



HyPerforma G3Pro Universal Bioreactor Controller User's Guide

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Contents

	Warnings, safety, and warranty information	1
	How to use this guide	7
Chapter 1	G3Pro overview	9
	1.1 Introduction	9
	1.2 G3Pro components	10
	1.2.1 Overview	10
	1.2.2 Left side panel	12
	1.2.3 Right side panel	17
	1.2.4 Vessel Adapter Box	19
Chapter 2	Gas and liquid handling	20
	2.1 TruFlow gas manifold	20
	2.1.1 Connecting the TruFlow	21
	2.1.2 Connecting the DeviceNet cable to the TruFlow	23
	2.2 Sensors and auxiliaries	24
	2.3 Pumps	24
	2.3.1 Installing pump tubing	24
	2.3.2 Pump tubing flow rates	27
	2.4 Electrical	27
	2.4.1 Electrical connections	27
	2.4.2 Grounding	27
	2.4.3 System assembly	28
Chapter 3	Maintenance	29
	3.1 Cleaning	30
	3.2 Replacement parts	30
Chapter 4	G3Pro specifications	31
Appendices	Appendix A—Complete list of certifications	34

Warnings, safety, and warranty information

Thank you for purchasing this high-quality Thermo Scientific™ equipment. We have included safety information in this guide, based on our knowledge and experience. It is important, however, for you to work with your safety management personnel to ensure that this equipment is integrated into your safety practices. Please take some time to perform your own job safety analysis in order to identify and control each potential hazard.



WARNING: Read and understand this user's guide before using this equipment.

The Thermo Scientific™ HyPerforma™ G3Pro™ Universal Bioreactor Controller is designed to be operated under traditional pharmaceutical conditions. A general understanding of mixing systems and their operation is important prior to using the system for the first time. Read and understand the user's guide before operating; failure to do so could result in injury, loss of product, and/or voiding of the product warranty.



WARNING: Use ladders and elevated platforms with caution.

A few operations may require the use of a ladder or platform. Before use, ensure the ladder has been inspected and weight-rated for its user. When using a ladder or platform, be sure it is stable, maintain three points of contact, and make sure the steps are clean.



WARNING: Follow lockout/tagout procedures.

To prevent injury, when servicing equipment, use your company's lockout/tagout procedures to isolate electrical, mechanical, pneumatic, hydraulic, chemical, thermal, gravitational, or any other potential energy and protect workers from the release of hazardous energy.



WARNING: Hazardous voltage inside.

There is a risk of electrical shock and injury. Disconnect power before opening electrical components. Service should be performed only by Thermo Fisher Scientific service personnel.



WARNING: Static electricity may build up in BPCs.

- BioProcess Containers (BPCs) may act as insulators for electrostatic charge. If electrostatic charge is transferred to a BPC, the charge may be stored in the BPC and/or the product inside. This phenomena varies by product and use; therefore, it is the sole responsibility of the end user to ensure a hazard assessment is conducted and the risk of electrostatic shock is eliminated.
- Where applicable, a product contact stainless steel coupler may be grounded to the frame to dissipate electrostatic build up from the material within a BPC. It is good practice to dissipate electrostatic buildup by grounding all BPCs prior to coming in contact with them. When working with BPCs, the use of nonconductive materials, such as nonconductive gloves, is recommended.



WARNING: Rotating parts—entanglement hazard.

Rotating and moving parts can cause injury. Keep hands away from moving parts during operation.

- Do not operate this equipment unless the supplied guarding is in place and properly functioning.
- It is the responsibility of the end user to assess this equipment and ensure that equipment and safeguards are in good working condition, and that all operators are trained and aware of entanglement hazards and associated protective devices, such as hazard signs and guarding.

WARNING: Use caution with hazardous chemicals or materials.

Personnel servicing equipment need to know the hazards of any chemicals or materials that may be present on or in the equipment. Use general hazard communication techniques such as Safety Data Sheets, labels, and pictograms to communicate any hazards.



WARNING: Burst hazard—air under pressure.

The BPC chamber is under slight pressure under normal operating conditions. Normal passive venting prevents any excess of pressure building up within the chamber. Chamber pressure and inlet line pressure should be monitored for proper settings.

- Contents under pressure
- Do not exceed 0.03 bar (0.5 psi) BPC pressure
- Do not exceed 0.345 bar (5 psi) inlet pressure
- Ensure vent filter is properly positioned and working properly



WARNING: Hot surface—do not touch.

The heating jacket is designed to heat the inner vessel wall. Normal operating conditions generate heat and could create hot surfaces.

- Hot surface inside
- Contact with surfaces may cause burns
- Do not touch while in operation



WARNING: Pinch hazard.

The utility tower on the controller can be manually raised and lowered. Caution should be used to avoid pinching an operator or causing damage to the equipment.



WARNING: The Thermo Scientific HyPerforma G3Pro Universal Bioreactor Controller may not be installed in a potentially explosive atmosphere as set forth in the applicable EU ATEX Directive.

It is the responsibility of the end user to review and understand the potential dangers listed in the ATEX 2014/34/EU guidelines.

Controller cabinets

The controller does not contain user-serviceable internal components. Any service must be performed by Thermo Fisher Scientific service personnel, only.

Never open the controller cabinet, unless specifically instructed to do so by a Thermo Fisher Scientific service team member.

All auxiliary equipment should be connected to the controller before the controller is connected to the main power supply. If a piece of auxiliary equipment is to be added or replaced, first turn off the power to the controller and disconnect it from the main power.

Always disconnect the power before moving a control cabinet or other piece of equipment.

Protective earth grounding

Protective earth grounding must be verified prior to plugging a piece of auxiliary equipment into any electrical outlet. Ensure the connection is properly earth grounded.

Because current leakage is possible with any electrical appliance, all controllers must be earthed (grounded), either by use of a grounding stud on the exterior of the cabinet or connection to a properly earthed circuit. Thermo Fisher Scientific recommends use of both a grounding stud and earthed circuit.

Handling equipment

Much of the equipment created or supplied by Thermo Fisher Scientific is significantly heavy. Never attempt to move a piece of equipment without assistance. Refer to the equipment specifications (Chapter 4) to find weight information before handling any equipment.

Control cabinets are made of metal (steel or aluminum) that is finished before being sent to a customer site. However, extreme care should be taken around edges or corners of control cabinets and other equipment, as these surfaces can be very sharp.

Cords, cables, and tubing

Cords, cabling, and tubing should be placed out of the way of other equipment, chairs, other obstacles. Cords or tubing that are subjected to friction or repeated pinching from foot traffic, chairs, etc. can become a safety hazard.

Pumps

Pump tubing should be examined regularly and changed when the tubing shows signs of wear. Failure to monitor the condition of the tubing could result in leakage of possibly hazardous material, and could also harm personnel and equipment.

Pump heads on some controller models have a safety switch that prevents the pump from operating when the head is opened. If your model is equipped with this feature, under no circumstances should the safety switch be bypassed or disabled.

Keep hands away from the pump when running, such as when “jogging” the pump to feed tubing through or when priming the tubing.

Warranty information

Any warranties, if applicable, covering this equipment exclude: (a) normal wear and tear; (b) accident, disaster or event of force majeure; (c) your misuse, fault or negligence; (d) use of the equipment in a manner for which it was not designed; (e) causes external to the equipment such as, but not limited to, external puncturing, power failure or electrical power surges; (f) improper storage and handling of the equipment; (g) use of the equipment in combination with equipment or software that we did not supply; (h) equipment sold to you as 'used' products; (i) contact with improperly used or unapproved chemicals or samples; (j) installation, removal, use, maintenance, storage, or handling in an improper, inadequate, or unapproved manner, such as, but not limited to, failure to follow the documentation or instructions in the deliverables or related to the equipment, operation outside of stated environmental or other operational specifications, or operation with unapproved software, materials or other products; (k) manufacture in accordance with requirements you gave us; (l) installation of software or interfacing or use of the equipment in combination with software or products we have not approved; (m) use of the deliverables or any documentation to support regulatory approvals; (n) the performance, efficacy or compatibility of specified components; and (o) the performance of custom equipment or products or specified components or achievement of any results from the equipment, specified components or services within ranges desired by you even if those ranges are communicated to us and are described in specifications, a quote, or a statement of work. **ADDITIONALLY, ANY INSTALLATION, MAINTENANCE, REPAIR, SERVICE, RELOCATION OR ALTERATION TO OR OF, OR OTHER TAMPERING WITH, THE EQUIPMENT PERFORMED BY ANY PERSON OR ENTITY OTHER THAN US WITHOUT OUR PRIOR WRITTEN APPROVAL, OR ANY USE OF REPLACEMENT PARTS WE HAVE NOT SUPPLIED, WILL IMMEDIATELY VOID AND CANCEL ALL WARRANTIES WITH RESPECT TO THE AFFECTED EQUIPMENT. IF THE EQUIPMENT IS TO BE USED IN THE UNITED STATES, WE MAY VOID YOUR WARRANTY IF YOU SHIP THE EQUIPMENT OUTSIDE OF THE UNITED STATES.**

Use restrictions

You must use this equipment in accordance with our documentation and if applicable, with our other associated instructions, including without limitation, a “research use only” product label or “limited use” label license. This equipment is intended for research use or further manufacturing in bioprocessing applications and not for diagnostic use or direct administration into humans or animals, we do not submit the equipment for regulatory review by any governmental body or other organization, and we do not validate the equipment for clinical or diagnostic use, for safety and effectiveness, or for any other specific use or application.

How to use this guide

Scope of this publication

This document covers information about installation, operation, specifications, and maintenance of the Thermo Scientific HyPerforma G3Pro Universal Bioreactor Controller.

Document change information

A summary of the changes that have been made to this document are listed below.

Revision	Date	Section	Change	Author
Rev. A	07/2021	--	Initial release	T. Golightly

Questions about this publication

If you have any questions or concerns about the content of this publication, please contact **technicaldocumentation@thermofisher.com** and your Thermo Fisher Scientific sales team.

Related publications

Other publications related to the Thermo Scientific G3Pro Universal Bioreactor Controller are listed below.

Publication	Document number
TruBio Bioprocess Control Software Version 5.0 User's Guide	DOC0088

Abbreviations/acronyms

See the list below for definitions of abbreviations and acronyms used in this publication.

BPC	BioProcess Container
COTS	Commercial off-the-shelf
E-Box	Electrical control panel
E-Stop	Emergency stop button
GFCI	Ground fault circuit interrupter
HMI	Human-machine interface
RTD	Resistance temperature detector
S.U.B.	Single-Use Bioreactor
S.U.M.	Single-Use Mixer
TCU	Temperature control unit
VAB	Vessel Adapter Box
VFD	Variable frequency drive



G3Pro overview

1.1 Introduction

The Thermo Scientific™ HyPerforma™ G3Pro Universal Bioreactor Controller is a control cabinet for use with a DeltaV™ control platform from Emerson™ Process Management and Thermo Scientific™ TruBio™ DV Control Software.

The G3Pro Universal Controller is designed to operate vessels, up to 2000 L, from Thermo Scientific as well as other major brands.

The controller consists of a utility tower and a Vessel Adapter Box (VAB). The stainless-steel utility tower enclosure is rated NEMA12 or optionally NEMA4X. The enclosure contains the sensor transmitters, power supplies, pumps, and I/O. It also contains the hardware required to connect to the control network and interface to the TruBio Software.

Each controller also has eight (8) additional analog input connectors (4–20 mA) plus four (4) auxiliary control loop connectors (0–10 V) for system expansion capability.

A separate computer is required for the controller's user interface. Consult your local sales representative for the required capabilities. The information is also available in the TruBio Bioprocessing Software User's Guide Version 5.0 (DOC0088).

1.2 G3Pro components

1.2.1 Overview

The G3Pro Controller is designed to be mounted on the control cart. Each cart can support two (2) utility towers, mounted on opposite sides of the cart. The top of the cart is designed to hold the TruFlow gas manifold(s).

The cart and the utility tower are pre-assembled by Thermo Scientific personnel and shipped together.

The utility tower contains the pH and DO sensor transmitters, temperature sensors, the SmartPump controls, and the vent heater power and control.

The VAB provides the interface between the utility tower and the Single-Use Bioreactor (S.U.B.). It contains load cell and pressure transmitters, agitator control, and heating blanket control. The VAB is customized to match each specific vessel and is bolted to the S.U.B. cart. When the G3Pro Controller is switched from control of one vessel to control of another, the VAB of the new vessel is used.

The cabinet doors of both the utility tower and the VAB(s) are secured with a quarter-turn latch with a flush slotted insert. As an option, the cabinet doors can be equipped with a keyed lock for security and to conform to cGMP regulations.

The control cart is equipped with an adjustable cable guide (the structure extending out from the top of the cart) designed to carry the cables and tubing from the cart to the bioreactor/fermenter vessel. This protects the cables and tubing from being tangled or obstructed by other equipment or laboratory activity.

Because the G3Pro Controller can be configured in a number of different ways to fit individual user needs, the illustrations shown in this manual are intended to be representative only.

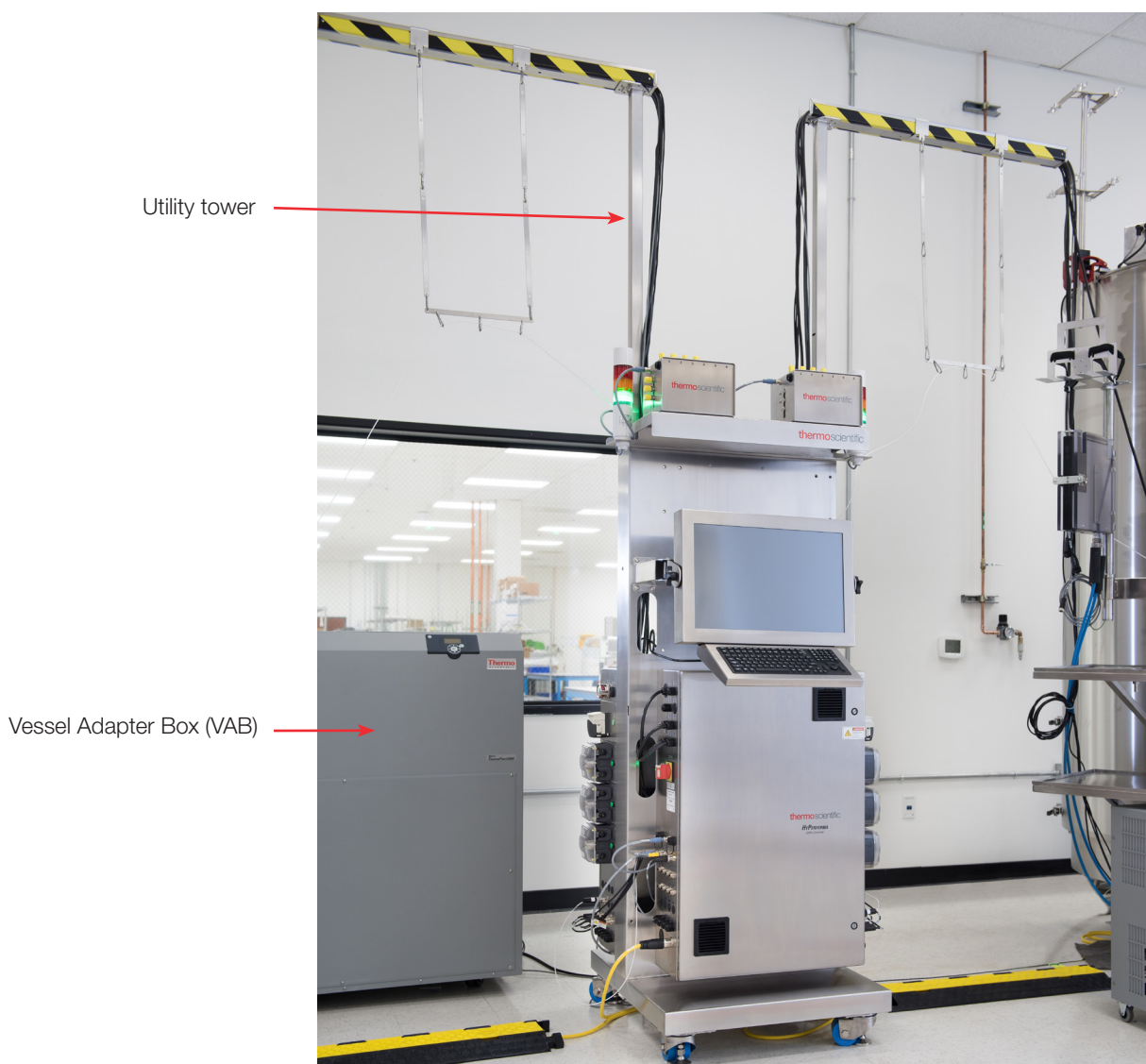


Figure 1.1. VAB and utility tower for the G3Pro.

The image above shows the G3Pro utility tower on its cart with two TruFlow gas manifolds on top.

The associated VAB contains the pressure transmitter, the agitator transmitter, load cell transmitters, and the electric blanket control (used to heat vessels smaller than 250 L).



Figure 1.2. Vessel Adapter Box mounted on a Millipore bioreactor.

The image above shows the VAB mounted on a Millipore™ bioreactor.

The VAB will vary depending on S.U.B.; some are large as shown here; some will be much smaller. See section 1.2.4.

1.2.2 Left side panel

For clarity, the left side panel is shown in two separate figures. Figure 1.3 shows the upper portion of the panel.

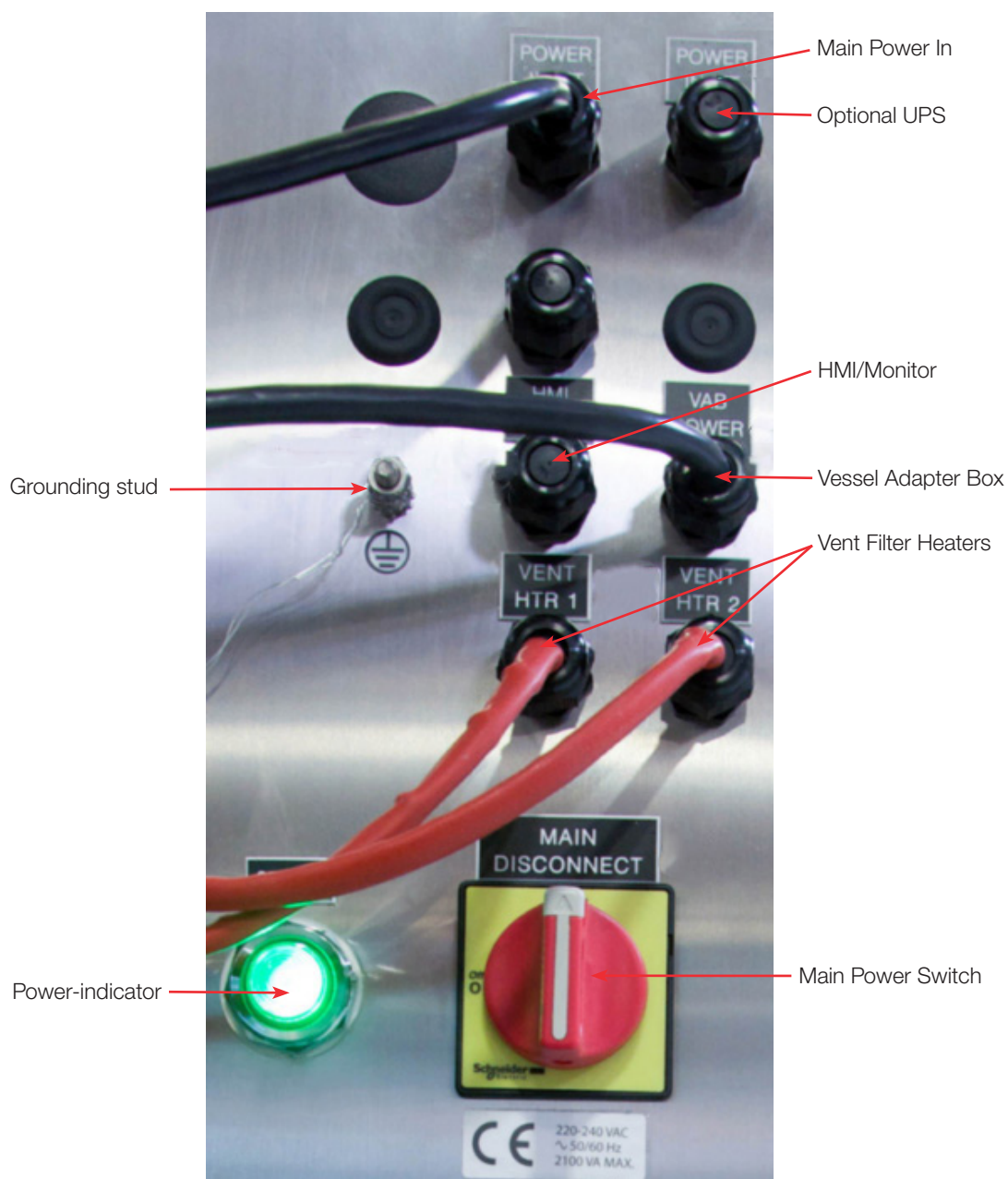


Figure 1.3. Upper half of the left side panel.

The components listed are described below:

- Main Power In**—Used to supply power to the unit and is either 120 VAC or 240 VAC based on facility requirements. Ensure that adequate power is supplied to the Controller (15 A at 120 VAC or 6 A at 240 VAC).

- **Optional Universal Power Supply (UPS)**—A backup power unit (APC Smart UPS). It supplies power for a given amount of time (approximately 20 minutes) in the event of power failure which could be catastrophic during a process event.
- **HMI/Monitor**—Supplies power for the computer monitor.
- **Vessel Adapter Box**—This connector provides control for large S.U.B. electric heaters. Used in conjunction with the Vessel Heater In connector when operating without a TCU.
- **Vent Filter Heaters**—These connectors provide a paired connection for each of the two (2) vent filter heaters. Power is supplied through the receptacles. **Note:** Because the voltage used for the unit is carried through to the vent filter heater receptacles, you must ensure that the vent filter heaters are rated for the appropriate voltage.
- **Main Power Switch (On)**—Turns main power on and off.
- **Ground Stud**—Used to connect a permanent true earth bonding conductor (see section 2.4.2).
- **Power-indicator/Status light**—Illuminates green when power is on.

Figure 1.4 shows the lower portion of the left side panel.

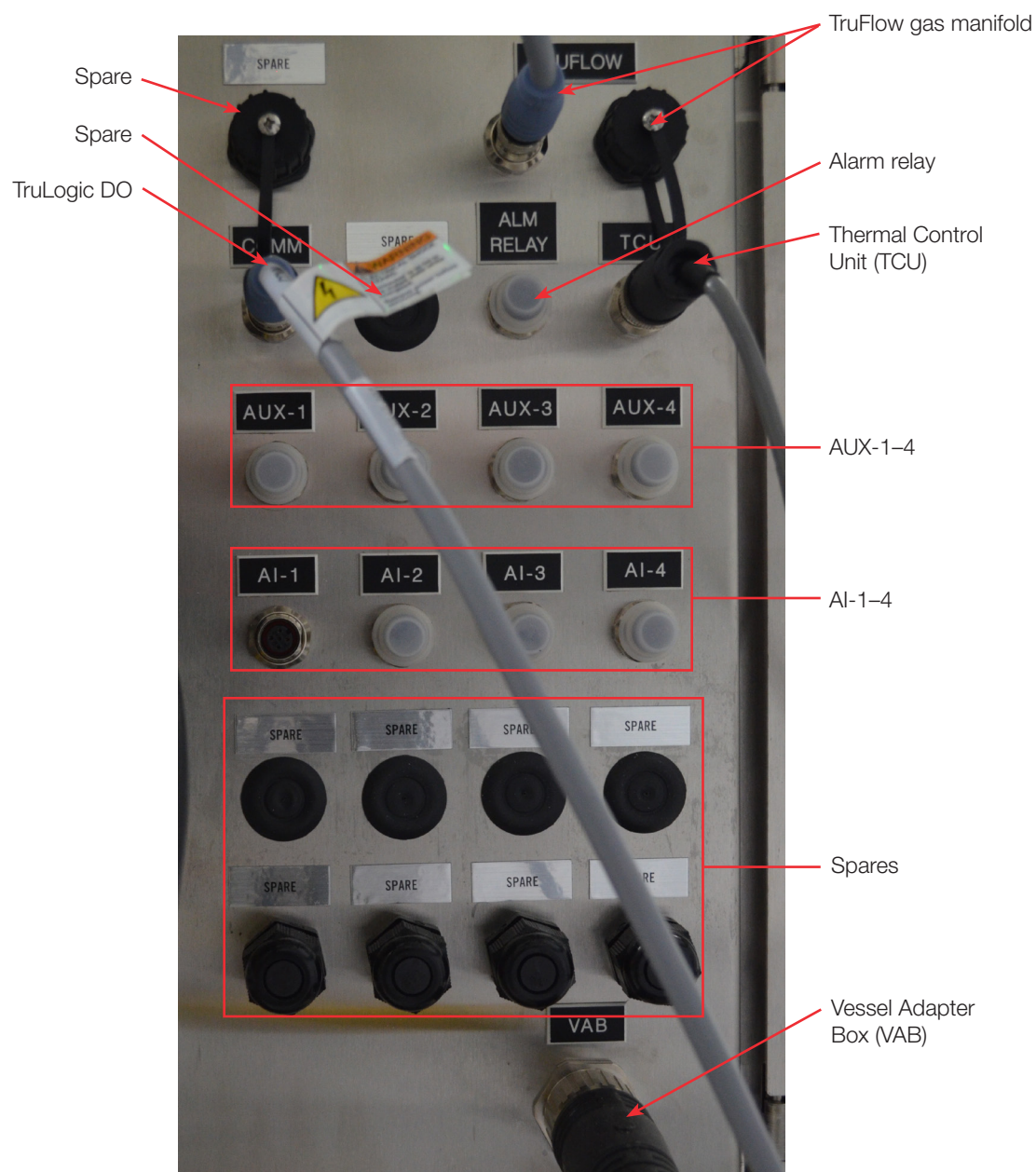


Figure 1.4. Lower half of the left side panel.

The components listed are described below.

- **TruFlow**—Used to connect the TruFlow gas manifold (see section 2.1).
- **Alarm Relay**—Dry contact relay that can be used to activate a building alarm if a user-configured alarm condition is detected by the system.

- **Thermal Control Unit (TCU)**—8-pin connector that provides control of the TCU, if used. Used only on vessels larger than 250 L.
- **TruLogic** (required for DeltaV platform)
- **AUX-1 through 4**—5-pin (0–10 V) auxiliary connectors for control loops. **Note:** Spare connectors are available as needed.
- **AI-1 through 4**—5-pin analog (0–20 mA) inputs. They are input only, with no control capacity.
- **Vessel Adapter Box (VAB)**—Enables you to easily switch vessels according to the requirements of the process.

Auxiliary input pin-out

The connectors marked AUX 1 through 4 are for control loops requiring feedback from the controller and contain analog input (AI) and analog output (AO).

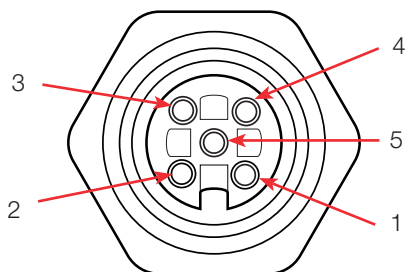


Figure 1.5. 5-pin connector.

The connectors are 5-pin and are set up as follows:

1. Setpoint +
2. Setpoint Return
3. Process Value +
4. Process Value Return
5. Shield

The connectors marked AI 1 through 8 are input-only and are used for auxiliaries such as CO₂ sensors.

1. +24 V
2. 24 V Return
3. Process Value +
4. Process Value Return
5. Shield

1.2.3 Right side panel

For clarity, the right side panel is shown in two separate figures. The upper half of the right side of the control tower contains the Start/Reset button, Emergency Stop button, audible alarm, and four pumps and four pump jog buttons.



Figure 1.6. Upper half of the right side panel with pump heads.

The components listed are described below.

- **Start/Reset**—Pressed after system is powered on with the Main Power Switch. It will allow the systems to enter the “ready to use” status. **Note:** The Start/Reset button must also be pressed after an emergency stop to restart the system.
- **Emergency Stop (E-Stop)**—Stops all activities of the G3Pro controller, although sensor monitoring will continue. When the button is pressed, it will remain depressed and show a red light, as well as sounding an audible alarm. To release the E-Stop button, turn it 1/4 turn clockwise and it will return to the original position, silence the alarm, and shut off the red light.
- **Pump Heads**—Controlled by SmartPump motors with individual microprocessors for maximum control and accuracy. The pump heads are peristaltic variable-speed Watson-Marlow™ stop on open pump heads, the size determined by customer specifications (see Table 2.1).
- **Pump jog**—Used run the pump at a constant low speed for as long as the button is depressed.

The lower half of the right side panel is shown below.

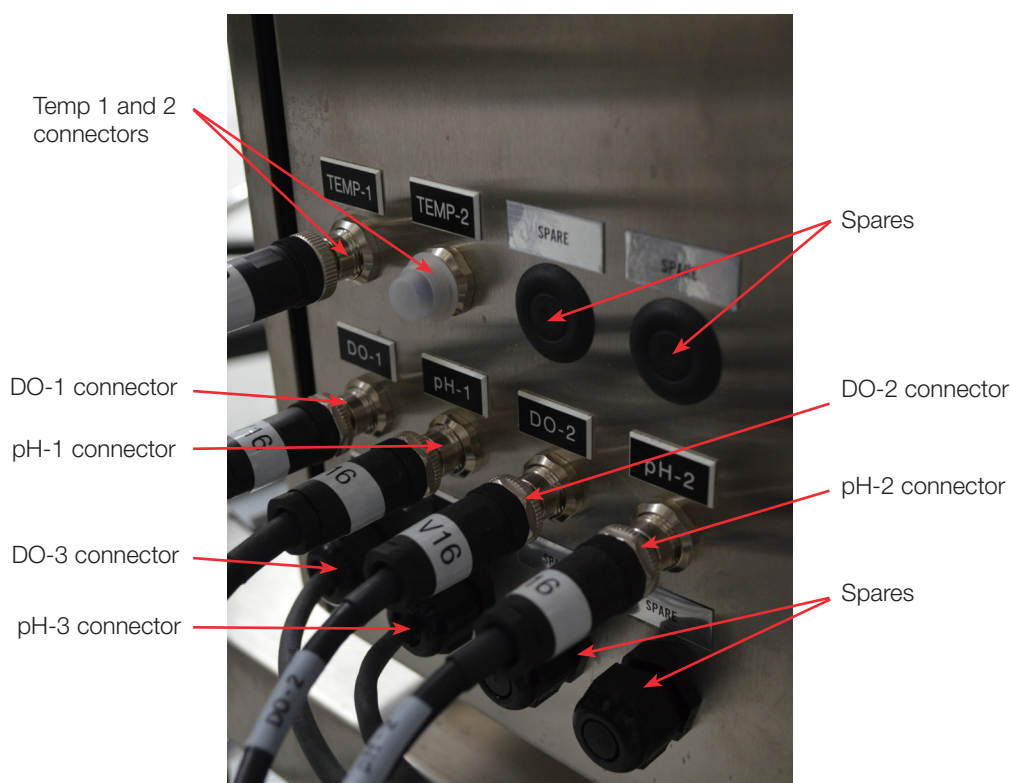


Figure 1.7. Lower half of the right side panel with sensor connections.

The lower part of the panel (Figure 1.7) houses connectors for the sensors. These are configured to each user's specifications and can be any combination of electrochemical and TruFlow sensors. Up to three (3) each of pH and DO sensors are allowed, and up to two (2) temperature sensors.

1.2.4 Vessel Adapter Box

The VAB is specific to the vessel it is attached to and enables you to easily switch vessels according to the requirements of the process. All the connectors are on the bottom of the box.

Each VAB has a power switch on the side and must be powered on prior to use.

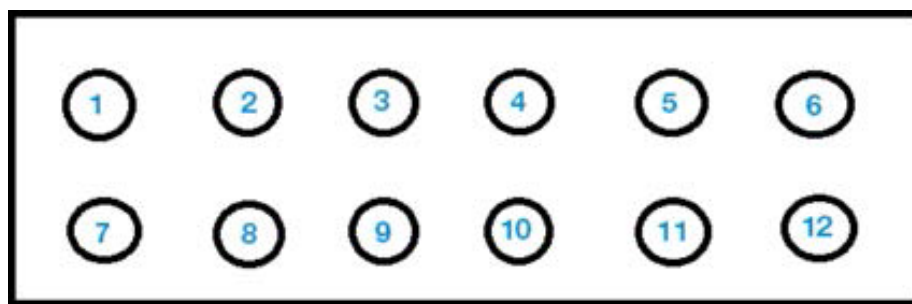


Figure 1.8. Generic configuration of the VAB.

The generic configuration is shown in Figure 1.8:

- **Ports 1 and 2**—For the heater blanket, if used.
- **Ports 3 and 12**—Spares to be used as needed.
- **Ports 4, 5, 10, and 11**—For load cells.
- **Port 6**—For a pressure sensor.
- **Ports 7 and 9**—Connect to the utility tower. Port 7 is the power inlet; port 9 provides control and communications.
- **Port 8**—For an agitator motor connection.

2

Gas and liquid handling

2.1 TruFlow gas manifold

The TruFlow gas manifold is designed to accurately control the flow of gases into the bioreactor vessel. It is controlled by the G3Pro Controller and is designed to be placed on top of the controller. There are six 12.5 mm (1/2-inch) diameter holes in the top of the controller for the feet of the TruFlow to engage and three associated solenoid valves. Position the TruFlow so the feet engage the appropriate holes for maximum stability.

The TruFlow is shipped with yellow plastic caps on the inlet and outlet ports to protect against dust. Remove the plastic caps from all ports to be used.

The TruFlow available comes with six inlets, one headspace (HS) outlet, as well as two sparger outlets (SPG-1, SPG-2), as shown in Figure 2.1 below.



Figure 2.1. TruFlow gas manifold.

The gas supply to the TruFlow should be regulated to between 2 to 2.4 bar (30 and 35 psi) pressure. Since the TruFlow has no regulators, the regulators must be fitted at the supply tanks, gas lines, or the utility panel .

Note: Regulators should be installed as close to the TruFlow as possible as to avoid any flow problems.

2.1.1 Connecting the TruFlow

1. Ensure the TruFlow is placed in a secure location where it cannot tip or be knocked over. **Note:** The TruFlow must be placed on top of the utility tower.
2. Use the respective TruFlow communication cable to connect the controller to the TruFlow. Refer to Figure 2.2 and Figure 2.3.



Figure 2.2. TruFlow ports on the controller.



Figure 2.3. TruFlow communication ports.

3. If present, remove the plastic caps from all ports to be used.
4. Loosen the nut on the TruFlow port enough that the 6.35 mm (1/4 in.) outer diameter (OD) pneumatic tubing can be inserted into the fitting (Figure 2.4). **Note:** If the fitting comes off, make sure that the flange is seated properly in between the threaded nut and the fitting.

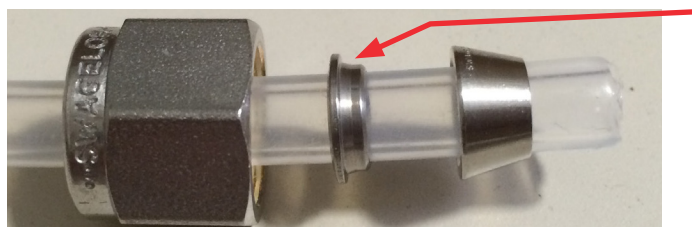


Figure 2.4. Flange seated properly into the threaded nut.

5. Attach the tubing by inserting the tubing into the fitting (Figure 2.5) and finger-tighten the nut.
6. Use a 9/16 in. or adjustable wrench (spanner) to tighten the nut by a full turn (Figure 2.6).
7. Ensure the tubing is properly connected to facility gas.



Figure 2.5. Inserting the pneumatic tubing into the TruFlow.



Figure 2.6. Using a 9/16 in. wrench to tighten the nut.

8. Turn on the gas flow and check for leaks at the fitting. If there is a leak, tighten the nut by 1/4-turn increments until the leak is sealed.

Caution: Gas flow to the TruFlow cannot exceed 2.41 bar (35 psi).

9. Connect the outlet tubing, in the same manner as the inlet tubing.
10. Connect the remaining end of the tubing to the headspace and sparger(s) of the bioreactor vessel. Refer to the vessel specific documentation for tubing connections.

2.1.2 Connecting the DeviceNet cable to the TruFlow

The fittings on the outlet ports are connected in the same way.

The unit is designed so the outlets can be on either side. The connectors are set to user specifications at the factory. If you wish to switch the connections to the other side (only one side can be used) contact your Thermo Scientific representative for assistance.

The TruFlow is connected to the Controller by a single DeviceNet™ cable that attaches to the side of the TruFlow and the second connector panel of the controller.



Figure 2.7. Truflow gas manifold and connections.

Once the tubing and DeviceNet cable are connected to the TruFlow and the Controller, connect the outlet tubing to the headspace and sparger(s) of the bioprocess container (BPC).

2.2 Sensors and auxiliaries

Temperature (RTD) sensors, pressure sensors, and the heaters all have designated connections. See section 1.2 for the position and description of the connectors.

To connect cables, align the connector with the locator tab, push the connector firmly into place and then screw the knurled nut down for a secure connection.

2.3 Pumps

The pumps on the G3Pro utility tower use Watson-Marlow series 114, 313, or 520 stop on open pump heads. The size is determined by the requirements of your process.

Both the 114-series (Figure 2.8) and 313-series (Figure 2.9) pump heads are opened by raising the curved top cover. The 520-series pump (Figure 2.10) is larger and requires a flathead screwdriver to open.



Figure 2.8. 114 pump head.



Figure 2.9. 313-series pump head.



Figure 2.10. 520 pump head.

2.3.1 Installing pump tubing

1. To install pump tubing into the 100 or 300-series pumps, open the pump head by lifting up on the upper curved section of the cover.
2. Lay the tubing into the pump over the driver (Figure 2.11).
3. Close the pump by bringing the top of the pump head down and pressing firmly so it snaps closed.



Figure 2.11. Installing pump tubing into pump.

4. Jog the pump by pressing the jog button next to the pump to feed the tubing through the pump.

Notes:

- The 500-series pump requires that the tubing be fed in from the side (Figure 2.12).
- Pumps should be calibrated before use. Use the same tubing in calibration as will be used in the process. Otherwise, errors in delivery volume may occur. See the appropriate TruBio Bioprocessing Software User's Guide Version 5.0 (DOC0088) to calibrate the pumps.
- Ensure the tubing is not in danger of being kinked or occluded by other equipment.

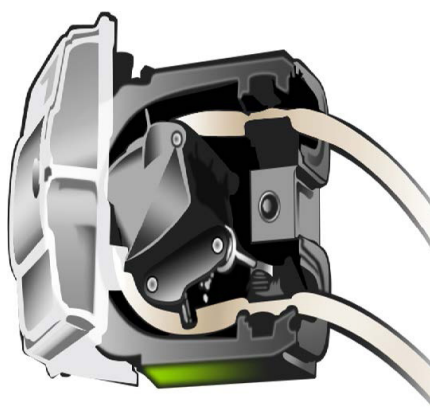


Figure 2.12. Feeding tubing through the side of the 500-series pump.

2.3.2 Pump tubing flow rates

The size of the pump and the installed tubing determines the flow rate of the pump. The table below shows the expected flow rates for each size of pump and representative tubing.

Table 2.1. Pump specifications.

Pump series	114	313	520
Power supply	24 V DC	24 V DC	24 V DC
Maximum current (at 25°C)	0.25 A	0.95 A	1.5 A
Average current (at 25°C)	0.2 A	0.75 A	1 A
Speed	5–160 rpm	1–300 rpm	1–300 rpm
Accuracy	±2 rpm, or ±2% of set point	±1 rpm, or ±2% of set point	±1 rpm, or ±2% of set point
Tubing (thickness, ID)	0.8 mm, 4.8mm	0.8 mm, 8.0 mm	1.6 mm, 9.6 mm
Operating temperature	5 to 50°C (41 to 122°F)		
Storage temperature	–10 to 70°C (14 to 158°F)		
Humidity	10 to 90% (noncondensing)		
Certifications	CE: EN-60101 and EN-61326		

2.4 Electrical

2.4.1 Electrical connections

Install power to the system with a minimum of 14 AWG (1.5 mm) gauge wiring. Conduit and cord connections to the system should be in accordance with NEC/CEC or equivalent and all local codes.

The cables connecting the utility tower to the Vent Heaters must be the same length.

2.4.2 Grounding

Install a permanent true earth bonding conductor (14 AWG/1.5 mm minimum) to the ground stud provided on the outside of the utility tower (Figure 1.3). The utility tower should not be powered on until this earth bonding conductor is in place and connected to true earth ground.

2.4.3 System assembly

The utility tower should be powered off during assembly and installation of the other system components. The main power cable should be disconnected from the wall plug or any other source of electricity. The cables to the other components should also be disconnected.

All cabling should be protected from moving parts, foot traffic, chairs/stools, and any other source of abrasion that might compromise the cable integrity. Damage to the cables will result in system malfunction.

3

Maintenance

Each G3Pro Universal Controller is fully tested before leaving the factory. The unit requires minimal maintenance; Thermo Scientific provides support, repair, maintenance, and refurbishment services for all G3-series systems sold.

Any servicing of the unit should be done by Thermo Fisher Scientific personnel only.

Power cords should be 14 AWG gauge wiring. Connections to the equipment should comply with NEC/CEC regulations or equivalent and all local codes.

All cabling should be protected from moving parts, foot traffic, chairs/stools, and any other source of abrasion that might compromise the cable integrity.

For safety and compliance, the system must be grounded when in use. A permanent true earth bonding conductor (14 AWG/1.5 mm minimum) must be attached to the grounding stud shown on Figure 1.3.

All units (including the VAB) should be powered off during installation or changing of components and the power cables disconnected from the wall plug or other source.

3.1 Cleaning

The G3Pro Universal has a NEMA12/IP52 or NEMA4X /IP65 rating. The unit can be wiped down with alcohol or a dilute solution of sodium hypochlorite (bleach).

Note: The unit is not rated for cleaning with more aggressive cleaning solutions. These agents will damage the enclosure.

3.2 Replacement parts

Only a few components of the Controller are user replaceable. Spare parts that you may wish to have available include the following.

- Spare gas manifold (TruFlow)
- Swagelock tubing ferrules and nuts (for TruFlow)
- RTDs
- pH and DO sensors
- Sensor cables
- Watson-Marlow series 114, 313, and/or 520 pump heads
- Pump tubing

4

G3Pro specifications

Tables 4.1 and 4.2 provide specifications for the G3Pro Universal Bioreactor Controller.

Table 4.1. G3Pro specifications.

	Item	Description
General	Overall (maximum extended) height	335.28 cm (132 in.)
	Overall (minimum extended) height	213.36 cm (84 in.)
	Overall length	254 cm (100 in.)
	Overall width	124.46 cm (49 in.)
	Enclosure rating	NEMA12/IP52 or NEMA4X/IP65
	Operating temperature	5 to 40°C (41 to 104°F)
	Storage temperature	–25 to 85°C (–13 to 185°F)
	Relative humidity	5–95% non-condensing
	Weight/shipping weight	18.1/41 kg (40/90 lb)
	Control cart weight/shipping weight	75/120 kg (165/265 lb)
Components	pH (up to 3 available)	Thermo Scientific Transmitter (electrochemical mV), two included as standard for redundancy, third is optional
	Dissolved oxygen (DO) (up to 3 available)	Thermo Scientific Transmitter (electrochemical nA), two included as standard for redundancy, third is optional
	Temperature (up to 2 available)	TruSens Transmitter resistance temperature detector (RTD), one included as standard
	Pressure (up to 2)	PendoTECH PT-10, one included as standard
	Liquid control	Four (4) variable-speed Watson-Marlow peristaltic pumps
	Pump head options	Watson Marlow 114, 313, or 520 series
	Gas control (TruFlow)	Thermo Scientific TruFlow mass flow controller (MFC): option of up to six (6) MFCs (up to six gas inlets and three gas outlets) Option of high flow and very high flow rates available—up to 600 L/min on separate manifold
	Scales/balances	4 x AI (Profibus) available for digital scales (analog optional)
	Inputs/outputs	AI x 4 (4–20 mA, 16-bit resolution) (24 V DC, PV) AI x 4 (4–20 mA, 12-bit resolution) (24 V DC, PV) AUX x 4 (4–20 mA, 12-bit resolution) (SP, PV)

Note: Because the Utility Tower is not free-standing and must be mounted on the Cart, the Cart is shipped with the Utility Tower.

Table 4.2. G3Pro specifications (continued).

	Item	Description
Components	Thermal control	Thermal control unit (TCU) for jacketed vessels and optional heated S.U.B.
	External pumps	In addition to the pumps on the cart, additional external pumps can be mounted on a pump tower, and optional analog controlled case pumps
	Agitator	Vessel adapter box (VAB) with VFD supplied for HyPerforma vessels and third-party vessels
	Alarm	Alarm relay for building alarm, optional stack light circuitry (must order stack light separately)
	Vent filter heater	Option to have 2 or 4 vent filter heaters

Note: Because the utility tower is not free-standing and must be mounted on the cart, the cart is shipped with the Utility Tower.

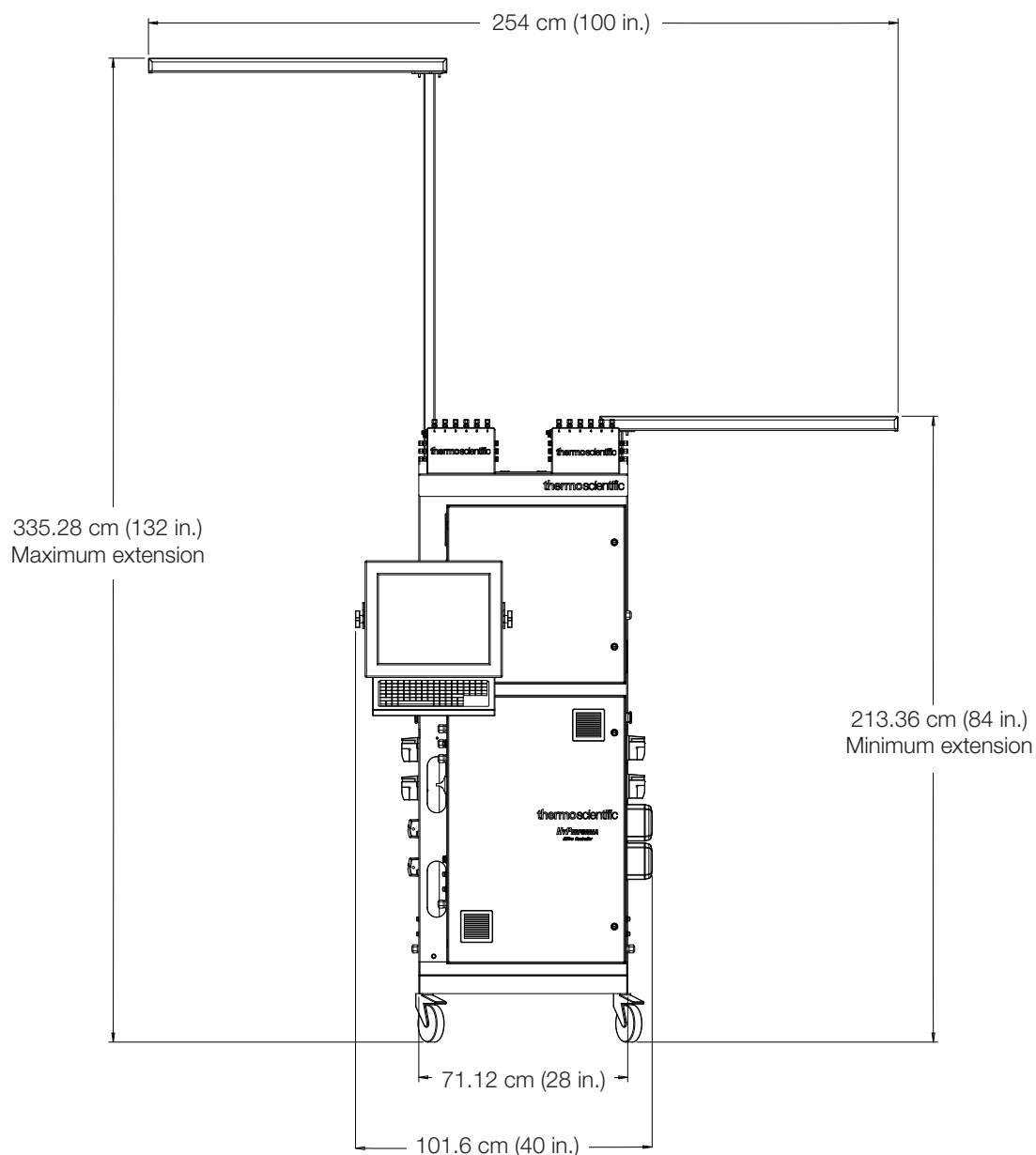


Figure 4.1. Front view of G3Pro dimensions.

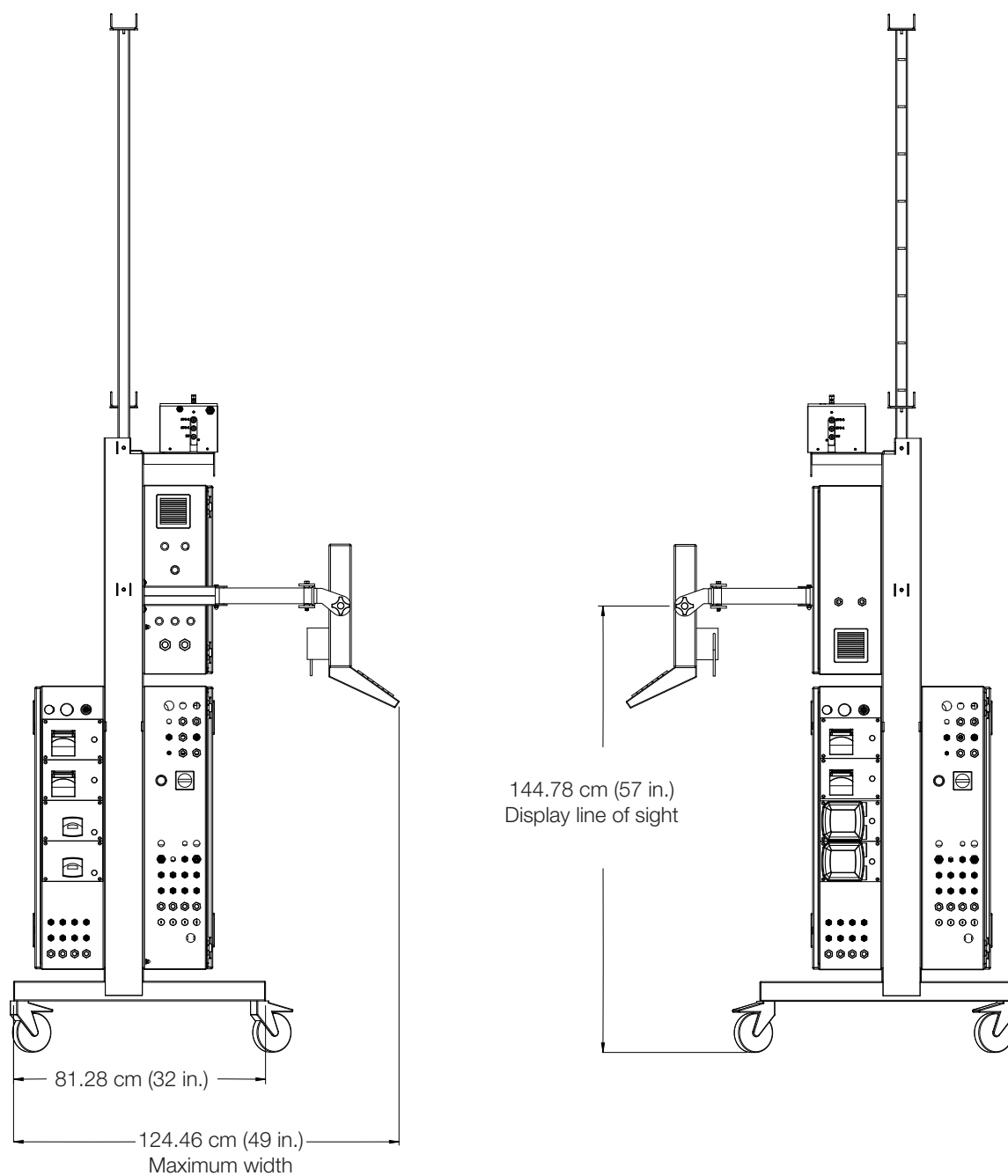


Figure 4.2. Side view of G3Pro dimensions.

Appendix A—Complete list of certifications

cTUVus

2006/95/EC - Low Voltage Directive

2004/108/EC - EMC Compatibility

2006/42/EC - Machinery directive

93/68EEC - CE Markings directive

EN60204 - Machinery directive

EN61010-1 - Safety of Electrical Equipment for measurement and control

IEC61010-010 Part 2-010 - Particular requirements for laboratory equipment for the heating of materials

IEC61010-081 Part 2-081 - Particular requirements for automatic and semi-automatic laboratory equipment for analysis and other purposes

EN61326/-1 - Electrical control and measurement, EMC

2003/94/EC - EU GMP regulations

2012/19/EC - WEEE

2011/65/EC - RoHS directives

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