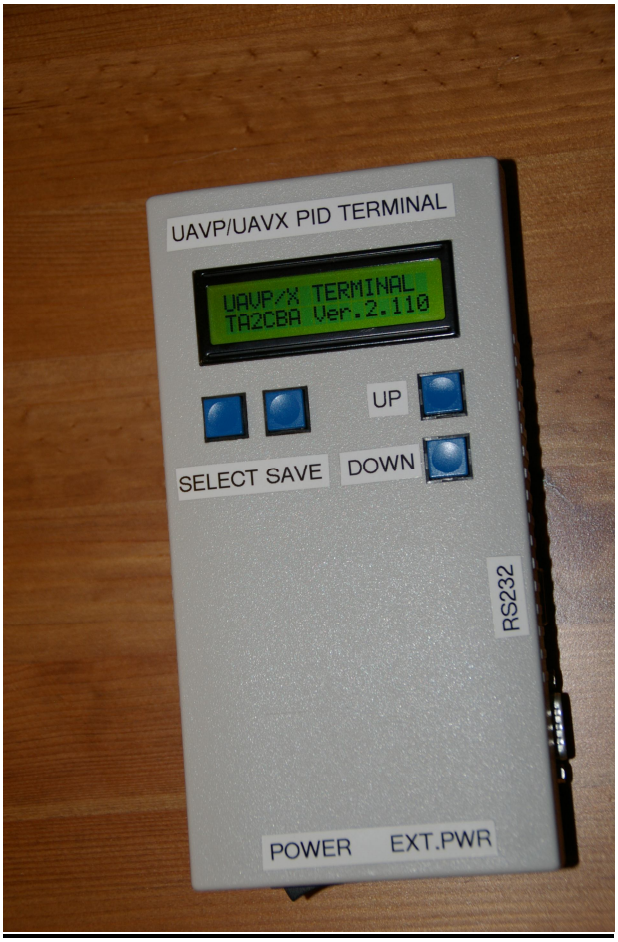
UAVP/UAVX Universal Aerial Video Platform

Handheld PID Parameter Setting Terminal

Construction and User Manual



Rev 2.1

October 2009

This manual gives details on how to construct and use the hand held PID parameter setting terminal for UAVP and UAVX Aerial Video Platform.

Parameter Setting Terminal is a handheld portable terminal for changing the UAVP and UAVX software parameters while flight testing and trimming the Quad in the field without the need for a full fledged PC and UAVPSET software. However this terminal is **not** a replacement for UAVPSET. The initial parameter loading,TX/RX setup etc has to be done with the UAVPSET and the quad must be tested for all of it's functions before using this Terminal.

Parameter Setting Terminal Features

Parameter Setting Terminal is a battery operated Hand held terminal that allows the user to modify most of the parameters in UAVP/UAVX flight firmware. Below is a list of parameters that can be modified with the Hand held Terminal for UAVP and UAVX. Also there is a list of parameters that **can't** be modified with this terminal.

List of Parameters that can be modified by Parameter Setting Terminal:

- ROLL PROP – Roll Proportional
- ROLL INTEGRAL – Roll Integral
- ROLL DIFF – Roll Differential
- ROLL INTEG. LIM. – Roll Integral Limiter
- PITCH PROP – Pitch Proportional
- PITCH INTEGRAL – Pitch Integral
- PITCH DIFF – Pitch Differential
- PITCH INTEG. LIM. – Pitch Integral Limiter
- YAW PROP – Yaw Proportional
- YAW INTEGRAL – Yaw Integral
- YAW DIFF – Yaw Differential
- YAW LIMITER – Yaw Limiter
- YAW INTEG. LIM. – Yaw Integral Limiter
- ACC ROLL AXIS - Acc Roll Axis
- ACC PITCH AXIS – Acc Roll Axis
- ACC VERT.AXIS – Acc vertical Axis
- ACC VERT.DAMPING – Acc Vertical Damping
- ACC VERT.DECAY – Acc Vertical Decay
- ACC HORZ.DAMPING – Acc Horizontal Damping
- ACC HORZ.DECAY – Acc Horizontal Decay
- RTH. ALT. (M)
- RADIUS (M)
- NEUTRAL RADIUS
- WIND COMP.
- VELOCITY COMP.
- GPS SENSE 6Ch(%)
- GPS ALT PROP
- GPS ALT INTEGRAL
- MAG.VAR.(+E Deg)
- BARO.ALT PROP.
- BARO.ALT DIFF.

- COMPASS
- CAM ROLL
- CAM.ROLL.TRIM
- CAM PITCH
- PULSE CYCLE(mS)
- THROTTLE IDLE(%)
- LOW BATT.WARNING
- EST.HOVER THROT%
- ACC NEUTRAL VALUES

Also has a menu for getting the Nuetral values for ACC and an option to write them into the Quad.

List of Parameters that can't be modified by Parameter Setting Terminal:

- TX/RX Parameters
- GYRO's
- ESC's
- Altitude Source
- RTH.Auto Descend
- Flight Mode
- Rx to Quad
- TX Mode

- Parameter Settings Terminal can detect automaticaly the flight software type on board if it is the UAVP or recently released UAVX.

- It will establish serial communication connection between UAVP/UAVX, check if it is working properly and display the status before letting the user to modify any settings.

- It is a battery powered, self contained unit. For serial communication with the UAVP flight PCB it uses the same connection, K7, on the UAVP flight board which is used to connect to the PC and UAVPSET

- It has a menu driven setup with 4 push buttons and a 2 lines by 16 characters alphanumeric LCD display.

- There are 7 main menus which categorizes the UAVP/X parameters under certain categories which are Roll,Pitch,Yaw,Acc,Nav and General which is almost similar to UAVPSET and a menu called NEUTRAL Paramtrs for retrieving Accelerometer Neutral Values. Each selected menu has sub menus for parameter values i.e Roll main menu has sub menus as Roll Prop,Roll Diff,Roll Integral,Roll Integral Limit.

- All the parameters have upper and lower limits consistent with UAVPSET Limits and Terminal firmware restricts any values beyond these limits by locking the function of up/down keys if these limits are reached.

Parameter Setting Terminal Circuitry:

Parameter Setting Terminal uses a PIC18F4520 microcontroller. Four push buttons enables the user to navigate through the menu system and save parameters to Quad. To display menus and parameters a 2 lines by 16 characters standard alphanumeric LCD is used. A MAX232, TTL to RS232 level converter IC is used to shift PIC serial port signal levels to match with the UAVP board signal levels.MAX232 is manufactured by various companies. Anyone of the compatible products can be used.

The electronics are powered from 7 volts to 15 Volts DC. A small 9 Volts battery will be enough to give a reasonable amount of operating time of several hours continously. The unit draws approxiomately 30 miliamps.It can equally be powered from the Lipo battery on board the quad.

The PC connection cable prepared to communicate with the UAVPSET and Quad, which has a female 9 Pin DB9 connector can be used also between this terminal and Quad.

Please see below for the schematics of UAVP/UAVX Parameter Setting Terminal.

The hex file to be programmed into PIC18F4520 is also included in the zip file. You must have a suitable PIC programmer to program the pic with the hex file included. A good and relatively cheap programmer is Pickit2 from Microchip Ltd. http://www.microchip.com

The firmware for PID parameter setting Terminal is written in Picbasic Pro from MicroEngineering Labs. http://www.melabs.com/products/pbp.htm .
There are three firmware files for different PIC processor types. These are for PIC18F4520, PIC18F2520 and PIC18F2620. All working identical but for different types of PIC processors to give a flexibility in processor choice. The sources and all the related files are included in the zip file.

Two types of schematics are included.One for 40 pin PIC processor, PIC18F4520 and the other one for 28pin PIC processors, PIC18F2520 and PIC18F2620.

Two PCB layouts are designed,one for 40 pin PIC version and the other one for 28 pin PIC version. The PCB Layouts are included in the zip file for both types and can be used for ease of building. PCB layouts in PDF files are in scale which can be used to etch directly from them. Layouts are drawn in ExpressPCB. Expresspcb files required for ordering the pcb's from www.expresspcb.com are included in the zip file.

I wish to thank Don, dleroi for his excellent help by designing the PCB layouts.

As can be seen from the schematics it is not an overly complicated circuit. All the semiconductor components used can be purchased from Sparkfun Electronics, www.sparkfun.com.

Alternatively these PIC Development boards from Sparkfun can be used also.

http://www.sparkfun.com/commerce/product_info.php?products_id=21

http://www.sparkfun.com/commerce/product_info.php?products_id=18

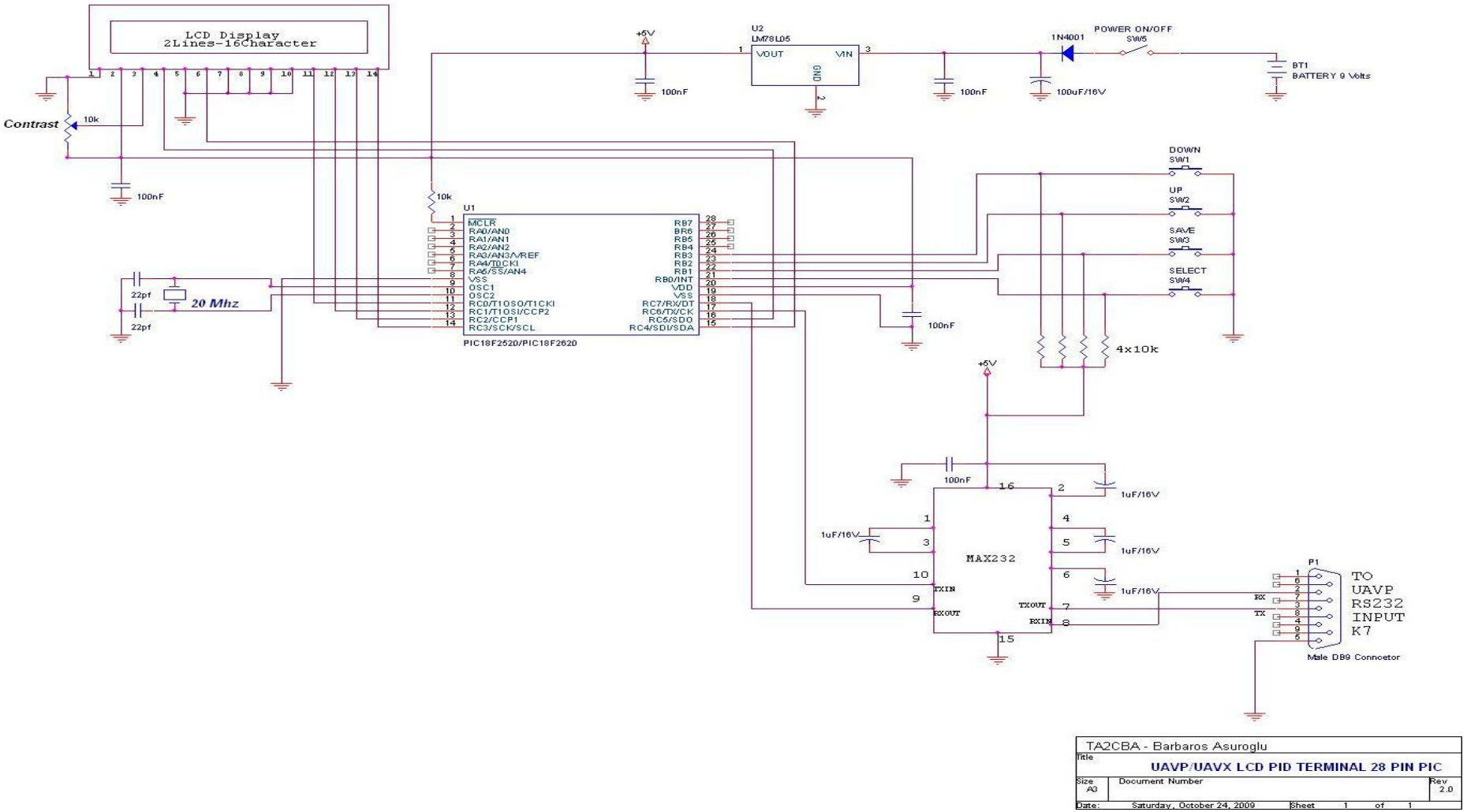
They have a 40 pin DIP socket or 28 pin DIP socket for PIC with the 20 Mhz crystal and related components in place, RS232 level shifter, a DB9 Connector and a 7805 Voltage Regulator.Only the LCD,switches and a few components are missing. I used this board for the prototype.

Just beware that the pin connections of DB9 connector on this board is swapped compared to Terminal schematics and PCB layouts.TX is RX and RX is TX.Also the DB9 connector is female which means you can't use the PC cable you were using between the PC and UAVP.You have to prepare a new cable with male DB9 connector at Terminal unit end if you intend to use this board.

As an alternative for the RS232 Level Shifter,this unit from Sparkfun can also be used
http://www.sparkfun.com/commerce/product_info.php?products_id=8780
For an easy LCD connection this breakout board from Mikrolelektronika might be helpful.
http://www.mikroe.com/en/tools/glcd/lcd/

Parts List for the Circuit:

1 x PIC 18F4520 , 40 Pin PIC Microcontroller or PIC18F2520 or PIC18F2620 28pin PIC Microcontroller
1 x MAX232 RS232 Level shifter
1 x 2 Lines by 16 character Alphanumeric LCD Display
1 x 78L05 , 5 Volt Voltage Regulator
1 x 1N4001 Diode
1 x 40 pin DIP IC Socket or 28 pin DIP Socket
1 x 16 pin DIP IC Socket
1 x 20 Mhz Crystal
2 x 22pF ceramic capacitor
1 x 100uF/25 V Electrolytic capacitor
4 x 1 uf/16V Electrolytic capacitor
5 x 100nF unipolar capacitor
1 x 10K variable resistor for LCD Contrast Adjust.
5 x 10K Resistor
4 x tactile SPST Pushbutton switch
1 x 9 pin male DSUB9 connector
1 x SPST switch for power on
1 x 14 pin male header for LCD
1 x 14 pin female header for LCD



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Title: UAVP/UAVX LCD PID TERMINAL 28 PIN PIC		
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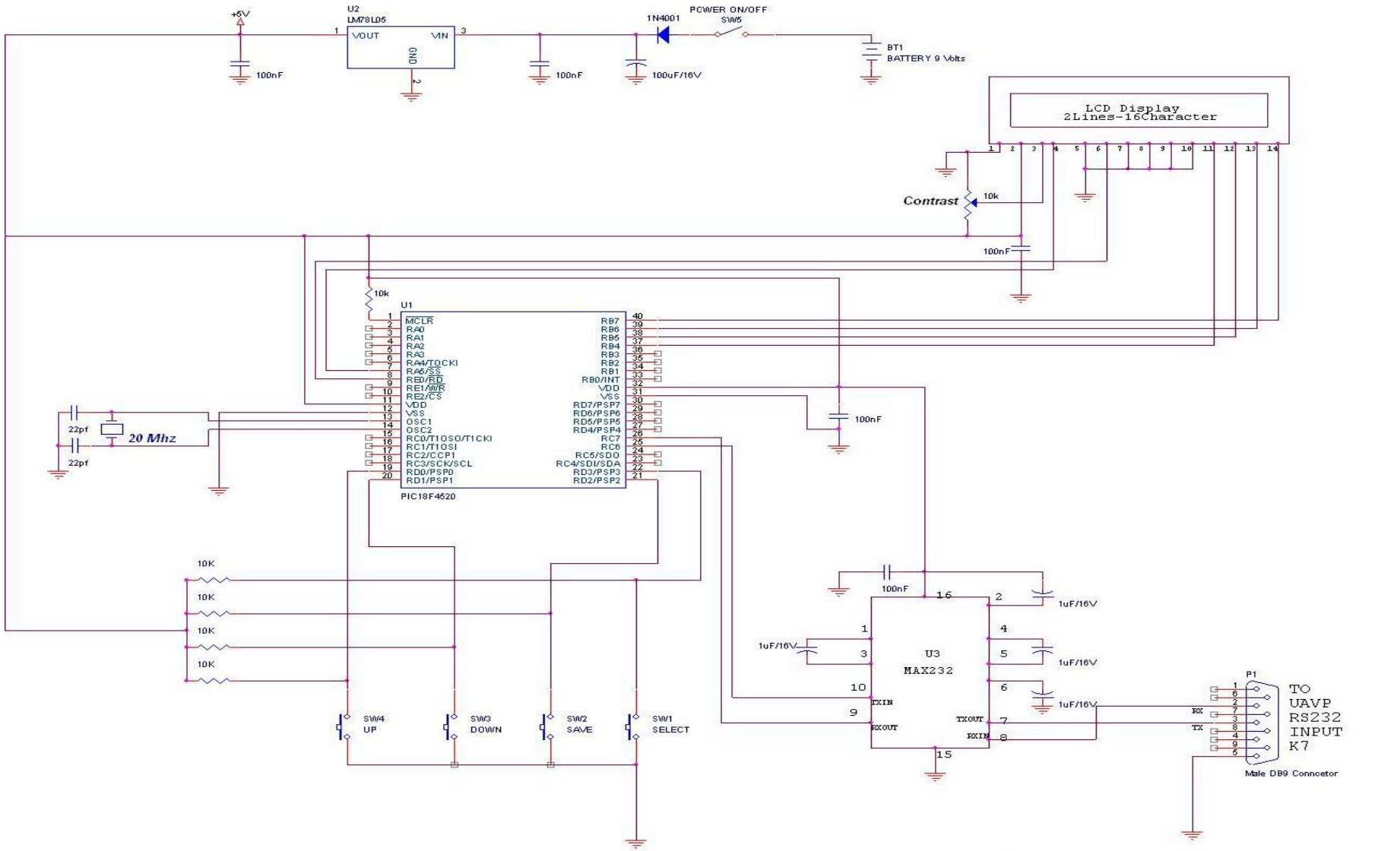

TA2CBA - Barbaros Asuroglu		
Title: UAVP/UAVX LCD PID TERMINAL for 40 pin PIC		
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Using the UAVP/UAVX Parameter Setting Terminal:

Using the Terminal is relatively easy with the menu based screens. There are four push buttons to navigate through menus and functions.

These buttons are:

UP – For scrolling up the menus
DOWN – For Scrolling down the menus
SELECT – To select the menu
SAVE – To save the modified parameter value to Quad

Always connect the Terminal Unit to the UAVP PCB first and then power the UAVP then power on the Terminal Unit.

Never pull the connection cable while both UAVP and the Terminal Unit is powered on as this may damage the MAX232 IC. Always power off the Terminal Unit first before disconnecting from the UAVP.

Power on Displays:

When the Terminal Unit is powered on, a greeting message is displayed showing the unit info and firmware version.

UAVP/X TERMINAL
TA2CBA Ver.2.119

After the greeting screen a message will be displayed as

CONNECTED!

if the terminal successfully communicates with the UAVP flight controller board. If no connection then

DISCONNECTED!

will be displayed.

If the unit can't establish connection it will stall and **DISCONNECTED!** will be displayed until the unit can establish connection with the UAVP. Check the connection cables and if the right pins of the level shifter on the unit is connected to the correct pins of the DB9 male connector on the terminal unit.Also make sure the PC cable works fine with the UAVPSET.

- After connection is established flight firmware type will be detected and displayed. If the flight sotware on the quad is UAVP then:

UAVP FLIGHT
Software

will be displayed briefly.

If UAVX software is on board the Quad then:

UAVX FLIGHT
Software

will be displayed.
When UAVP software is detected then only UAVP related parameters will appear in menus and all the UAVX parameters will be masked and not shown.

Main Menus :
After the power on screens are displayed and connection is established with the UAVP, all parameter data is downloaded from the Quad to the Terminal Unit. Then the main menu screen displays the first menu:

ROLL Parameters

Scroll up and down in the main menu choices by the **UP** and **DOWN** keys.

Displayed main menu categories are:
ROLL Parameters
PITCH Parameters
YAW Parameters
ACC Parameters (Accelerometer Parameters)
NAV Parameters (Navigational Parameters)
GENERAL Paramtrs
NEUTRAL Paramtrs **(**Accelerometer Neutral Parameters)

Sub Menus and changing the value of a selected Parameter:
To select one of the main menu items use **SELECT** button**.** For example if SELECT is pressed to display **ROLL Parameters** then the first item in that submenu is ROLL PROP which will be displayed with it's value downloaded from UAVP Roll proportional Register:

ROLL PROP.
Parm= +20 1

This reads as Roll proportional value +20 and that "1" at the right end of the display will show the active parameter set, in this case it is parameter set 1 which is active.If parameter set 2 will be active then "2" will be displayed.

Now to change the value press **SELECT** and the display will look like this:

ROLL PROP.
Parm? +20 1

This is the Parameter Input Screen. It will be the same display format with a "**?**" sign instead of "**=**" which means now you can modify the value up and down by using the

UP and **DOWN** keys. If the desired value is reached and ready to save to UAVP then press **SAVE** button and the value displayed will be saved to UAVP with below message displayed.

SAVING PARM !

After saving is complete the screen will revert to the submenu screen displaying the recent input value.

To leave the parameter input screen without any changes then press **SELECT** and the screen will revert to the sub menu screen without changing the value in UAVP register.

When scrolling with up and down buttons through the submenu parameters they are displayed with their values stored in UAVP/X.

Submenu Items:

ROLL Parameters are divided into sub menus:

- ROLL PROP – Roll Proportional
- ROLL INTEGRAL – Roll Integral
- ROLL DIFF – Roll Differential
- ROLL INTEG. LIM. – Roll Integral Limiter
- EXIT – Exit to Main Menu

PITCH Parameters are divided into sub menus:

- PITCH PROP – Pitch Proportional
- PITCH INTEGRAL – Pitch Integral
- PITCH DIFF – Pitch Differential
- PITCH INTEG. LIM. – Pitch Integral Limiter
- EXIT – Exit to Main Menu

YAW Parameters are divided into sub menus:

- YAW PROP – Yaw Proportional
- YAW INTEGRAL – Yaw Integral
- YAW DIFF – Yaw Differential
- YAW LIMITER – Yaw Limiter
- YAW INTEG. LIM. – Yaw Integral Limiter
- EXIT – Exit to Main Menu

ACC Parameters are divided into sub menus:

- ACC ROLL AXIS - Acc Roll Axis
- ACC PITCH AXIS – Acc Roll Axis
- ACC VERT.AXIS – Acc vertical Axis
- ACC VERT.DAMPING – Acc Vertical Damping
- ACC VERT.DECAY – Acc Vertical Decay
- ACC HORZ.DAMPING – Acc Horizontal Damping

- ACC HORZ.DECAY – Acc Horizontal Decay
- EXIT – Exit to Main Menu

NAV Parameters are divided into sub menus:

- RTH. ALT. (M)
- RADIUS (M)
- NEUTRAL RADIUS
- WIND COMP.
- VELOCITY COMP.
- GPS SENSE 6Ch(%)
- GPS ALT PROP
- GPS ALT INTEGRAL
- MAG.VAR.(+E Deg)
- EXIT – Exit to Main Menu

GENERAL Parameters are divided into sub menus:

- BARO.ALT PROP.
- BARO.ALT DIFF.
- COMPASS
- CAMERA ROLL
- CAM.ROLL.TRIM
- CAMERA PITCH
- PULSE CYCLE(mS)
- THROTTLE IDLE(%)
- LOW BATT.WARNING
- EST.HOVER THROT%
- EXIT – Exit to Main Menu

NEUTRAL Paramtrs have one sub menu and when **NEUTRAL Paramtrs** will be selected by **SELECT**, the Accelerometer Neutral Values will be displayed as:

NEUTRAL VALUES
R-25 P-40 V+6

To exit from the menu without saving the ACC NEUTRAL Values just press **SELECT** and you will exit to the main menu.

To save the values press **SAVE.** Displayed values will be saved to ACC registers: ACC Roll Axis,ACC Pitch Axis and ACC Vertical Axis.

SAVING NEUTRAL
VALUES !

will be displayed while saving.

After saving these Values, display will revert to the main menu, **NEUTRAL Paramtrs**.To check the values stored for ACC Neutrals goto ACC Parameters in the main menu and check ACC Roll axis,ACC Pitch Axis and ACC Vertical Axis values.

Before selecting the **NEUTRAL Paramtrs** menu, align Quad perfectly horizontal and avoid any movement.

IF the NEUTRAL Values are beyond the limits of ACC settings then an error message will be displayed :

ERROR! Values
Exceed Limits

And after two seconds the display will revert back to **NEUTRAL Paramtrs** menu.
In this case check the Accelerometer is working properly and it is aligned straight along all it's axis and fixed firmly.

Limitations and Restrictions:

This Terminal Unit is aimed only for modifying the flight related parameters and ACC Neutral Values while flight testing and trimming the Quad in the field without the need for a PC.

The Parameter Setting Terminal is designed to work in conjunction with UAVP and UAVX flight software. It is tested and used with the latest UAVP gke firmware for PIC16F876 and latest UAVX 768 gke firmware.Although all effort has been put to test the Terminal unit to eliminate any errors please consider it as a BETA version until there is enough feedback from fellow users who choose to use it, so proceed with caution and perform your own tests.

In case of any errors detected please report to ta2cba@yahoo.com so that I can take on board and correct it immediately.

I haven't tested it with the original UAVP3.15 firmware from Wolferl but as both UAVP gke firmware and wolferl versions use the same parameter setting logic it should work fine.

This unit is not a complete replacement for UAVPSET as you can't modify some of the parameters that is necessary initially to setup the Quad i.e RX/TX, Gyro types etc.as listed above in this manual.

Also there is no testing facilities or similar advanced features UAVPSET offers.

Disclaimer:

I tried to test the unit extensively with the above mentioned UAVP and UAVX softwares. Although all effort has been done to eliminate any errors please consider it still as a BETA version until there is enough feedback, so proceed with caution and perform your own tests.

You use and build this Parameter Setting Terminal Unit at your own risk.I can't be held liable for any damage caused to you or others by using this unit and your quad.

The firmware for UAVP/UAVX Parameter Setting Terminal unit is free; you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation; either version 2 of the License, or (at your option) any later version.

This manual and related program with the schematics is distributed in the hope that it will be useful,but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License included in the zip file for more details.

Barbaros Asuroglu de TA2CBA
ta2cba@yahoo.com

27 October 2009