

## Installation and User Guide

### MPD 2.5kV to 30kV, 10W Range of High Voltage Power Supply Modules



Document number: 81408-4

Issue	1	2	3
Date	19/01/2021	05/03/2021	
Issuing Authority	I-7632	10377P	
Checked			
Approved			

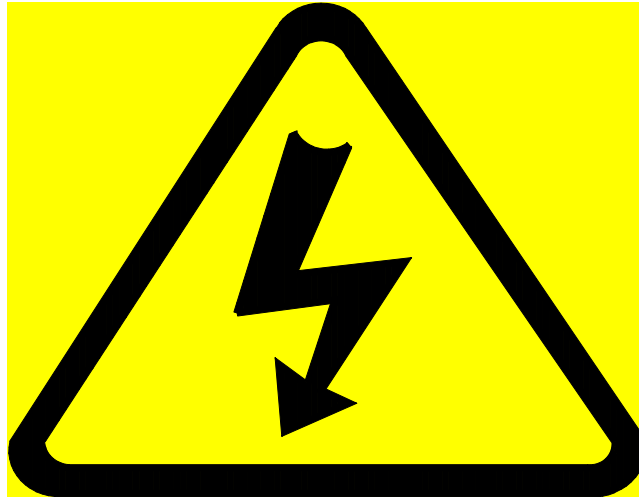
## CHANGE HISTORY

Section	Reason for Change	Issue
All	Created from 81408-1	1
1 2.2	Updated different cable length ordering Updated approval wording	2

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# SAFETY



## DANGER HIGH VOLTAGE RISK OF ELECTROCUTION

Observe extreme caution when working with this equipment

- High voltage power supplies must always be connected to a protective earth
- Do not touch connections unless equipment is turned off and the capacitance of both the load and power supply are grounded
- Allow adequate time for discharge of internal capacitance of the power supply
- Do not ground yourself or work under wet or damp conditions

### Servicing Safety

- When maintenance of equipment fitted with this power supply requires removing the equipment cover with the power on, this should only be done by qualified personnel aware of the hazards
- This power supply has no user serviceable parts. Return to supplier for servicing

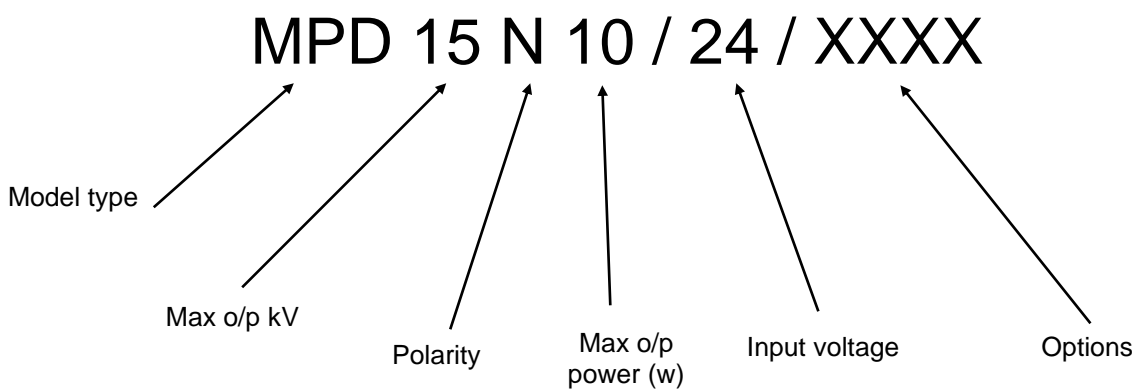
## 1. Unit Description

The MPD range of high voltage 2.5kV to 30kV dc-dc converters produce a high performance dc output for a wide range of instrumentation and analytical applications. The combination of linear and switch mode power conversion techniques provides low noise and high efficiency. The unit also offers excellent ripple levels and stability.

The units are designed for operation from a 24V dc input and will supply up to 10W of output power. The signal and power inputs and outputs are via a 15 way male 'D' connector.

The HV output is via a 1m long un-terminated HRG58 screened cable, other lengths up to 5m can be requested, please consult with factory.

The part number for a given unit describes its characteristics:



## 1.1 Ratings

The units provide the following rated HV outputs:

Unit	Voltage	Current
MPD2.5P10/24	+2.5kV	4mA
MPD2.5N10/24	-2.5kV	4mA
MPD5P10/24	+5kV	2mA
MPD5N10/24	-5kV	2mA
MPD10P10/24	+10kV	1mA
MPD10N10/24	-10kV	1mA
MPD15P10/24	+15kV	0.67mA
MPD15N10/24	-15kV	0.67mA
MPD20P10/24	+20kV	0.50mA
MPD20N10/24	-20kV	0.50mA
MPD30P10/24	+30kV	0.33mA
MPD30N10/24	-30kV	0.33mA

The input rating for all units is 24Vdc  $\pm$ 2V, 1A

Unit masses:

2.5kV to 10kV units 420g

15kV and 20kV units 650g

30kV units 950g

Environmental conditions:

The operating temperature range is 0°C to +50°C.

Relative humidity rating (RH)% is 20% to 85% (non-condensing).

Altitude 0 to 2000m above mean sea level

## 2. Safety

The HV outputs of the units are hazardous and the conditions of this manual must be complied with to maintain safety. The unit is contained in an earthed case with a screened HV output cable and the HV output cable must be terminated safely before the unit is operated. This unit must be sourced with a UL recognised double insulated or SELV 24 V dc supply.

The unit shall be properly bonded to the main protective earthing termination in the end product.

The unit has been evaluated for use in a Pollution Degree 2, Installation Category II environment.

Consideration should be given to conducting the following tests with the unit installed in the end product:

- a. Permissible Limits Tests with the unit installed in the end product.
- b. Temperatures on any accessible surfaces.

The case performs the function of heat sink and can exceed 60°C, therefore access to the unit shall be prevented during operation.

The protection against electric shock provided by the unit may be impaired if the unit is not operated in accordance with the instructions in this manual.

## 2.1 Explanation of Symbols



This symbol means Caution, consult the manual.



This symbol means Caution, risk of electric shock.



This symbol indicates the Protective Earth (PE) terminal.



This symbol means Caution, hot surface

## 2.2 Applicable standards

The unit is designed to meet the requirements of EN 61010-1, UL 61010-1 and CAN/CSA-22.2 No. 61010-1. Please consult the factory for further approval information.

### 3. Installation of the Units

#### 3.1 Electrical Installation

The units should only be connected to a Category II supply installation.

The power for the unit should be sourced from a UL recognised double insulated or SELV 24 V dc supply.

The unit shall be properly bonded to the main protective earthing termination in the end product.

The input and output connectors are not intended for field connections and should only be connected to internal wiring in the end product.

All external circuits connected to High Voltage outputs shall be Double/Reinforced insulated from any accessible parts.

The connector details on the standard unit are shown in table 1 overleaf.

#### 3.2 Mechanical Installation

The units are only to be used in a pollution degree 2 (PD 2) environment.

The physical outline of the units is shown in Appendices 1 and 2.

Fixings:

M3 x 0.5 blind inserts, maximum thread depth 5mm.

Note: Failure to comply with the above could compromise the safe operation of the unit and invalidate the warranty.



**Table 1. Connector pin-out, all units**

The control and monitoring signals and supply power are connected via a single 15 way male 'D' connector:

PIN	SIGNAL NAME	PARAMETERS
1	Power Ground	Ground
2	+24Vdc Input	+24Vdc @ 1 amp maximum
3	Voltage Monitor Output	0 to 10 Vdc equals 0 to 100% of rated output, Zout = 10kΩ
4	Voltage reference output	10V
5	Voltage Program Input	0 to 10 Vdc equals 0 to 100% of rated output, Zin = 10MΩ
6	Voltage Program Differential Amplifier Output	0 to 10 Vdc equals 0 to 100% of rated output, Zout = 10kΩ
7	Voltage Program Differential Amplifier Input Positive	0 to 10 Vdc differential between pin 7 and pin 9 equals 0 to 100% of rated output, diode clamped to ground, Zin = 38kΩ
8	Current Monitor Output	0 to 10 Vdc equals 0 to 100% of rated output, Zout = 10kΩ
9	Voltage Program Differential Amplifier Input - Negative	0 to 10 Vdc differential between pin 7 and pin 9 equals 0 to 100% of rated output, diode clamped to ground, Zin = 38kΩ
10	Voltage Program Digital Output	0 to 10 Vdc equals 0 to 100% of rated output, Zout = 10kΩ
11	Analog signal ground	Analog signal ground for control and monitoring
12	Enable Input	Low = Enable. TTL, CMOS and open collector compliant
13	Digital Mode	RS232 or RS485 configuration Low = RS485 Open circuit = RS232
14	RS232 TxD/ RS485-	Transmit data (output) wrt pin 1 or RS485 inverting
15	RS232 RxD/ RS485+	Receive data (input) wrt pin 1 or RS485 non inverting

## 4. Operation of the Units

The units are operated by either analogue input, using any of the methods detailed below, or by digital control using an RS232/485 serial port with a PC connection and a suitable interface.

### 4.1 Analogue Control

#### 4.1.1 Control and Monitoring Signals

The units are controlled and monitored using the following analogue signals.

PARAMETER	MIN.	VALUE	MAX.	UNITS
Voltage control: 0 to 10V = 0 to Full scale output V (i)	-1		+1	%
Voltage reference output (wrt signal ground)		10		V
Enable: Active low enable, input impedance. Designed to be operated by TTL or CMOS logic or open collector transistor.	10			kΩ
Voltage monitor: 0-10V for 0 to full scale output (wrt signal ground)	-1		+1	%
Current monitor: 0-10V for 0 to full scale output (wrt signal ground)	-1		+1	%

Note:

(i) a stable, low noise reference source is recommended to achieve full unit performance.

The following sections describe the various connections that can be used to control the MPD HV units.

### 4.1.2 Remote DAC Control

The differential input allows the voltage programming circuit to be remote from the power supply. It prevents voltage drops in the ground connection from affecting the programming signal. However, if there are voltage drops in the ground connection, the DAC should be provided with its own reference.

24V Power input on Pin 2.

Power Common on Pin 1.

0 to 10V voltage control signal to Pin 7.

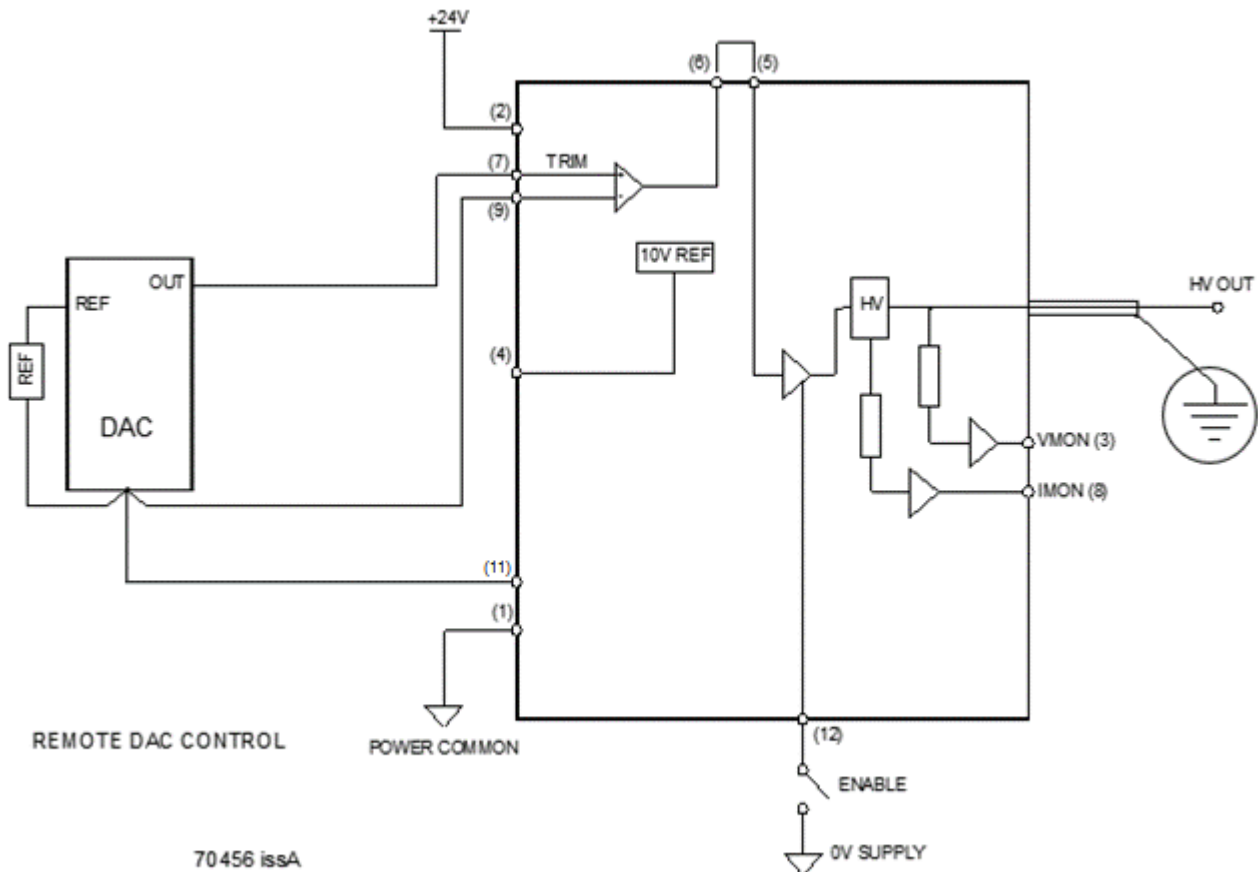
Signal ground reference for 0 to 10V control signal. Connected to signal ground for 0 to 10V voltage control, also connected to Pin 9 and Pin 11.

Link Pin 5 to Pin 6.

Connect Enable Pin 12 to ground to enable HV output.

Voltage monitor output is on Pin 3.

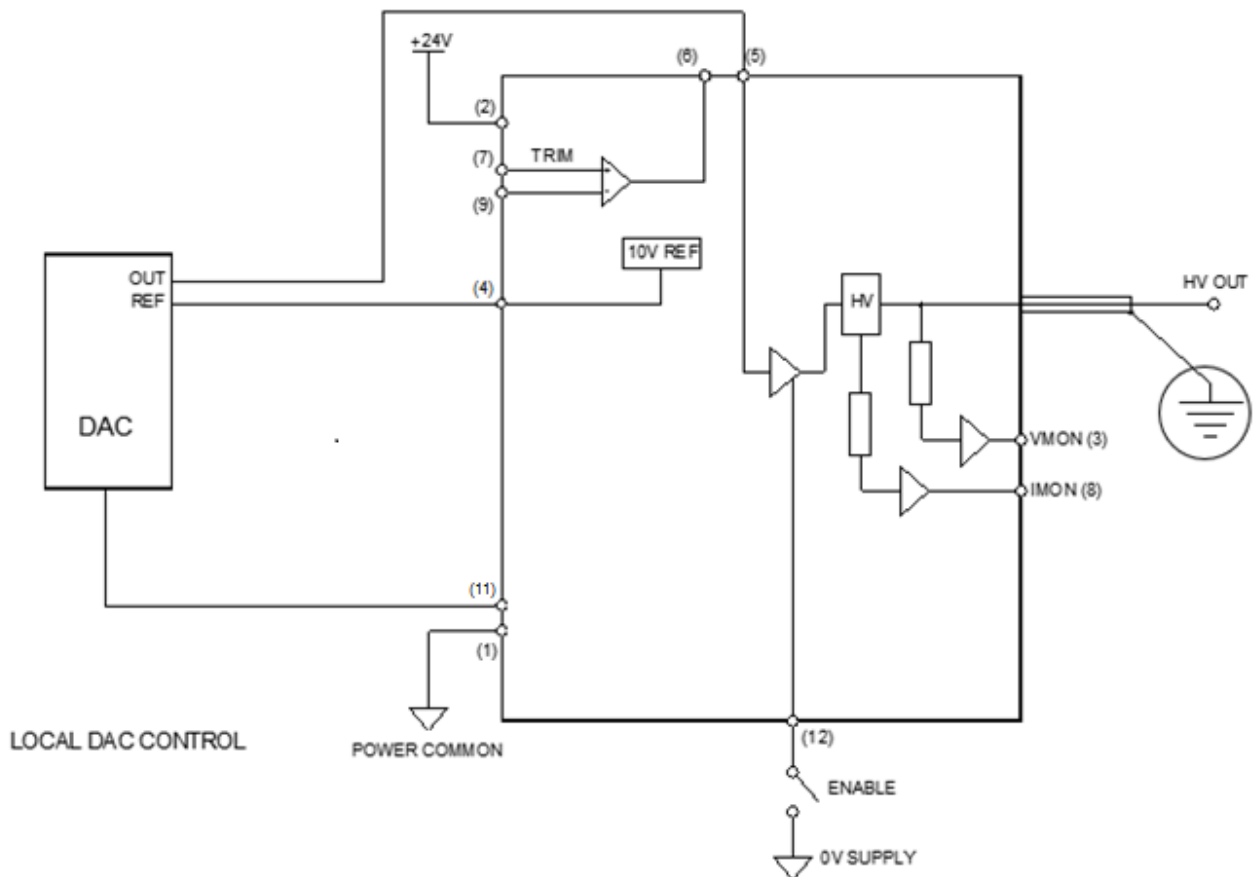
Current monitor output is on Pin 8.



### 4.1.3 Local DAC Control

It is not necessary to use the differential input when the voltage control circuit is close to the power supply, however it is important to connect all grounds at Pin 1 of the PSU to prevent voltage drops in the ground circuit from affecting the programming signal. Take care to avoid ground loops.

- 24V Power input on Pin 2.
- Power Common on Pin 1.
- DAC output to Pin 5.
- DAC ground to Pin 11.
- Connect Pin 4 to the DAC reference input.
- Connect Enable Pin 12 to ground to enable HV output.
- Voltage monitor output is on Pin 3.
- Current monitor output is on Pin 8.



### 4.1.4 External potentiometer control

An external potentiometer can be connected between the 10V reference on Pin 4 and ground with the wiper connected to Pin 5, this will allow the potentiometer to be used to control the unit. The user should note the use of a potentiometer may affect the performance of the MPD unit.

The unit may be controlled by an external potentiometer as follows: -

24V Power input on Pin 2.

Power Comon on Pin 1.

Connect Pin 4 to external pot CW.

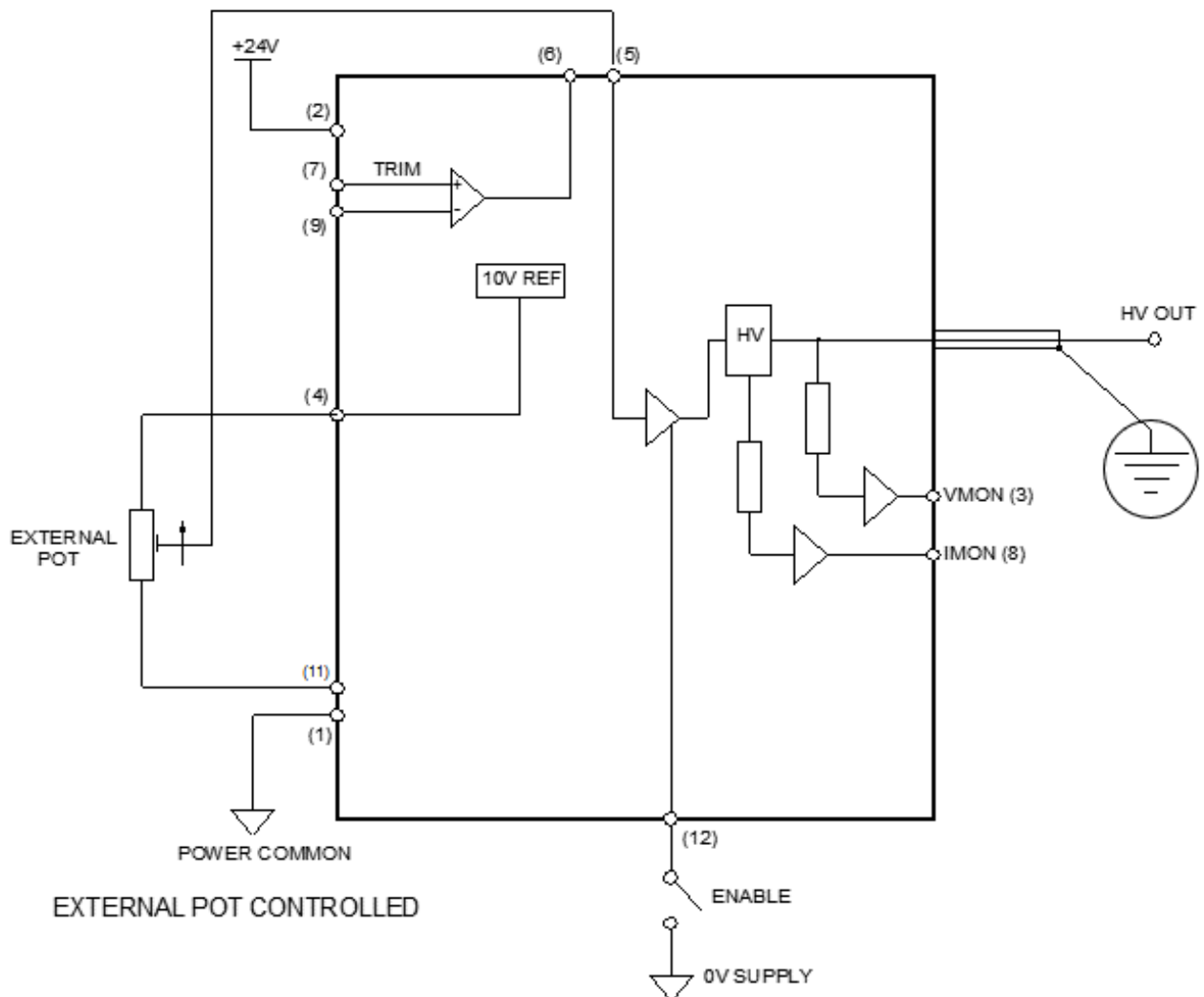
Connect Pin 11 to external pot CCW.

Connect Pin 5 to external pot wiper.

Connect Enable Pin 12 to ground to enable HV output.

Voltage monitor output is on Pin 3.

Current monitor output is on Pin 8.



## 4.2 Digital Control

The units operate with a simple ASCII protocol see document number 48113-21 which covers systems with both single and multiple slaves. The following parameters apply.

PARAMETER	MIN.	VALUE	MAX.	UNITS
Digital Mode - RS232 or RS485 Low = RS485 Open circuit = RS232				
Enable - Active low enable, input impedance. Designed to be operated by TTL, CMOS logic or open collector transistor or software command.	10			k $\Omega$
Voltage control resolution		16		Bit
Monitor resolution		16		Bit

The following sections describe the circuits used for RS232 and RS485 to make digital (serial) connection the MPD HV units; refer to Table 1 for pin out details.

The units are controlled using a Graphical User Interface (GUI), for more information on a GUI refer to Appendix 4.

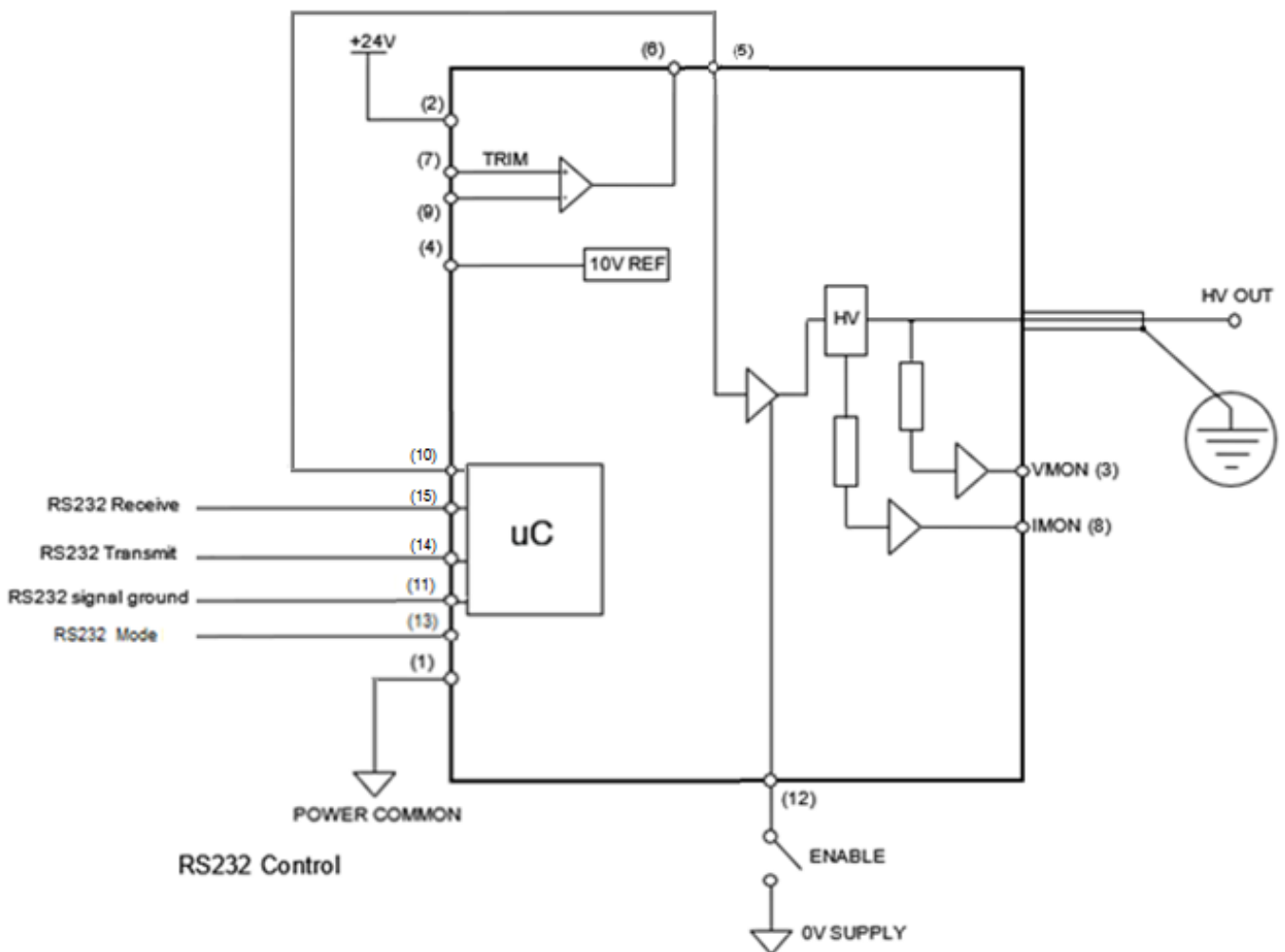
### 4.2.1 RS232 Connection

The unit has RS232 communication facilities available via pins 14 and 15 of the 15 way 'D' connector. For the protocol used, refer to protocol document 48113-21, which can be provided on request.

The unit may be controlled digitally as follows: -

- 24V Power input on Pin 2.
- Power Common on Pin 1.
- Select Mode RS232 on Pin 13 by leaving open circuit
- RS232 signal ground on pin 11
- RS232 transmit on Pin 14 – connect to Rx pin on PC
- RS232 receive on Pin 15 – connect to Tx pin on PC

Connect Enable Pin 12 to ground to enable HV output. This is independent of the firmware/communications interface and can be used to shut down the HV output.  
Connect Pin 5 to Pin 10.



### 4.2.2 RS485 Connection

The unit has RS485 communication facilities available via pins 14 and 15 of the 15 way 'D' connector. For the protocol used, refer to protocol document 48113-21, which can be provided on request.

The unit may be controlled digitally as follows: -

24V Power input on Pin 2.

Ground on Pin 1.

Select Mode RS485 – connected Power common to Pin 1.

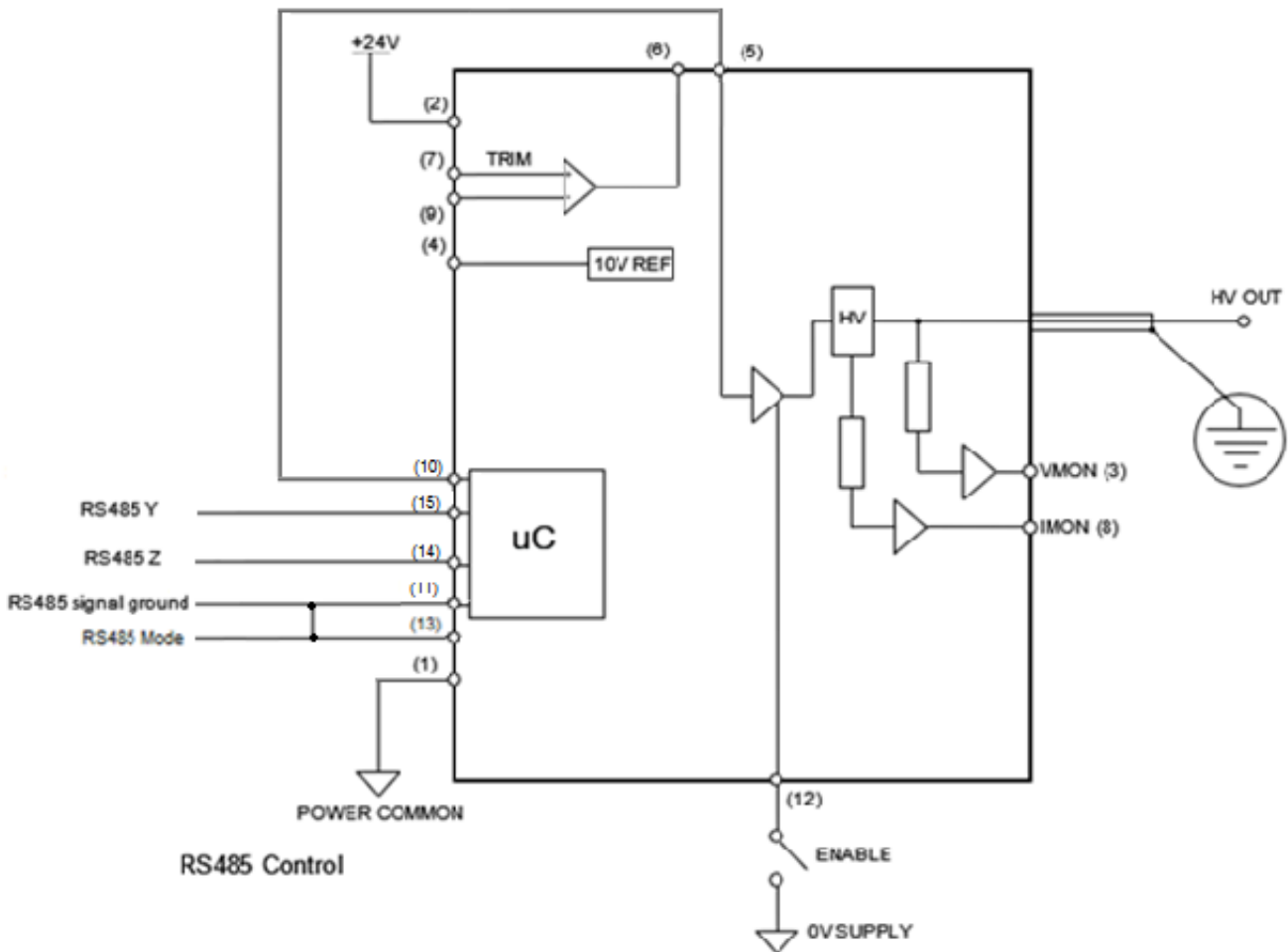
RS485 signal ground on Pin 11.

RS485 Z (inverting) on Pin 14 – connect to RS485 inverting pin, Z or B on PC

RS485 Y (non-inverting) on Pin 15 – connect to RS485 non-inverting pin, Y or A on PC. A

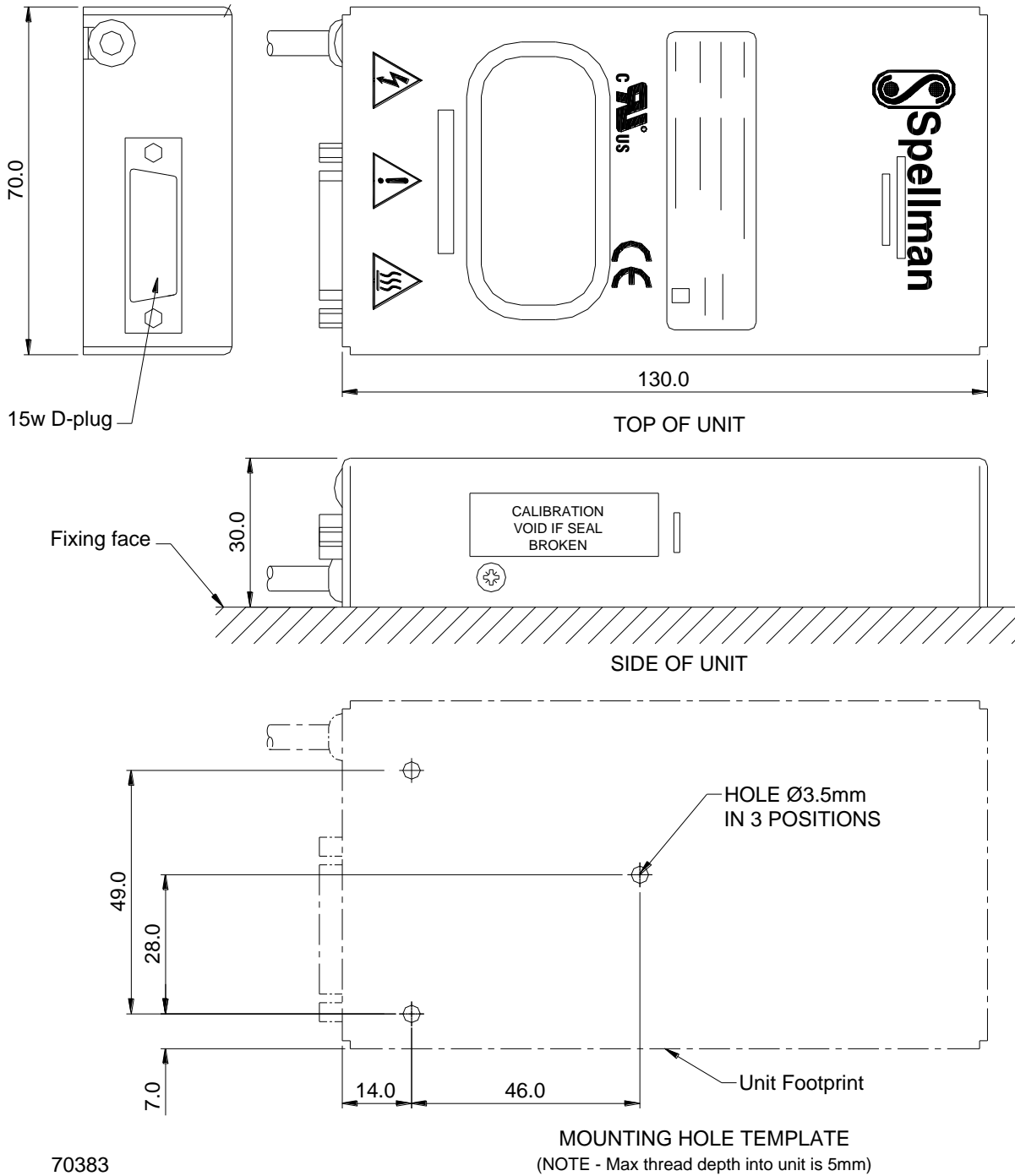
120R termination resistor should be fitted to the last MPD particularly if long cabling is used.

Connect Enable Pin 12 to ground to enable HV output. This is independent of the firmware/communications interface and can be used to shut-down the HV output. Connect Pin 5 to 10 and link Pin 11 to 13.

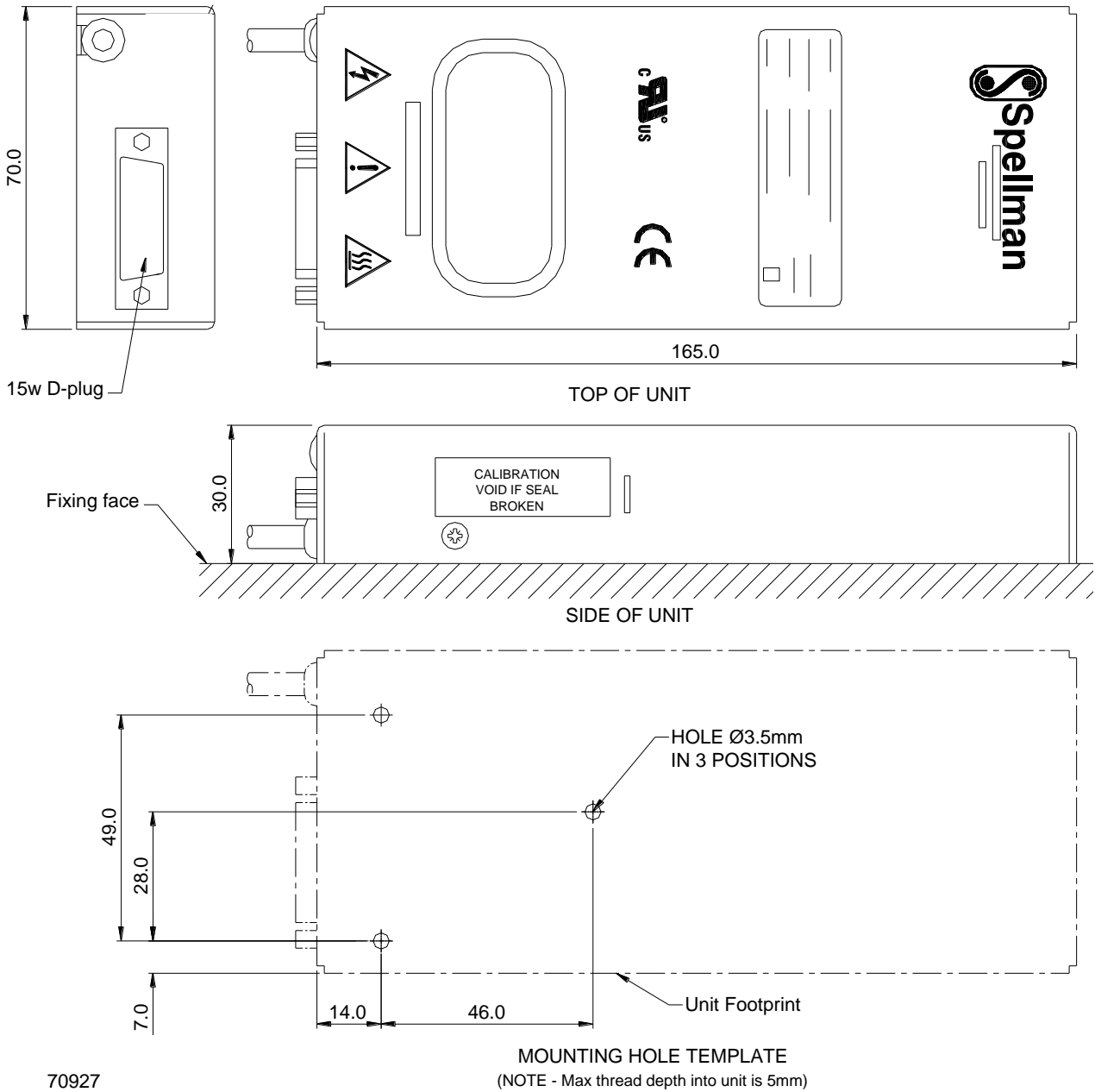




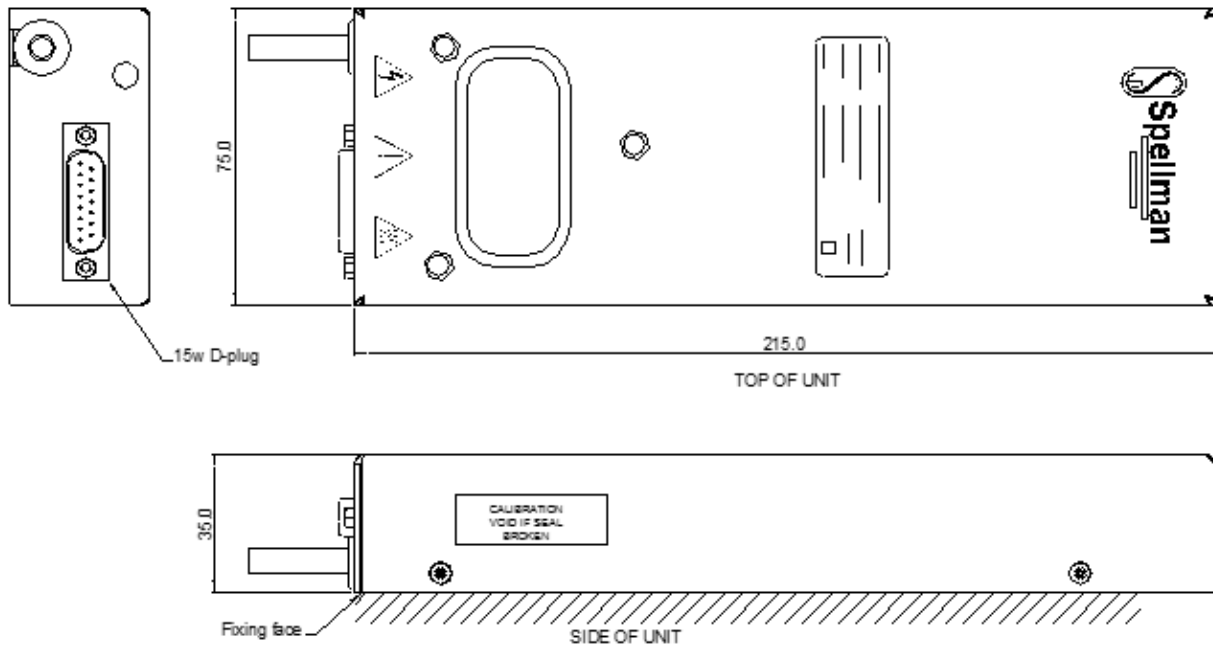
**Appendix 1. Mechanical Outline 2.5kV to 10kV units.**



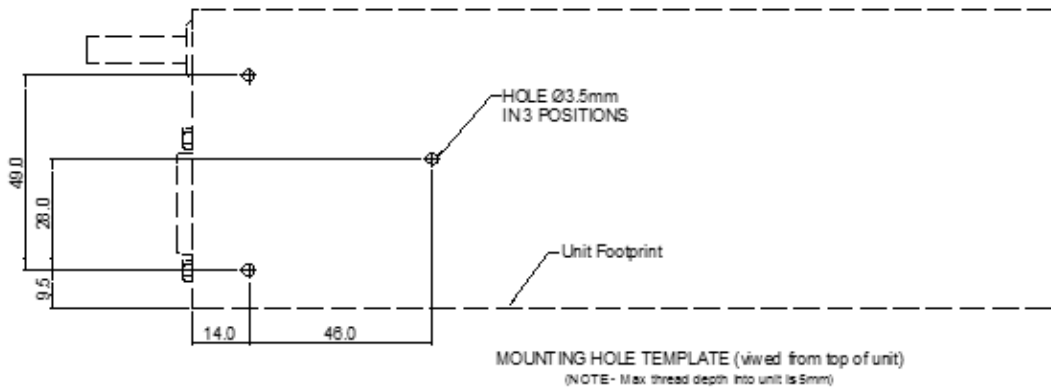
**Appendix 2. Mechanical Outline 15kV, 20kV units.**



**Appendix 3. Mechanical Outline 30kV units.**



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## Appendix 4. Graphical User Interface (GUI)

### Use of the GUI

During development and testing Spellman HV Ltd. use an in-house developed Graphical User Interface (GUI) to control and manage the MPD units. This GUI is not intended for customer use and so is an un-supported product. It is provided to customers to help them with initial product evaluation. Longer term it is normal for customers to use their own software to control the product.

The communications protocol for the MPD unit is specified in the Spellman document: 48113-21 Serial Communications Protocol.

### GUI Requirements

The GUI is written to run on Microsoft Windows 10 and uses Microsoft .Net Framework Version 4.

The GUI makes use of the Windows Registry to hold application configuration information. Your IT team MUST ensure the GUI has permission to access to the following area of the registry.

### GUI Limitations

The GUI does not support internationalisation. All GUI text is in English.

### GUI Installation

To install the GUI, the user will need the GUI installer application. This is comprised of two files.

- 'Customer 48113-GUIvxryy.exe'
- 'Customer 48113-GUIxryy.msi'

Where:

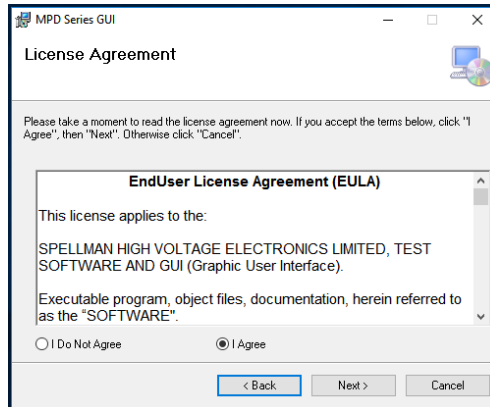
- x* Major Version Number
- yy* Minor Version Number

If you do not have the files, please contact your local Spellman Sales Office quoting '48113-GUI'. They will arrange for the installer files to be sent to you.

## First time installation

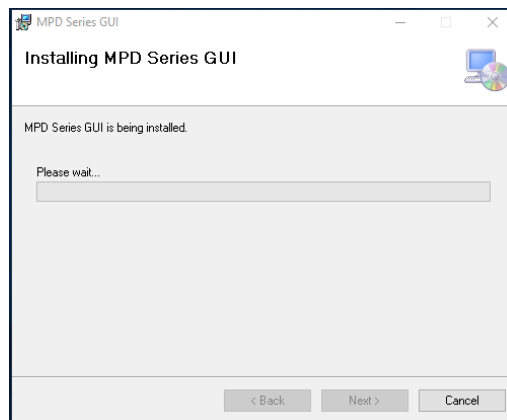
To install the GUI for the first time, follow the procedure below.

1. Copy the files above to a convenient location on your computer.
2. Double click the 'Customer 48113-GUIVxryy.exe' file. The GUI installer will start to run.
3. Click the 'Next' button. The End User License Agreement (EULA) will be displayed.

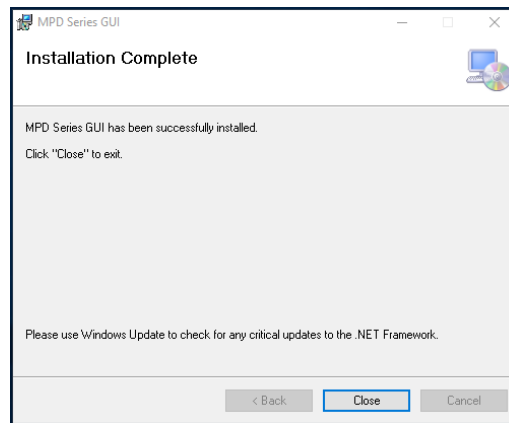


Read the EULA through and if you agree to the terms, click the 'I Agree' button and then click the 'Next' button. The installer is now ready to install the GUI.

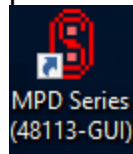
1. Click the 'Next' button once more. Installation will begin.



2. Once installation is complete, the following will be displayed.



Click the 'Close' button. The GUI has been installed in the 'C:\Projects\MPD\_Series GUI' folder on your computer and a shortcut placed on your computer's desktop.



## Installing GUI Updates

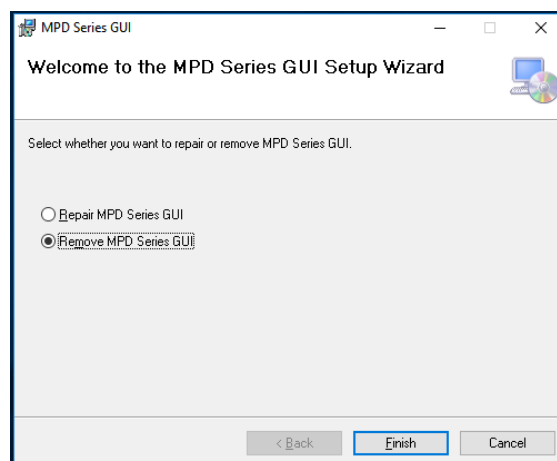
To install newer versions of the GUI, the old one must first be uninstalled. This can be done in two ways. See the following paragraphs.

Note: Once the previous version of the GUI has been removed, re-install the updated one using the procedure in paragraph 4.2.3.1.

Uninstall using the original GUI installation application.

Execute the installation application that was used to install the application and follow the procedure below.

1. Double-click the 'Customer 48113-GUI\vxryy.exe' file. The GUI installer will start to run.



2. Click the 'Remove MPD Series GUI' option and click the 'Finish' button.
3. The application will be removed.
4. When complete, a corresponding dialog will be displayed. Click the 'Close' button.

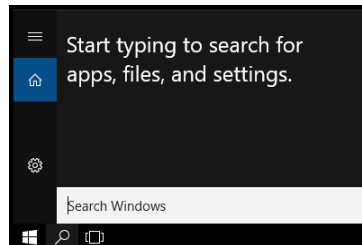
## Uninstall using the Windows 10 'Apps & Features' tool.

To uninstall the application using the 'Apps & Features' tool follow the procedure below.

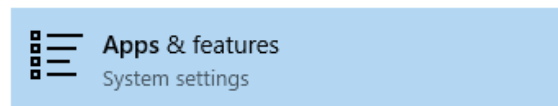
Click the Windows 10 task bar search icon.



The Search text box will be displayed.












1. Start to enter the text 'apps'. The search results will display the item below.



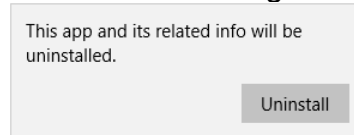
Click this item. The 'Settings' GUI will be displayed showing the 'Apps & Features' page.

2. Scroll down the list and find the 'MPD Series GUI'.

	Microsoft Visual C++ 2012 Redistributable (...)	17.4 MB
	Microsoft Corporation	16/09/2020
	Microsoft Visual C++ 2013 Redistributable (...)	17.2 MB
	Microsoft Corporation	16/09/2020
	Microsoft Visual C++ 2013 Redistributable (...)	17.2 MB
	Microsoft Corporation	16/09/2020
	Microsoft Visual C++ 2017 Redistributable (...)	23.7 MB
	Microsoft Corporation	16/09/2020
	Microsoft Visual C++ 2017 Redistributable (...)	20.2 MB
	Microsoft Corporation	16/09/2020
	MPD Series GUI	188 KB
	Spellman HV UK	16/09/2020
		Modify Uninstall
	MXR Series GUI	208 KB
	Spellman HV UK	18/08/2020
	PicoLog 6 6.1.14	401 MB
	Pico Technology	16/09/2020
	PicoLog 6 6.1.8	326 MB
	Pico Technology	16/09/2020

3. Click on the item highlighted in the image above. The option to 'Uninstall' will be displayed.

4. Click the 'Uninstall' option. Another small dialog will be displayed.

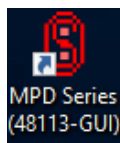


5. Click 'Uninstall' once more and the application will be removed.

## Using the GUI

During Installation, a shortcut to the GUI will have been placed on the Windows 10 Desktop.

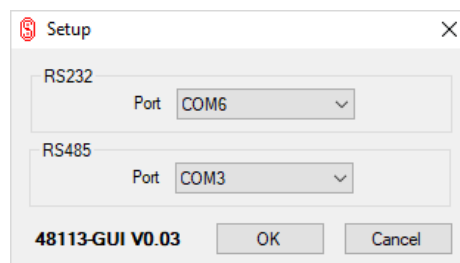
Double-click the shortcut icon to launch the GUI.



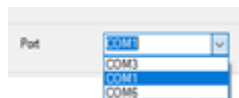
## GUI Configuration

Before attempting to communicate with the MPD, the GUI must first be told which serial comms port to use. To do this follow the procedure below.

1. Click the 'Setup' menu option on the GUI menu bar. The dialog box shown below will be displayed.



2. Select the serial port to use from the 'Port' combo box. Click the 'V' arrow and a list of all available comms ports will be displayed.



3. Click the Serial Port you have connected to the unit.
4. Click the 'OK' button and the 'Setup' dialog will close.



## Opening comms with the MPD unit

With the GUI configured correctly and connected to an RS232/485 port it will start communicating directly with the MPD: the GUI dialog's controls/data fields will be populated with data and status from the MPD.

As can be seen the GUI contains many controls that are grouped into areas. The following paragraphs briefly discuss each of these groups of controls.

## Monitoring the MPD Unit

Various groups of controls are provided to monitor the MPD outputs and status.

### Output Monitors

The controls shown below display the current operating status of the HV output voltage and current monitors, along with the 24V rail and temperature. This shows the raw (bits) data and scaled product.

Monitors			
	Scaled		Raw
VMon	23.8	V	117
IMon	2.4	µA	149
VProg	24.8	V	123
Temperature	32.9	°C	57347
24V rail	23.9	V	47215
Log	<input type="checkbox"/>	View	Delete

## System Status

The 'Status' group of flags provide the user with feedback regarding system fault, regulation or current trip conditions.

**Key:** Flag colours.

- OK/Good
- Fault/Trip

**Status**

- Enabled
- Fault
- O/P Regulation
- O/P Over I
- Over Temp
- Supply Voltage
- HW Enabled
- SW Enabled

The 'HW Enabled' and 'SW Enabled' flags are described in following section.

## Controlling the MPD Unit

The following paragraphs discuss the various groups of GUI controls that allow the user to control the MPD output.

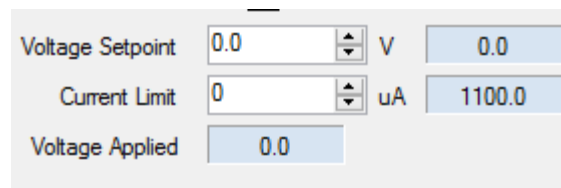
### Enable/Disabling MPD Outputs

The MPD unit HV output is enabled when both the 'SW Enabled' and 'HW Enabled' flags are green as shown in the Status field. The HW enabled requires a signal as defined in the table 1 in Section 3.2. To SW enable the output, check/tick the check box, a short time afterwards the indicator to the right of the check box will change colour. (See below.)



### Programming Output Demand

Programming the MPD output is achieved using the 'Voltage Setpoint' and 'Current Limit' controls.



The screenshot shows a control panel with three rows. The first row is 'Voltage Setpoint' with a numeric input field containing '0.0', a unit selector 'V', and a blue button containing '0.0'. The second row is 'Current Limit' with a numeric input field containing '0', a unit selector 'uA', and a blue button containing '1100.0'. The third row is 'Voltage Applied' with a blue button containing '0.0'.

To change the programmed demand of the output, the unit must first be enabled. Once enabled, enter the desired demand into 'Voltage Setpoint' or 'Current limit' numeric 'Up/Down control' and press the 'Enter' key.

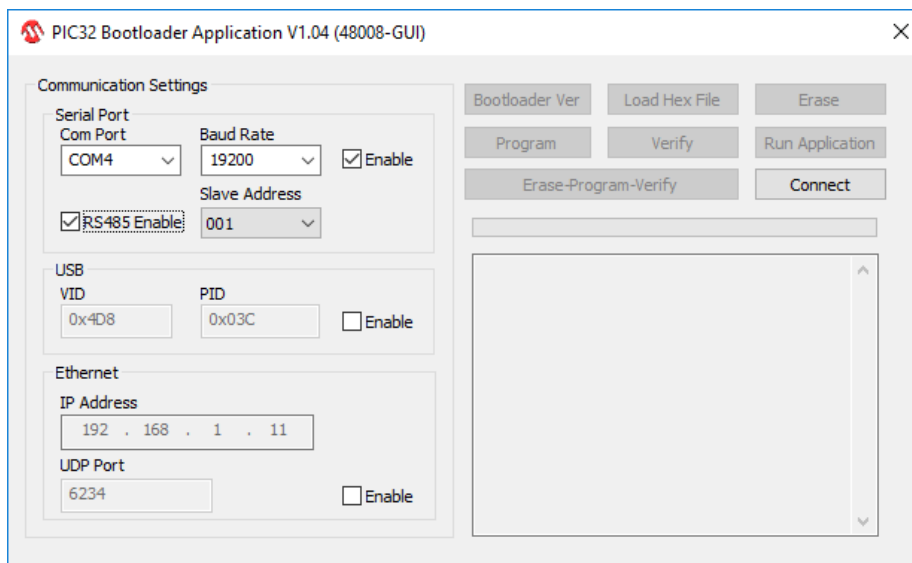
## Appendix 5. Loading firmware and program Slave Address

### Loading firmware

Connect serial comms to the MPD unit.

Run 'PIC32UBL.exe'. (48008-GUI V1.04+)

Configure the PIC32UBL programming GUI as below:



- i) Select the Serial '**Com Port**' to be used.
- ii) Set the '**Baud Rate**' to '**19200**' Baud.
- iii) Check the '**RS485 Enable**' checkbox.
- iv) Select the '**Slave Address**' of the unit to be programmed.

*Note:*

- *Select the slave address the module has been programmed with.*

Click the 'Connect' button.

Click the 'Load Hex File' button, browse to and select the MPD firmware (48113-14). The inactive buttons are now active.

Click the 'Erase-Program-Verify' button and the code is sent to the hardware. Wait for programming to finish. This will take some time.

Once finished click the 'Run Application' button.

Close the application.

Power cycle the unit.

If the unit needs to be programmed with a different slave address, please see section below.

### Loading when application code is running.

#### **Prerequisites;**

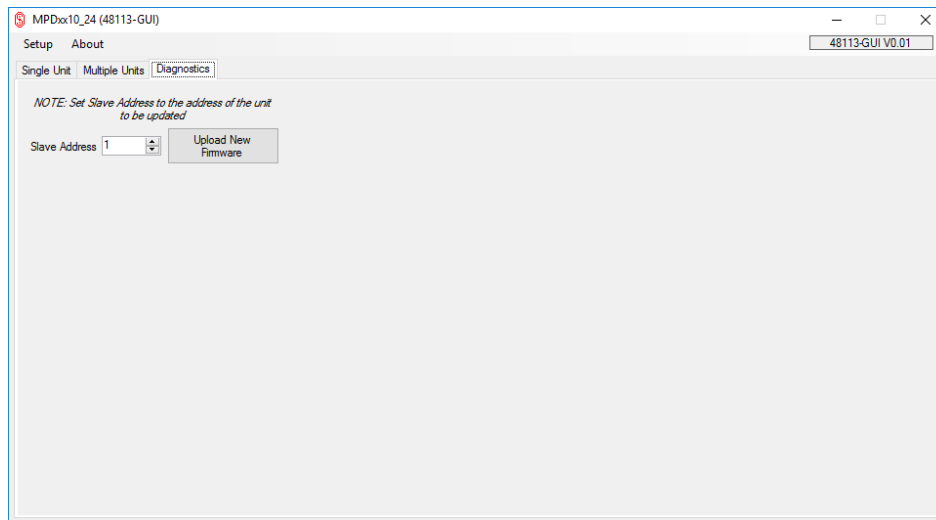
*i) Connect serial comms to and power up the unit.*

Run the MPD GUI (48113-GUI)

Click the 'Set-up' menu option. The Set-up dialog box will be displayed.

Click 'RS232' and select the serial Comms port to use. Click 'OK' when finished.

Click the 'Diagnostics' tab.



Set the 'Slave Address' to the address the unit is programmed with.

Click the 'Upload New Firmware' button. A command will be sent to the connected unit to place it in bootloader mode. Wait until you are prompted to close the GUI.

Close the GUI.

Follow the steps for loading firmware.

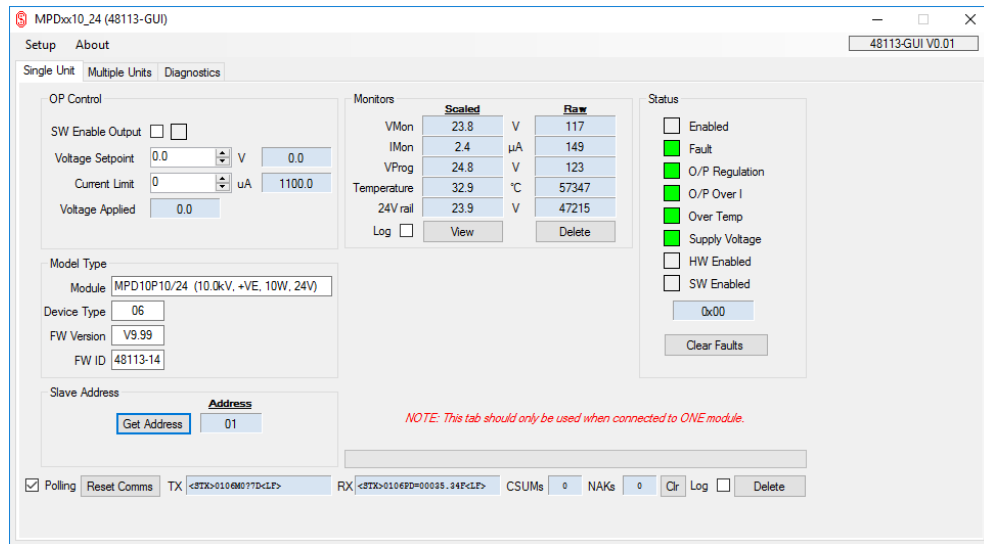
## Programming the Comms Slave Address

### Prerequisites;

i) Connect serial comms to and power up the unit.

Run the MPD GUI (48113-GUI).

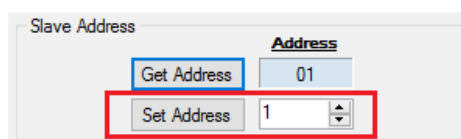
Click the 'Single Unit' tab. The GUI will look similar to the image below.



Click the 'Get Address' button. The GUI data fields will start to be populated.

Press the 'CTRL+A' keyboard buttons together.

Answer 'Yes' to the prompt. Some additional controls will be displayed.



Enter the address the unit is to be set to and click the 'Set Address' button.

When prompted click the 'Yes' button.

After a short time comms with the unit will stop. (The RX data will not be updated)

Re-click the 'Get Address' button, will be re-established.