HANDHELD PRECISION DIGITAL VOLTAGE SOURCE (Model PDVS1)

Handmade In Great Britain by www.ianjohnston.com

Unlike anything else on the market this is a truly handheld Precision Digital Voltage Source. With a user adjustable range from 50mV to 10Vdc and an accuracy/stability down in the tens of uV's it has a multitude of uses as a calibrator, reference & precision voltage source.

FUNCTIONS & FEATURES:-

- 50mV to 10Vdc user adjustable output (4d.p's, 5d.p's extended, i.e. 10's of uV's).
- Voltage setting or ramp up/down controls via the 12 button numeric keypad.
- Playback mode allows 5 preset voltages to be played back over time.
- Soft power switch.
- Based on the industry standard LM399AH (0.5 ppm/degC) voltage reference.
- No potentiometers inside or outside.
- 18bit DAC with an accuracy/stability down in the tens of uV's.
- Battery voltage monitor, including low voltage warning and auto-shutdown.
- Output voltage monitor & short circuit protection.
- 3" Graphics LCD (128x64 pixels).
- Atmel 328P micro-controller (uses Arduino bootloader).
- Precision chopper op-amp on final output with extra stability achieved using low tempco resistors.
- Re-calibration by the user possible via keypad/LCD and saved to flash rom.
- Battery powered.
- Quality Hammond 1599 case.
- Quality aluminium anodized & engraved front panel.
- Quality 4mm banana sockets.
- Single PCB integrating the electronics, LCD, keypad & battery terminals.

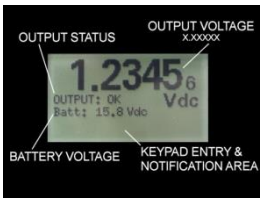
SPECIFICATION SUMMARY:-

- Voltage reference IC = LM399AH (0.5 ppm/degC temperature coefficient).
- Range = 0.05Vdc (50mV) to 10.0Vdc in 38.146uV steps (minimum).
- Load = 5mA (whilst maintaining output within approx. 10uV).
- Accuracy = 0.001% (within 100uV).
- Stability = 0.0001Vdc variation max. 4d.p. mode.
  Stability = 0.00004Vdc typical variation in extended 5d.p. mode.
- Temperature coefficient (output voltage) = <1 ppm/degC (tested range 15 – 30degC).
- Stabilization time = 5mins to within 30uV, 10mins to target (from cold).
- Output short circuit = indefinite, 20mA.
- Power Source = Two 9V PP3 batteries.
- Battery life = 14hrs (780mAh batteries) typical continuous operation.
- Current drain = 40mA (after LM399AH stabilizes).
- Dimensions = 158mm x 83mm x 35mm (case size).

IMPORTANT:-

- This is a precision instrument. Please take care when hooking up the output and using the unit.

OPERATION OF INSTRUMENT:-



Power on: Press and hold the power button till the LED lights, release the button immediately.

Power off: Press and immediately release the power button. The LCD will clear and the LED will turn off.

The unit will provide a low battery warning on the LCD at 12.5Vdc and will auto shutdown at 12.0Vdc.

Initialize: The splash screen will be displayed on power up, press any key. It is recommended to wait 10mins from cold to allow the LM399AH reference to stabilize.

Setting an output: Simply type the voltage required using the keypad. Use the '*' key as the d.p., and use the '#' as ENTER.
Note: The voltage being set will be displayed on the LCD as you type.

I.E. 1.23456 ↲

10.00000 ↲

You can also shortcut data entry when zero's are required:

I.E. 1.25 ↲

10 ↲

5.678 ↲

The unit will recognize when numbers are entered wrongly, or outwith the parameters of the unit, i.e. multiple d.p.'s, over 10Vdc, or under 0.04Vdc etc.

If you make a mistake and want to abort the voltage you are trying to set then there is no 'BACK' button, however simply keep pressing any number key and the display will roll round and clear allowing you to start again.

To ramp the currently set voltage up or down, simply press the '*' (down) or '#' (up) keys.
1 press at a time raises or lowers the voltage by 1 least significant digit (see Extended mode below).
Press and hold the '*' or '#' to ramp up/down the output 1mV at a time.

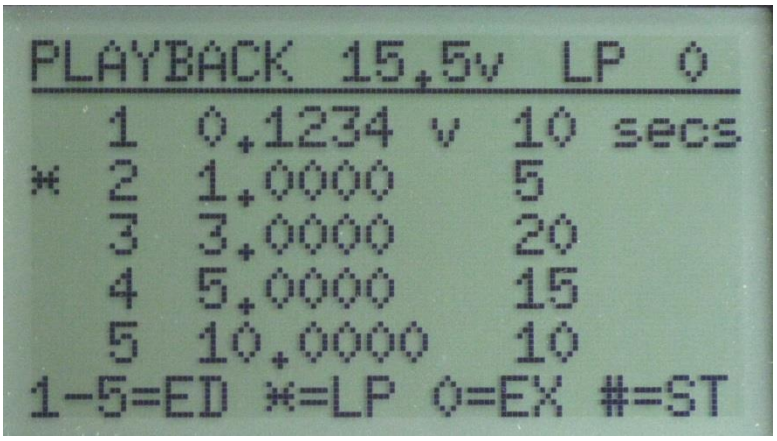
Extended mode: The units basic mode is 4 d.p.'s, i.e. X.XXXX, that's 100uV minimum.
However, the LCD shows X.XXXXx, and that extra least significant d.p. position allows the user to enter voltages down to 10uV minimum. However, the internal DAC is only capable of resolving down to 38.146uV.
Therefore, not every digit on the 5th d.p. position will deliver a change in output voltage. It is however, very handy to be able to resolve down to the very minimum the 18bit DAC can deliver.

Output Protection: The on-board output voltage monitor detects when the output has been overloaded (when the output is outwith 100mV of the desired setting) or subject to a short-circuit.

The unit will immediately reduce the output to 0Vc (approx.) and display a FAIL message on the LCD. The user will have to clear the fault and reset power to the unit.

Playback mode: The user can set up 5 voltages that can be played back over time. Each one of the 5 has a time in seconds associated with it.

To access this mode, press and hold the '1' button when on the main screen.



At the bottom of the screen is the menu.

1-5=ED EDIT VOLTAGE / TIME:
Press 1, 2, 3, 4 or 5 to edit the voltage and time for that line. The edit feature is enabled when the playback mode is inactive (not running).

To set line 1 to 1.2345 Vdc and for a specified time of 8 seconds:-

I.E. 1
1.2345 (no need to press ENTER)
08 (no need to press ENTER)

Changes made are saved to EEprom when existing playback mode.

*=LP ENABLE/DISABLE LOOP MODE:
If loop mode is enable then when playback is running and line 5 finishes it will loop around to the start again automatically.
With loop mode turned off, playback terminates when line 5 finishes.
LP will appear at the top of the screen when loop mode is enabled.

0=EX EXIT:
Exit back to the main menu.

#=ST START/STOP PLAYBACK:
Start and stop playback.
When running, the current time in seconds is displayed at the top right corner of the screen.

Notes:

1. The battery voltage is displayed at the top of the screen for convenience.

2. Setting a time of 0 seconds will effectively mean that line is skipped.

CALIBRATION:-

OUTPUT CALIBRATION:

Quick and very easy to do, 11 setpoints at 1Vdc steps rather than the usual two setpoint (min & max) technique which allows for better accuracy.

With the unit powered up, simply press & hold the '0' button and the display will change to the calibration screen. From there, press the '0' ADVANCE button and the output will cycle through the 11off setpoints one at a time:

0.05, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 (Vdc)

At each setpoint the output terminals will reflect the voltage set, so with a suitable transfer standard or high precision multimeter connected (6.5 digit minimum) the user can adjust the output voltage at each setpoint using the '*' (down) and '#' (up) keys. The calibration screen will show the set 'COUNTS' against each output voltage step.

To save & exit (at any time) press '1'.

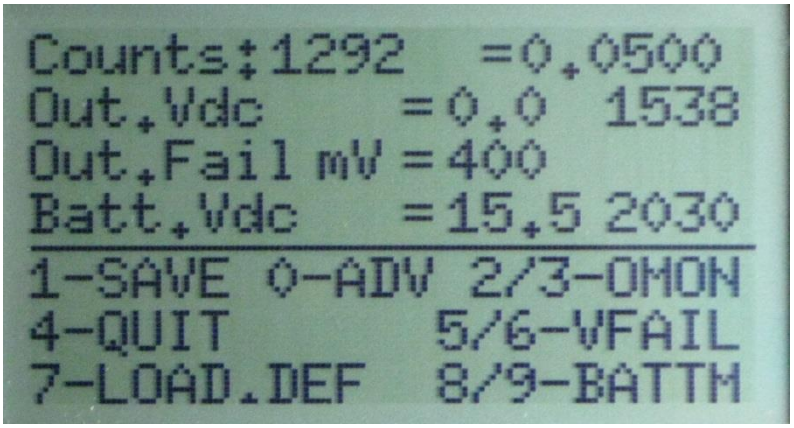
To abort without saving (at any time) press '4'.

TIP: Keep pressing '0' ADVANCE and the unit will roll back round to the start again.

The factory calibration can of course be overwritten by the user, so every unit comes with a customized calibration record which details the factory setpoint data we have set for that unit. So, in the event the user wants to return the unit to the supplied factory spec then they can do so and without the need for any high precision multimeter etc.

Example:

Volts	=	Counts
0.05	=	1293
1	=	25836
2	=	51671
3	=	77505
4	=	103340
5	=	129175
6	=	155009
7	=	180844
8	=	206678
9	=	232513
10	=	258347



There is also a set of defaults in permanent memory which are simply generic and will serve as a starting place if the user requires to do so. These can be loaded by pressing '7'. Please note the current calibration will be over-written and that this calibration will not render an accurate output voltage. Again, it's simply a starting point.

Note: User's can return their unit for factory re-calibration if required. This is a free service for now (user pays postage both directions). A new calibration certificate will be generated. The latest firmware will also be loaded. Please contact us.

OUTPUT VOLTAGE MONITOR CALIBRATION:

The unit has the capability to monitor its own output voltage. The calibration screen gives the user the ability to re-calibrate as well as check the output voltage:-

Output Voltage Monitor DOWN = press ‘2’

Output Voltage Monitor UP = press ‘3’

To ramp the current setting up or down faster, press and hold the relevant key.

To save & exit (at any time) press ‘1’.

To abort without saving (at any time) press ’4’.

OUTPUT VOLTAGE FAIL MONITOR SETTING:

The unit has the capability to monitor its own output voltage around a nominal value, so for example if the output banana’s are shorted then the unit will know about it and display accordingly on the LCD. The window around the output voltage for monitoring in mV is as follows (range 100 to 1000mV):-

Voltage Fail mV DOWN = press ‘5’

Voltage Fail mV UP = press ‘6’

To save & exit (at any time) press ‘1’.

To abort without saving (at any time) press ’4’.

BATTERY VOLTAGE MONITOR CALIBRATION:

The battery voltage monitor can also be calibrated via the calibration screen:

Battery Voltage Monitor DOWN = press ‘8’

Battery Voltage Monitor UP = press ‘9’

To ramp the current setting up or down faster, press and hold the relevant key.

To save & exit (at any time) press ‘1’.

To abort without saving (at any time) press ’4’.

FACTORY ASSEMBLY, TESTING & CALIBRATION:-

Prior to delivery, each unit is assembled & tested in our own fully equipped workshop.

Each unit:

- Hardware assembled and powered-up/tested using a strict procedure.
- Test point check at various places around the circuit for compliance.
- Burned-in for 48hrs, including numerous power cycles.
- Calibrated against a Keysight 34461a 6.5 digit multimeter (with current certificate).
- Output load tested.
- Calibrated at 23degC ambient.
- Unique serial number assigned.
- Calibration record generated.

NOTES:-

- From time to time firmware upgrades may be available. Please check our website (www.ianjohnston.com) for the current version info, and contact us as necessary. Software upgrades cannot be carried out by the user directly.

- It is recommended that high capacity rechargeable PP3 batteries are used, Lithium-Ion type can be obtained at up to 900mAh. The days of 150mAh PP3's are gone!

- If desired the unit can be powered by an external DC linear power supply (15 to 20Vdc). Use the two outside PP3 battery terminals, the PCB is marked V+ and GND for the appropriate connections. Note: the battery GND is connected to the output negative.

- User replaceable fuse = 375mA Littelfuse Nano2 P/N=154.375T

- The Arduino core and standard libraries are un-modified.

- The source code and the pcb design files are not available.

PRODUCT DISCLAIMER & WARRANTY:-

<u>Disclaimer:</u>

Information has been carefully checked and is believed to be accurate; however, no responsibility is assumed for inaccuracies.

Ian Johnston Engineering Ltd reserves the right to make changes without further notice to any products to improve reliability, function, or design. Ian Johnston Engineering Ltd does not assume any liability arising out of the application or use of any product or circuit; neither does it convey any license under its patent rights of others.

The general policy of Ian Johnston Engineering Ltd does not recommend the use of its products in life support, aircraft applications or other such critical activities wherein a failure or malfunction of the product may directly threaten life or injury. The user of Ian Johnston Engineering Ltd products in life support, aircraft applications or other such critical activities assumes all risks of such use and indemnifies Ian Johnston Engineering Ltd against all damages.

<u>Limited warranty:</u>

Ian Johnston Engineering Ltd warrants only to the purchaser of the Product from Ian Johnston Engineering Ltd (the "Customer") that the product purchased from Ian Johnston Engineering Ltd (the "Product") will be free from defects in materials and workmanship under the normal use and service for which the Product was designed for a period of:

12 months from the date of purchase of the Product by the Customer.

Customer's exclusive remedy under this Limited Warranty shall be the repair or replacement, at Company's sole option, of the Product, or any part of the Product, determined by Ian Johnston Engineering Ltd to be defective. In order to exercise its warranty rights, Customer must notify Company.

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CALIBRATION RECORD

DISPLAY	COUNTS	VOLTAGE OUTPUT
0.05000		
1.00000		
2.00000		
3.00000		
4.00000		
5.00000		
6.00000		
7.00000		
8.00000		
9.00000		
10.00000		

OTHER	COUNTS
OUTPUT Vdc	
VOLTAGE FAIL mV	
BATTERY Vdc	

Serial Number =

Calibration Ambient Temperature =

Date =