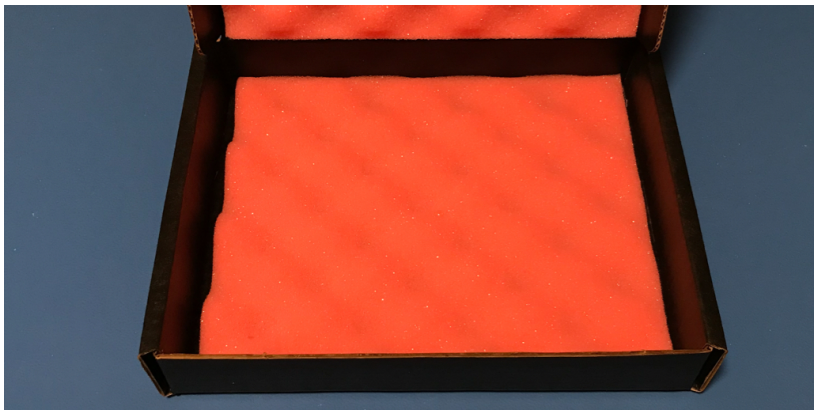
Item #	Description	Signature/Stamp
3.4.4.1	No marking required  Fig. 15: 1x QC Sticker	Stamp or sign here
3.4.4.2	No marking required  Fig. 16: 1x Large size anti-static bag	Stamp or sign here
3.4.4.3	No marking required  Fig. 17: 1x Packing box with foam inserts	Stamp or sign here

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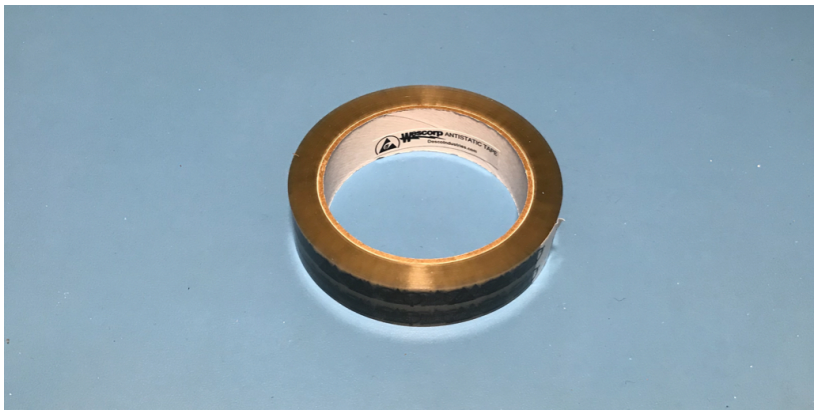
Table 9 – continued from previous page

Item #	Description	Signature/Stamp
3.4.4.4	No marking required  Fig. 18: 2x 1620A Stickers	Stamp or sign here
3.4.4.5	No marking required  Fig. 19: Roll of packing tape	Stamp or sign here

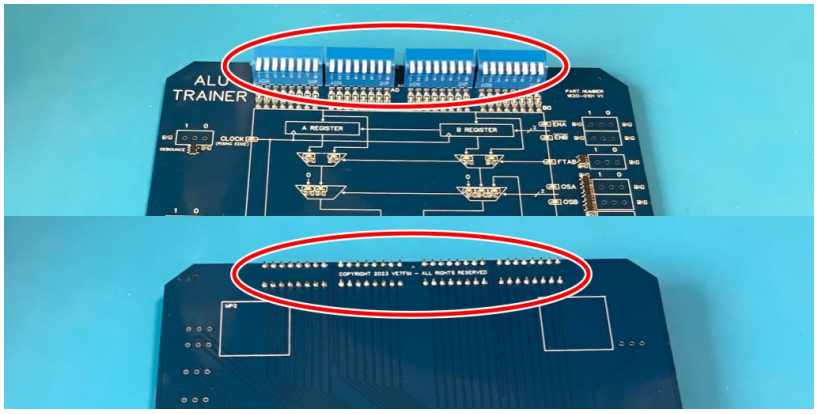
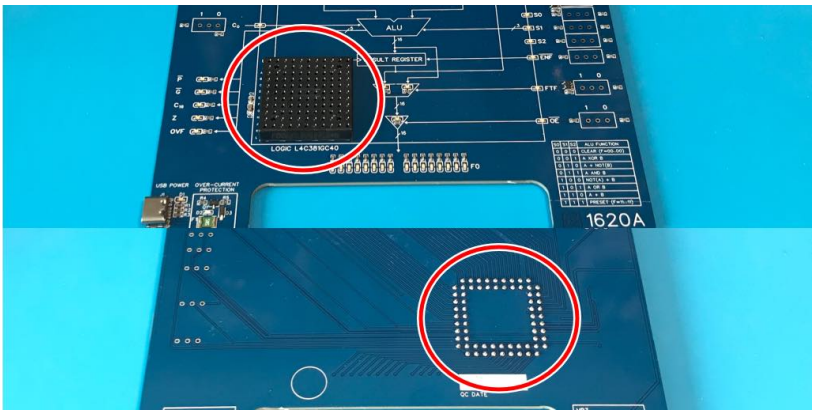
Section 4

Assembly

4.1 1620A assembly

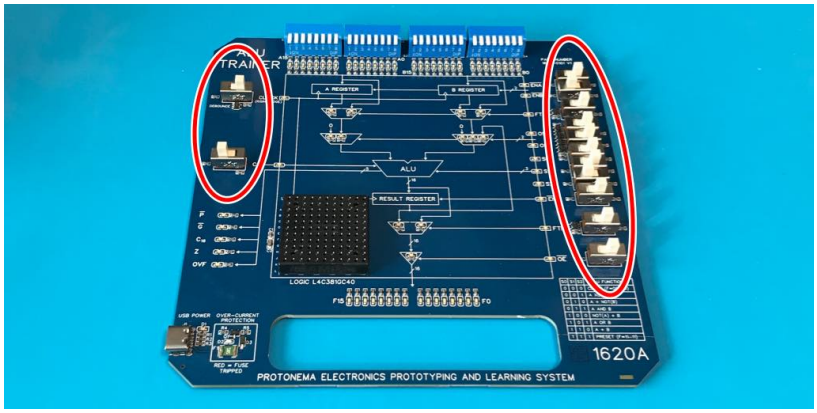
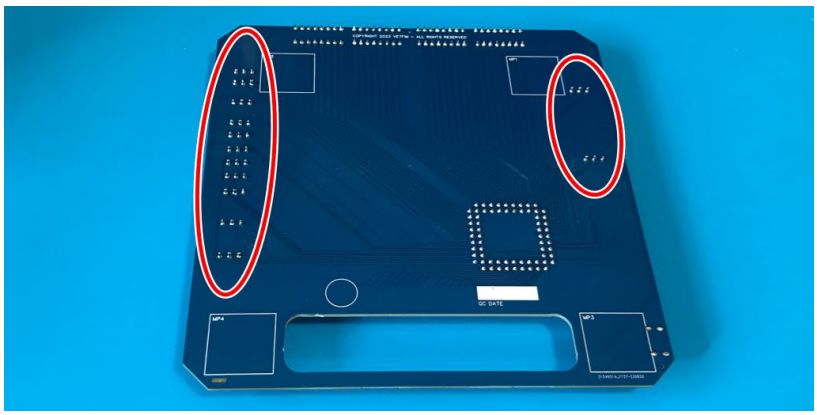
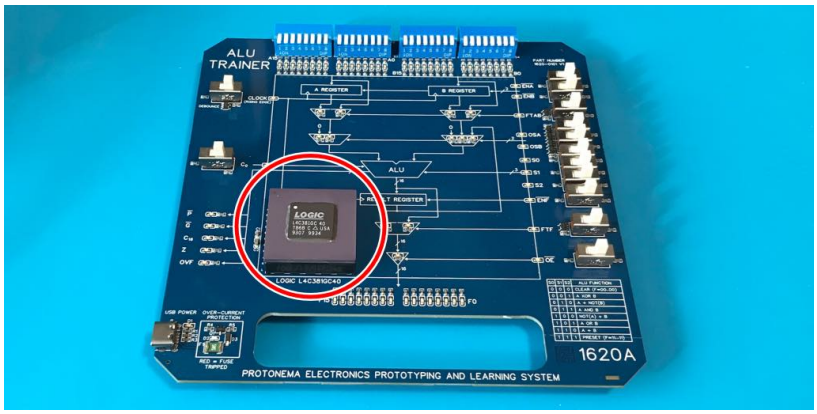
This assembly step takes five minutes.

Table 10: 1620A assembly steps

Step #	Description	Signature/Stamp
4.1.1	Solder S1 through S4 onto the 1620-0101 PCB.  Fig. 20: 1620-0101 PCB with S1 through S4 soldered on.	Stamp or sign here
4.1.2	Insert the PGA socket from the front of the board, with the “AMP” text facing towards the “LOGIC L4C381GC40” label. Flip the board, and solder one pin of the socket on, making sure that it is flush against the board.  Fig. 21: 1620-0101 PCB with U1 soldered on.	Stamp or sign here

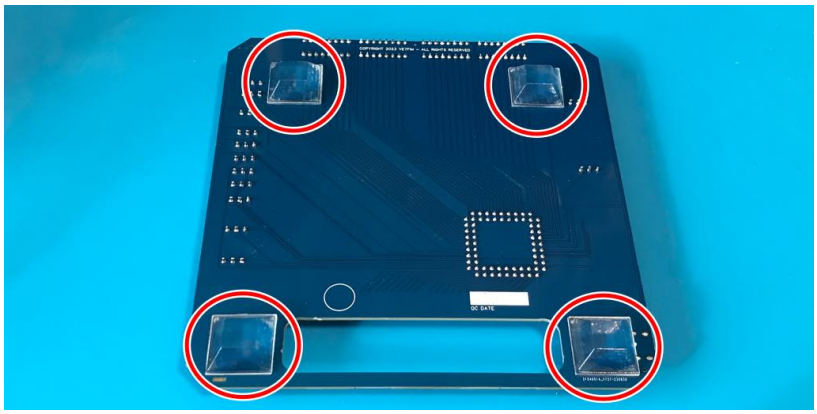
continues on next page

Table 10 – continued from previous page

Step #	Description	Signature/Stamp
4.1.3	Solder the 13 side siwtches onto the 1620-0101 PCB.  Fig. 22: 1620-0101 PCB with side switches soldered on (top).  Fig. 23: 1620-0101 PCB with side switches soldered on (bottom).	Stamp or sign here
4.1.4	Insert the LOGIC L4C3819G IC into the socket.  Fig. 24: 1620-0201 PCB with the IC inserted	Stamp or sign here

continues on next page

Table 10 – continued from previous page

Step #	Description	Signature/Stamp
4.1.5	Remove the protective paper from the clear rubber feet, and attach them to positions MP1 - MP4  Fig. 25: 1620-0101 PCB with feet mounted.	Stamp or sign here

Section 5

Test

5.1 Visual inspection

This test process takes two minutes.

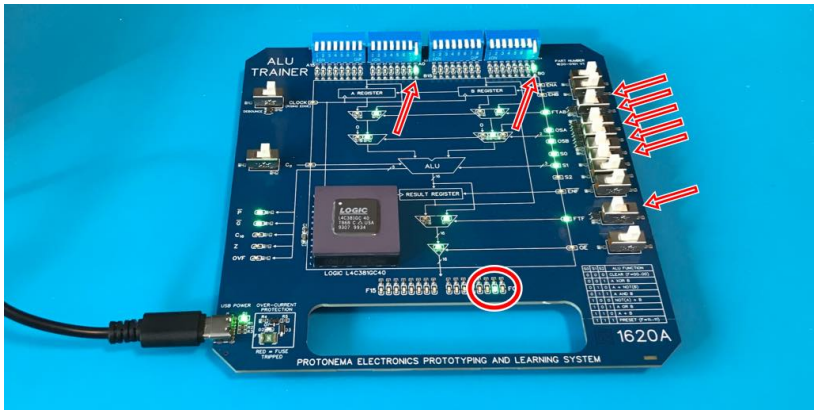
Table 11: 1620A visual inspection

Step #	Description	Signature/Stamp
5.1.1	Verify that there are no loose parts.	Stamp or sign here
5.1.2	Verify that there are no visible fingerprints.	Stamp or sign here

5.2 QC final check

This test process takes 2 minutes.

Table 12: 1620A QC final check

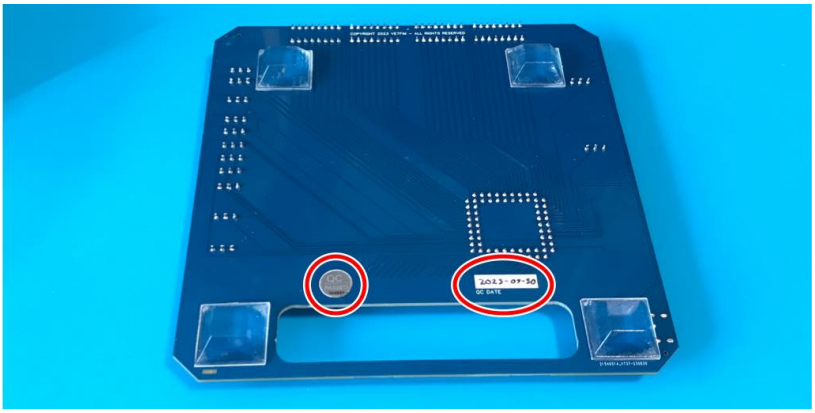
Step #	Description	Signature/Stamp
5.2.1	Turn off all switches on the 1620A. Turn on switches indicated below. Connect the 1620A to a USB power supply. Connect power. Verify that the LEDs illuminate as shown below. If test does not pass, write down the unexpected behaviour in the “Signature/Stamp” column on the right.  Fig. 26: Powered 1620A with power applied.	Stamp or sign here

5.3 QC PASS

Perform these steps only if all QC checks have passed.

This test process takes one minutes.

Table 13: 1620A QC approval

Step #	Description	Signature/Stamp
5.3.1	Using the tweezers, affix QC Passed sticker in location shown below, then write down the serial number from the QC sticker below the “Signature/Stamp” in the column to the right.  Fig. 27: 1620A with QC Passed sticker	Stamp or sign here
5.3.2	Take two photographs, one of the front of the 1620A, and one of the back of the 1620A.	Stamp or sign here

5.4 QC FAIL

Perform these steps if any QC checks have failed.

This test process takes two minutes.

Table 14: 1620A QC fail

Step #	Description	Signature/Stamp
5.4.1	Place the 1620A module in the anti-static bag.  Fig. 28: 1620A in anti-static bag.	Stamp or sign here
5.4.2	Take an A4 plastic bag, and place the 1620A, along with this document, in the “QC Fail” bin  Fig. 29: 1620A in QC Fail bin.	Stamp or sign here

Section 6

Packaging

6.1 1620A packing

This packaging process takes three minutes.

Table 15: 1620A packaging

Step #	Description	Signature/Stamp
6.1.1	Place the 1620A module in the anti-static bag.  Fig. 30: 1620 in anti-static bag.	Stamp or sign here
6.1.2	Seal the anti-static bag with a 1620A sticker.  Fig. 31: 1620A in anti-static bag with sticker.	Stamp or sign here

continues on next page

Table 15 – continued from previous page

Step #	Description	Signature/Stamp
6.1.3	Using the Sharpie pen, Write down the serial number of the 1620A on the sticker, at the end of the line listing the 1620A.  Fig. 32: Example photographs of the sealed bag with the serial number written on the sticker	Stamp or sign here
6.1.4	Place 1620A bag in the box on top of the bottom foam padding.  Fig. 33: 1620A in box.	Stamp or sign here
6.1.5	Take a photograph of the 1620A in the box.	Stamp or sign here

continues on next page

Table 15 – continued from previous page

Step #	Description	Signature/Stamp
6.1.6	Using the ESD tape, secure the lid of the box.  Fig. 34: 1620A in box, sealed with ESD tape.	Stamp or sign here
6.1.7	Affix a 1620A sticker to the lid of the box.  Fig. 35: 1620A in box with sticker.	Stamp or sign here
6.1.8	Using the Sharpie pen, Write down the serial number of the 1620A on the sticker, at the end of the line listing the 1620A.  Fig. 36: 1620A in box with sticker with serial number.	Stamp or sign here
6.1.9	Take a photograph of the sealed 1620A box.	Stamp or sign here

Section 7

Clean-up

7.1 Consumables

This packaging process takes five minutes.

Table 16: Consumables cleanup

Step #	Description	Signature/Stamp
7.1.1	If the ESD gloves have contacted solder paste, or are soiled, they shall be disposed of in the standard waste bin.	Stamp or sign here
7.1.2	If there is unused solder wire on the spool, it shall be returned to stores.	Stamp or sign here
7.1.3	Loose component packaging shall be disposed of in the standard waste bin.	Stamp or sign here

7.2 Tools

This cleanup process takes five minutes.

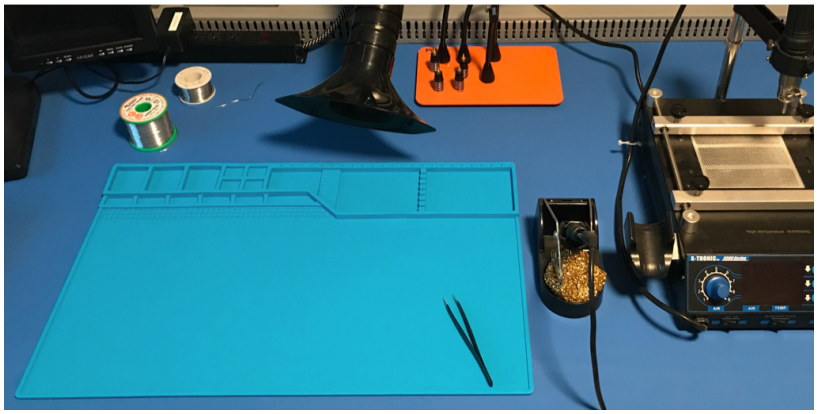
Table 17: Tools cleanup

Step #	Description	Signature/Stamp
7.2.1	All tools shall be returned to the assembly tools container, and returned to the stores supply shelf. If any tools are damaged or worn, return the container to stores, and let the manager know which tool is damaged or worn.	Stamp or sign here
7.2.2	Remove this document from the springback binder.	Stamp or sign here
7.2.3	Print a new copy of this document, and insert it into the springback binder that this document was originally in.	Stamp or sign here
7.2.4	Return the springback binder with the newly printed document to the 1620A section of the store supply shelf.	Stamp or sign here

7.3 Workspace

This packaging process takes five minutes.

Table 18: Workspace cleanup

Step #	Description	Signature/Stamp
7.3.1	Make sure that the workspace is clean and as it was when you started the assembly.  Fig. 37: Clean assembly workstation	Stamp or sign here

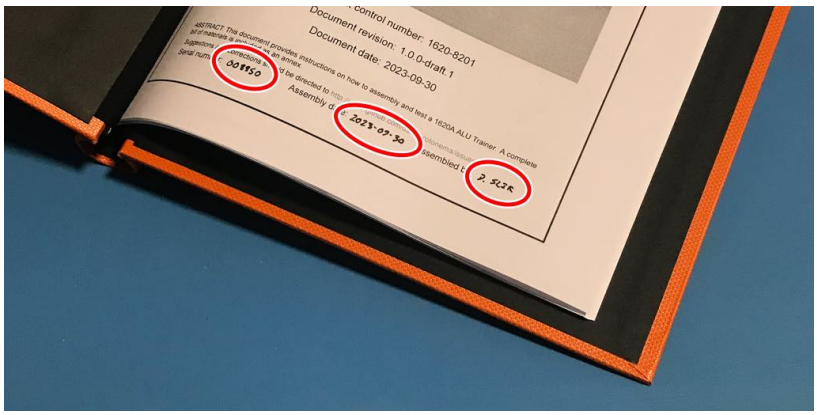
Section 8

Record keeping

8.1 1620A record keeping

This packaging process takes five minutes.

Table 19: 1620A record keeping

Step #	Description	Signature/Stamp
8.1.1	Write the serial number, the date, and your first and last name in large print on the bottom of the front cover of this document.  Fig. 38: Example of serial number on document cover	Stamp or sign here
8.1.2	Create a new folder under the 1620A folder, named with the serial number.	Stamp or sign here
8.1.3	Copy all photos taken during the assebly process into the newly created folder in step #2.	Stamp or sign here

continues on next page

Table 19 – continued from previous page

Step #	Description	Signature/Stamp
8.1.4	Remove this document from the binding clamps, scan the document, and save the scanned PDF into the newly created folder in step #2, with the name “1620A-SNAAAAAA.pdf”, where AAAAAA is replaced with the serial number.	Stamp or sign here
8.1.5	Three-hole punch the document, then file it at the end of the current month’s assembly records binder.	Stamp or sign here
8.1.6	Add an entry to the assembly records binder, “<Date> - 1620A - SN# AAAAAA - <Your Name>”, where <Date> is replaced with today’s date in ISO-8601 YYYY-MM-DD, where AAAAAA is replaced with the serial number of the 1620A, and where <Your Name> is replaced with your first and last name.	Stamp or sign here

Section 9

Process improvement

9.1 Feedback

Please submit an issue to the Protonema Issue Repository (http://www.github.com/dslik/protonema/issues) if you encounter any of the below situations:

- Error in this document
- Unclear directions
- Suggested process improvements
- Results of QC failure investigations
- Tool change suggestions

Quality processes and documentation is a team effort. This document would not exist without the participation and contributions of the entire assebly team.

Thank you for reading this assembly instructions document.

End of document.

Part II

1620A Annexes

Section 10

Printed Circuit Boards

10.1 1620-0101 PCB

Table 20: 1620-0101 PCB

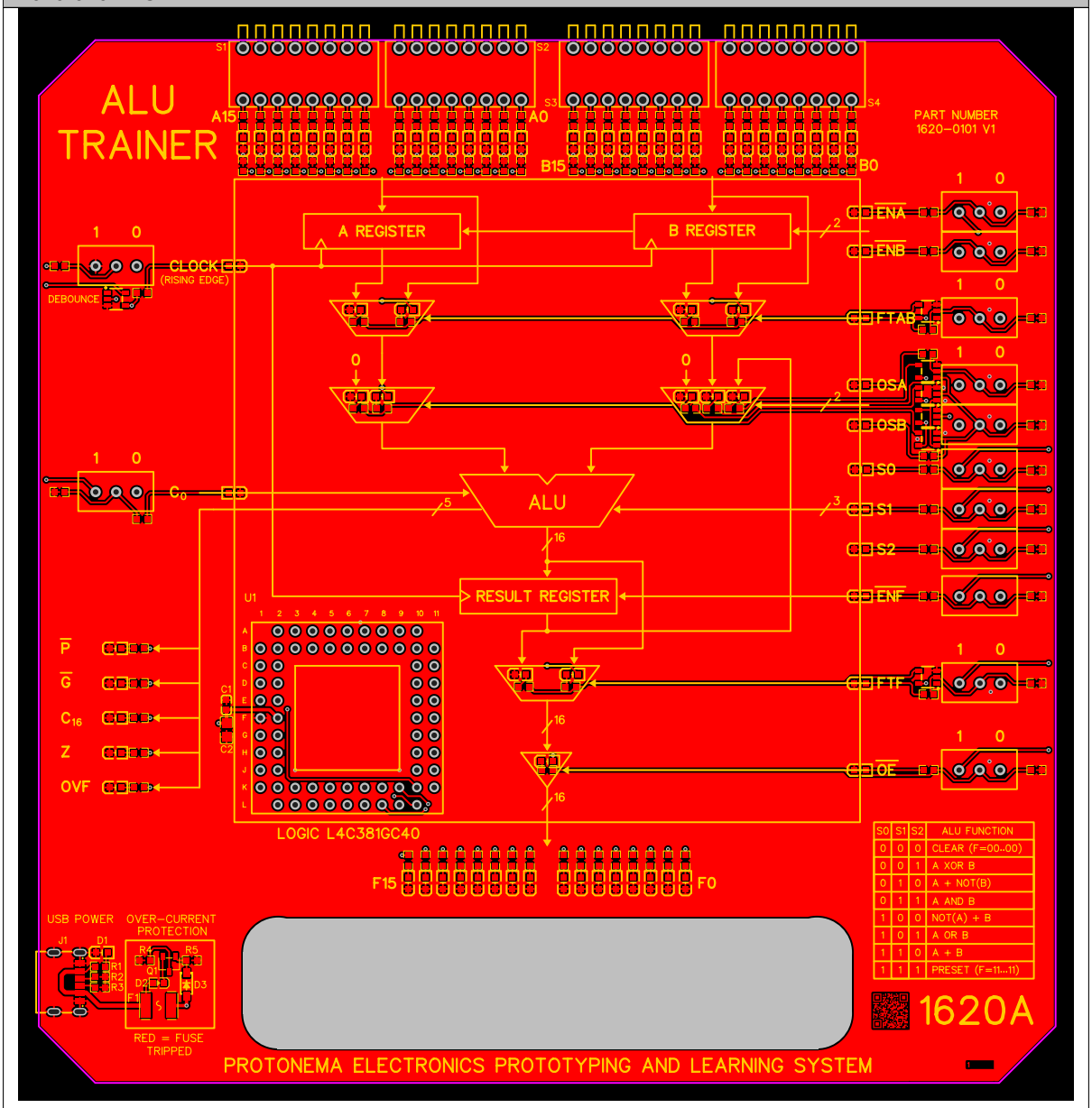
1620-0101 PCB


Fig. 39: 1620-0101 PCB Top

continues on next page

Table 20 – continued from previous page

1620-0101 PCB

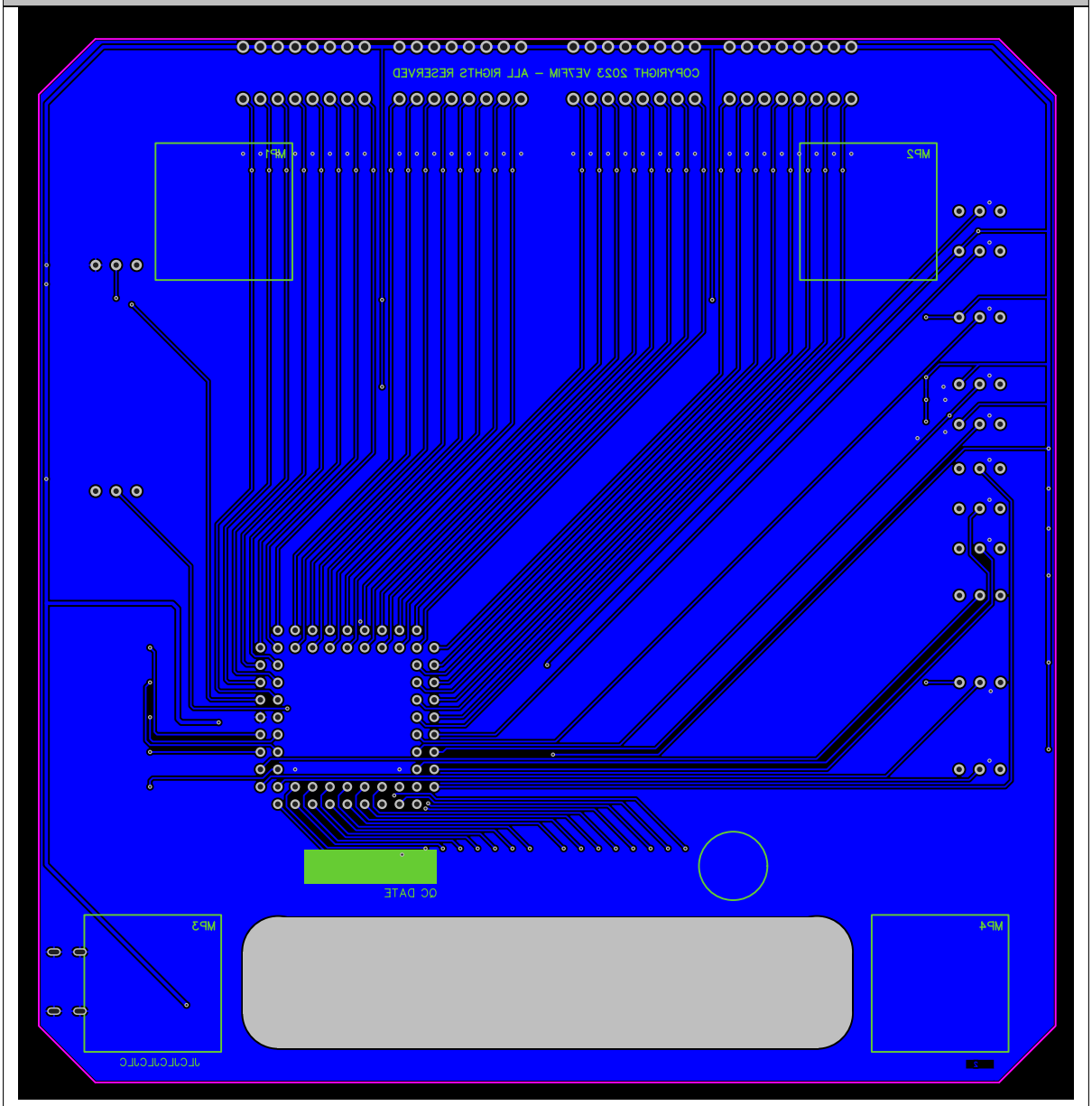


Fig. 40: 1620-0101 PCB Bottom

Section 11

Bill of materials

11.1 1620A ALU Trainer

The parts required to assemble a 1620 are listed in Table 21.

Table 21: 1620 parts

Reference Designation	Qty	Description	Manufacturer	Manufacturer Part Number	Supplier	Cost
1620-0101	1	Stamp PCBA	JLCPCB	SMT02308291373178-2154951A	JLCPCB	$8.51 CAD
S1 - S4	3	8Bit SPST 24V 25mA Blue Piano keys DIP Switch	Korean Hroparts Elec	DP-08BP	LCSC	$3.10 CAD
S5 - S18	13	SPDT Series Miniature Slide Switch	Shenzhen Kinghelm Elec	KH-SS12F17-G5 (subsitute for C&K SS-12F60-G)	LCSC	$0.35 CAD
U1 Socket	1	11x11 68 pin PGA socket	AMP	916221-3	Order By Description	
U1 IC	1	16-bit PGA Arithmetic Logic Unit	LOGIC / IDT	L4C381 / IDT7381 / IDT7383	Order By Description	
MP1 - MP4	4	Clear Rubber Feet	Cloverdale Supply	VSQBC35	Amazon	$1.61 CAD
SK1	1	QC Sticker	Order by Description			$0.0094 CAD
Total						$13.58 CAD

11.2 1620 Packaging

The parts required to package a 1620 are listed in Table 22.

Table 22: 1620 packing parts

Reference Designation	Qty	Description	Manufacturer	Manufacturer Part Number	Supplier	Cost
N/A	1	Static Shielding Bag 10” x 14”	Botron Company Inc.	B131014	Digikey	$0.48 CAD
N/A	1	CORREC-PAK SHIPPER 4 X 4 X 2” ID	Conductive Containers, Inc.	3180-3	Digikey	$11.83 CAD
1620-7001	2	1620A ESD Sticker	Jukebox Print			$4.00 CAD
Total						$16.31 CAD

Section 12

Reduction of Hazardous Materials

Compliance declarations, in BOM order.

12.1 MG Chemicals 4900

Table 23: MG Chemicals 4900 RoHS Compliance

Declaration for MG Chemicals 4900 -
https://www.mgchemicals.com/downloads/msds/01%20English%20Can-USA%20SDS/sds-4900-4917.pdf

MG Chemicals®

ISO 9001:2015 Quality Management System
SAI Global File #004008
Burlington, Ontario, Canada

SAC305 NO CLEAN SOLDER WIRE **4900–4917**

California Proposition 65 (Chemicals known to cause cancer or reproductive toxicity, USA)

This product does not contain any of the listed substances.

Europe

RoHS (Restriction of Hazardous Substances Directive)

This product does not contain any lead, cadmium, mercury, hexavalent chromium, PBB's, PBDE's, DEHP, BBP, DBP, or DIBP and complies with European RoHS regulations.

WEEE (Waste Electrical and Electronic Equipment Directive)

This product is not a piece of electrical or electronics equipment, and is therefore not governed by this regulation.

Section 16: Other Information

SDS Prepared by	MG Chemical's Regulatory Department
Date of Review	06 March 2020
Supersedes	09 July 2019

Reason for Changes: Update to the emergency phone number information.

Reference

1) ACGIH *2017 TLVs and BEIs: Based on the documentation of the threshold limit values for chemical substances and physical agents & biological exposure indices*, American Conference of Governmental of Industrial Hygienist Cincinnati, OH (2017).

2) All toxicological data were checked against the RTECS (Registry of Toxic Effects of Chemical Substances®)

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12.2 JLC lead-free PCB

Table 24: JLC PCB RoHS Compliance

Declaration for JLCPCB lead-free PCBs - https://s3.amazonaws.com/helpscout.net/docs/assets/59f1de7804286313cffbb22c/images/5d4d09562c7d3a036965d6a3/ROHS-Certificate-of-Compliance.jpg

ROHS-Certificate-of-Compliance.jpg 566×800 pixels 2022-08-16, 23:45

Shenzhen BCWT Technology Co., Ltd
1309, Dragon Year Building, Longgang Street ,Longgang Shenzhen

BCWT

Certificate of Compliance

Certificate Number: BCWR190813316R

Applicant:	**Shenzhen JLC Electronics Co.,Ltd.** 27th Floor, Olympics Building, No.2 Shangbao Road, Futian District Shenzhen, Guangdong, China
Manufacturer:	**Shenzhen JLC Electronics Co.,Ltd.** 27th Floor, Olympics Building, No.2 Shangbao Road, Futian District Shenzhen, Guangdong, China
Product:	**PCB**
M/N:	**FR-4**
Test Standard:	**IEC 62321-4:2013+AMD1:2017,IEC 62321-5:2013, IEC62321-6:2015,IEC 62321-7-1:2015, IEC62321-7-2:2017,IEC 62321-8:2017**

The EUT deacribed above has been tested by us and found in compliance with the council RoHS 2 Directive 2011/65/EU Annex II (EU) 2015/863 as amended by Directive (EU) 2017/2102. It is only valid in connection with the test report number: BCWR190813316R.

RoHS

BCWT TECHNOLOGY CO., LTD SHENZHEN
Aug. 07, 2019

This certificate of conformity is based on a single evaluation of the submitted sample(s) of the above mentioned product. it does not imply an assessment of the whole product and relevant. Directives have to be observed.
Tell: 0755-61954146 bcw@bcw-lab.com Http://bcw-lab.com

https://s3.amazonaws.com/helpscout.net/docs/assets/59f1de7804286...ages/5d4d09562c7d3a036965d6a3/ROHS-Certificate-of-Compliance.jpg Page 1 of 1

12.3 Cloverdale VSQBC35

Table 25: Cloverdale VSQBC35 Compliance

Declaration for Cloverdale VSQBC35 - N/A

BUMPER SPECIALTIES, INC.®

1607 Imperial Way, West Deptford, New Jersey 08066, USA
Phone: (856) 345-7650• Fax: (856) 345-7690
Website: www.bumperspecialties.com • Email: info@bumperspecialties.com

March 10, 2022

Compliance - EU Directive 2015/863 (RoHS 3), PAH, Phthlates and Nonylphenol

Please be advised that based on the information available to us from our raw material suppliers, the products manufactured by us do not contain, as intentional additives, any of the below referenced materials as referenced in the subject EU directive.

Further note that none of these materials are generated during production. We have confirmed this through a Certified Independent Laboratory who tested a representative sample of our bumper products.

- Hexavalent chromium compounds
- Cadmium and its compounds
- Mercury and its compounds
- Lead and its compounds
- Polybrominated diphenyl ethers (PBDEs)
- Polybrominated biphenyls (PBBs)
- Polycyclic Aromatic Hydrocarbons (PAH)
- Phthalates (DEHP, DBP, DINP, DIDP, DIBP, DNOP, BBP)
- Nonylphenol

Best Regards,

Joseph Ribinsky

Joseph Ribinsky
Director of Manufacturing
Bumper Specialties, Inc.