SP-7 AHRS

Firmware upgrade instructions

Installation and calibration

General

This document describes the firmware upgrade procedure and new functionality of the SP-7 Firmware release.

The firmware upgrade is applicable to all SP-7 units. First generation SP-7 devices require in addition the removal of three capacitors (described in this document).

The firmware upgrade adds the following functionality:

a) New dynamic gyro aiding algorithms for enhanced resilience to installation related problems such as vibration and airframe shocks.
b) Full CAN support with latest functionality.
c) Up to 4 addressable SP-7 units per installation (CAN bus only). User settable CAN addresses via setup function in EFIS.
d) Basic AHRS calibration functions – gyro bias reset, accelerometer calibration via CAN bus and EFIS setup function.

Upgrading SP-7 units

Download the Windows based update application from www.MGLAvionics.co.za/SP7.html.
The application has been tested with Windows XP, Vista and Windows 7.

This update will install new firmware into an existing SP-7 AHRS using a serial port.
You will need to construct a suitable RS232 cable.

RS232 connection from SP-7 to PC

Please construct a RS232 cable from a PC serial port to the SP-7 RS232 port. Pinouts for the SP-7 are on the sticker.
Note:

PC DB-9 male connector:

TX is pin 3
RX is pin 2
Ground is pin 5

Wire TX to pin 3 on the SP-7
Wire RX to pin 4 on the SP-7
wire ground to pin 1 or 2 on the SP-7

Supply the SP-7 from a stable 12V DC power source. A reasonable quality 12V DC wall AC/DC adaptor suffices. A 12V lead-acid battery is also a good choice.

Updating the SP-7

Run the application ARMPROG.EXE on your Windows PC. Select the serial port to use in the

setup. You can choose COM1 to COM16. If none of these are available, please reallocate an unused port in your windows setup (control panel) to fall in this range. Often, if you use USB to serial adapters, a new port number is allocated every time Windows thinks it is for a different USB port or application.

Control panel -> System -> Hardware -> Device manager -> Ports(COM&LPT). Then select the port currently allocated by your USB converter (for example COM32) then -> Port settings -> Advanced -> choose a port number in the range COM1 to COM16.

With ARMPROG running and the SP-7 connected, switch on power to the SP-7. If all goes well ARMPROG now shows "ready to program". Click the "Program" button and wait for the message "Application programmed". This takes less than a minute.

Close ARMPROG and verify that the SP-7 starts with the new code. Remove power from the SP-7 and re-apply. After a few seconds the LED should start flashing.

Run the AMRPROG.EXE Windows firmware update utility. You should see:
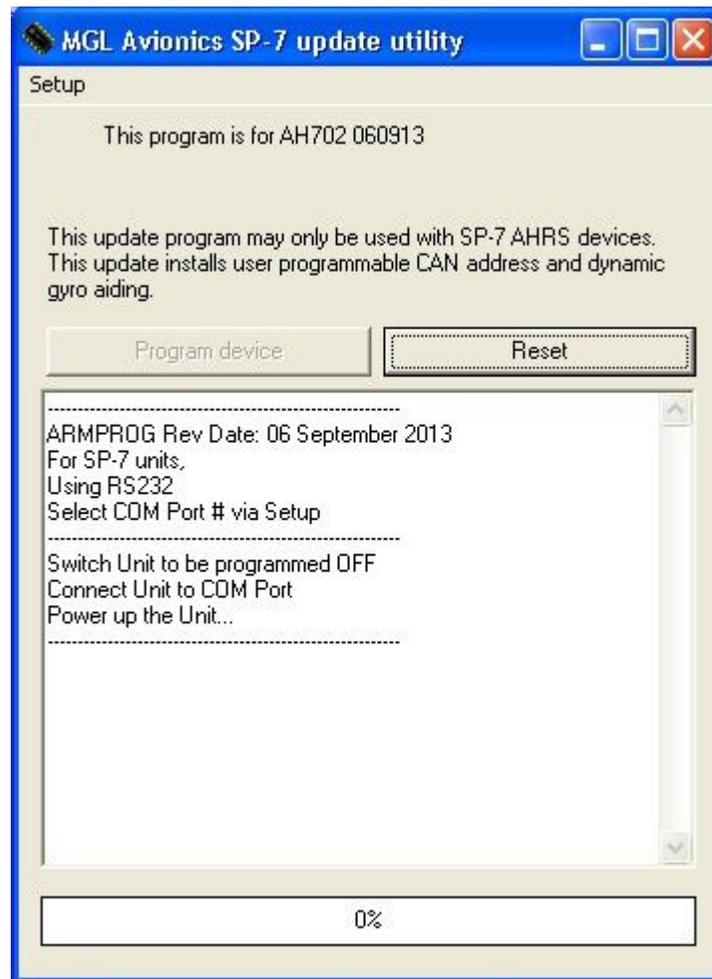
Select your serial port using the "Setup" menu.

Switch on the SP-7 (apply power). If the SP-7 is communicating with your ARMPROG program you will see:
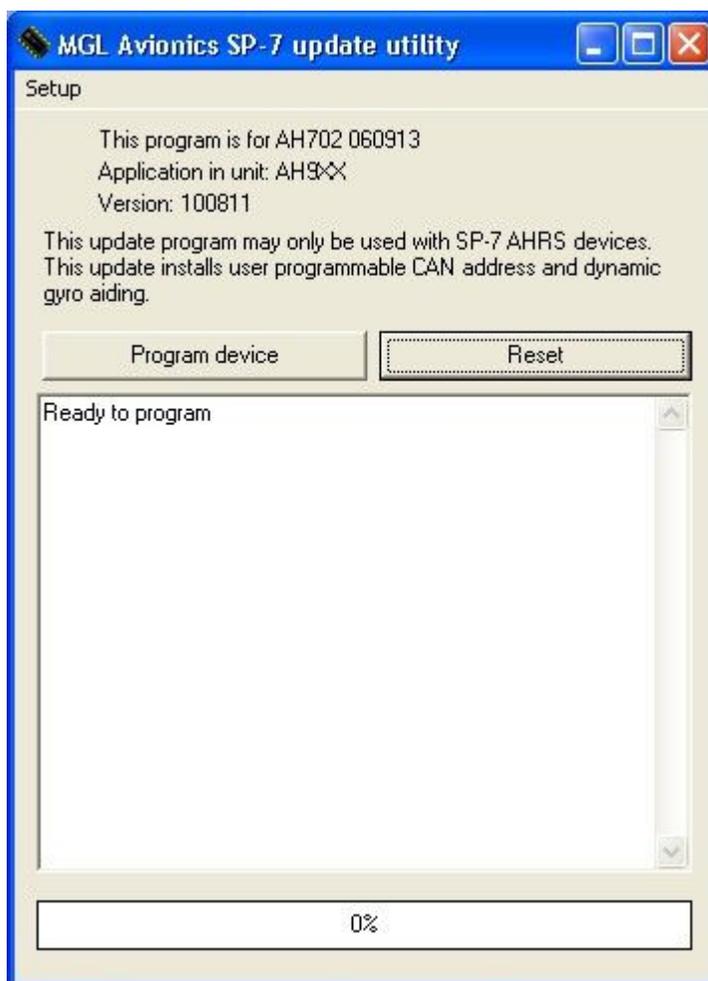
The version of firmware in your unit will be shown (Here it is 100811 which means August, 10th, 2011). We are about to program 060913.

When ready click "Program device".
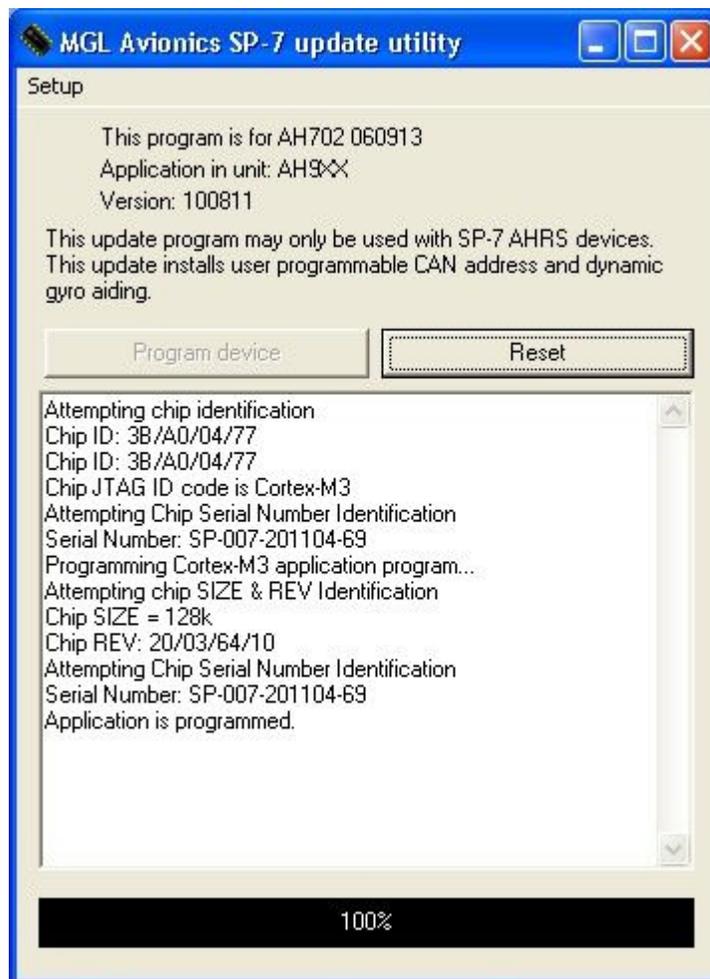
The programing process takes about 10-20 seconds. When it is done you should see something similar to the above.

At this point you can close the ARMPROG application, it is no longer needed.

Restart the SP-7 by removing and re-applying power. The LED on the SP-7 should start flashing after a few seconds.

Checking for a first generation SP-7

If you updated a first generation SP-7 it will show an incorrect horizon image (it will be randomly tilted and not follow rotation correctly). You need to remove three small capacitors. It requires an electronic soldering iron with a small tip.

Remove the two screws holding the front panel (the side that has the connector). The PCB then slides out.
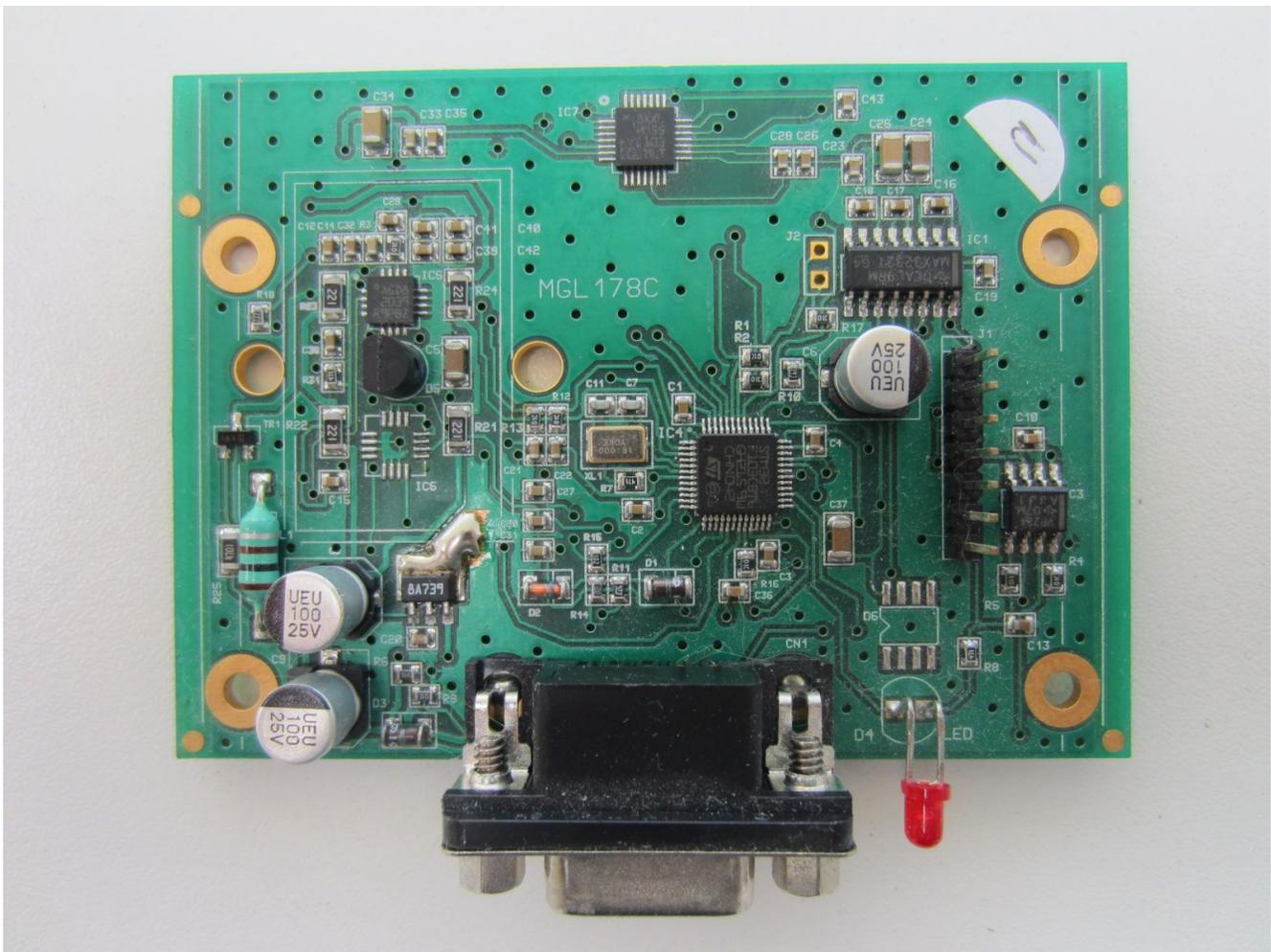
View of a first generation SP-7 PCB that needs to have the capacitors removed. They are labeled C30,C31 and C27.
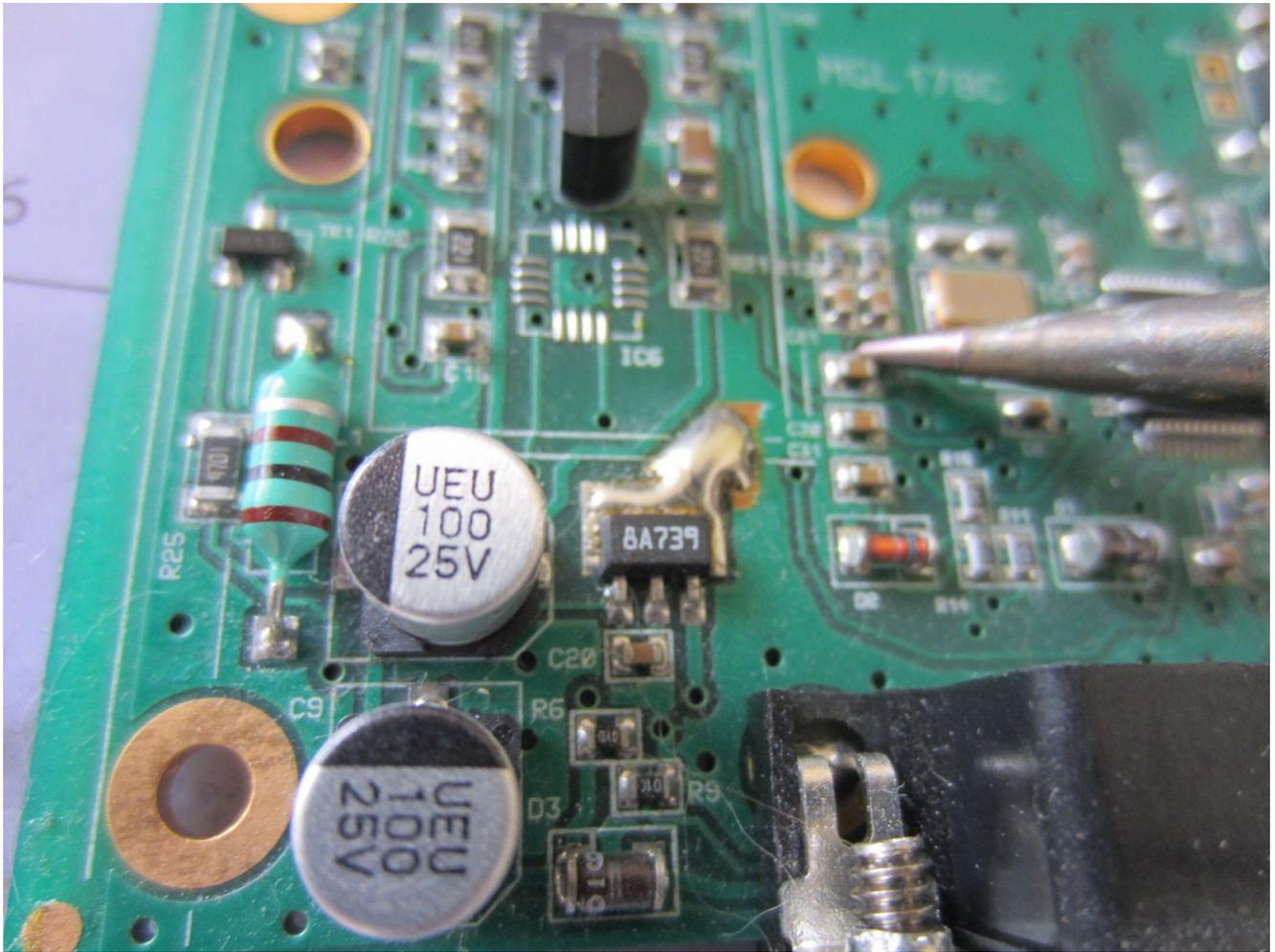
Apply heat to the capacitor until the solder melts and you can remove it. Here we are removing the first one (top of three).
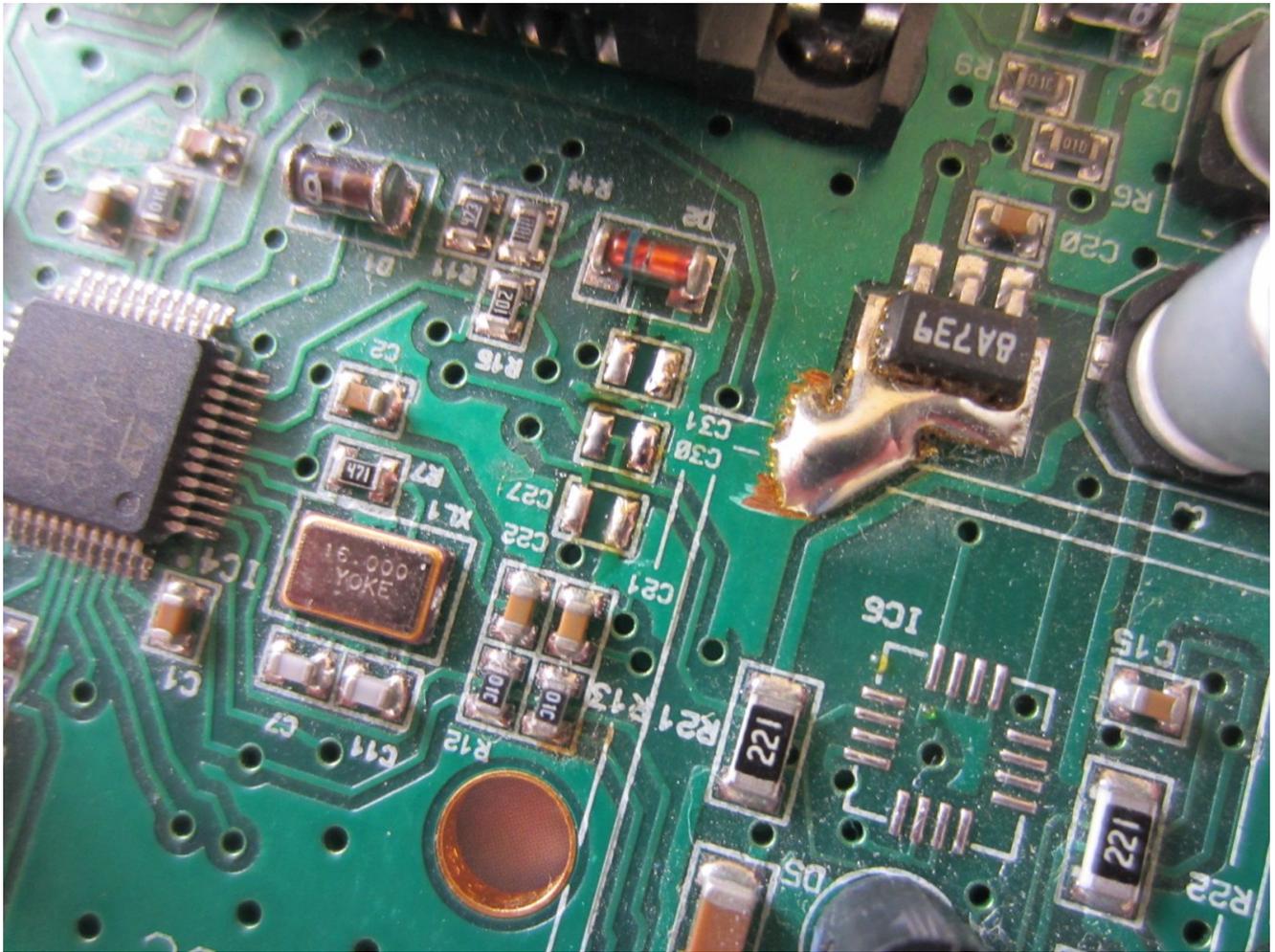
This is what it should look like once the three capacitors have bee removed.
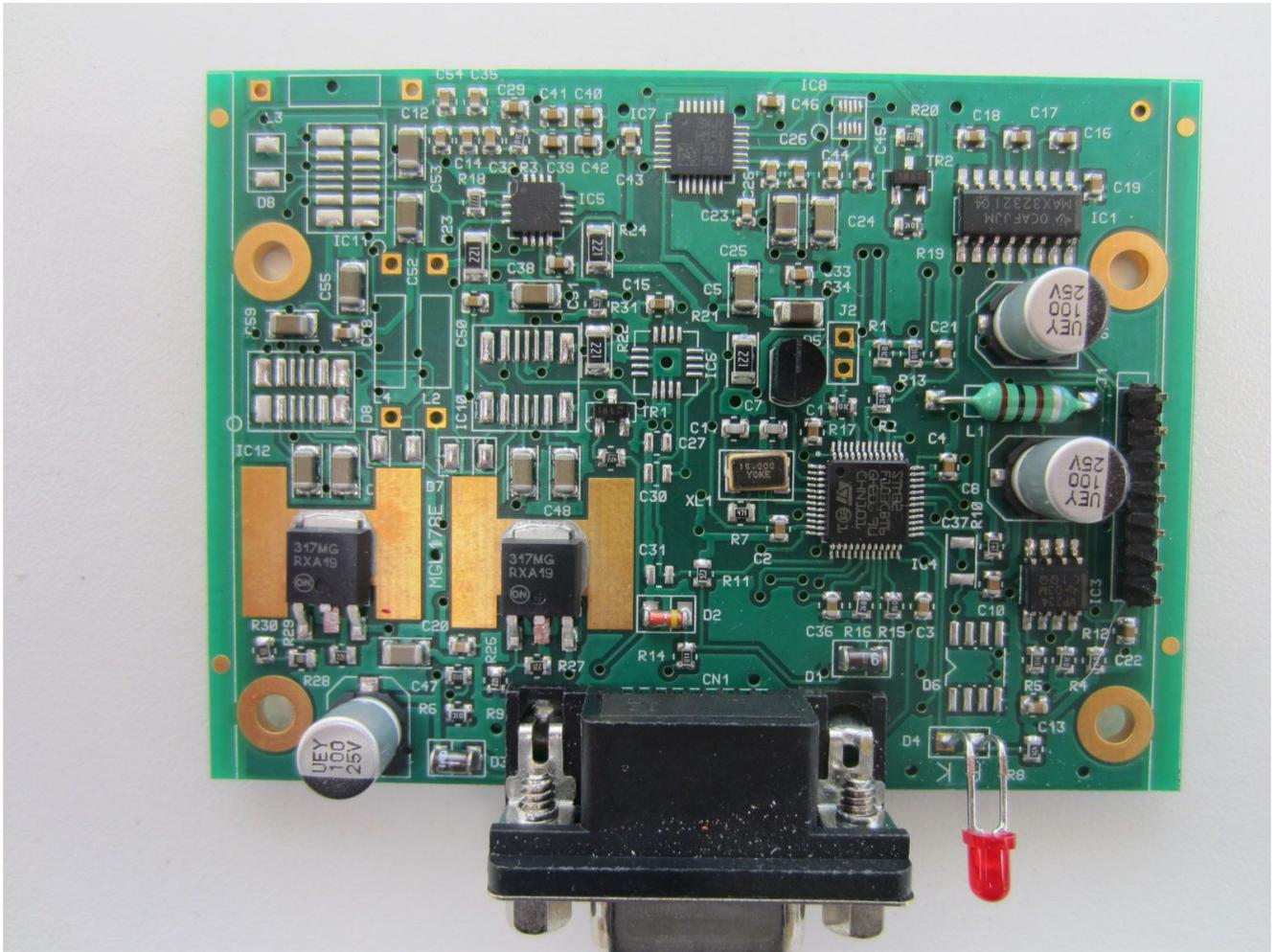
Picture of a newer version. This version does not have the three capacitors fitted. No need to do anything.
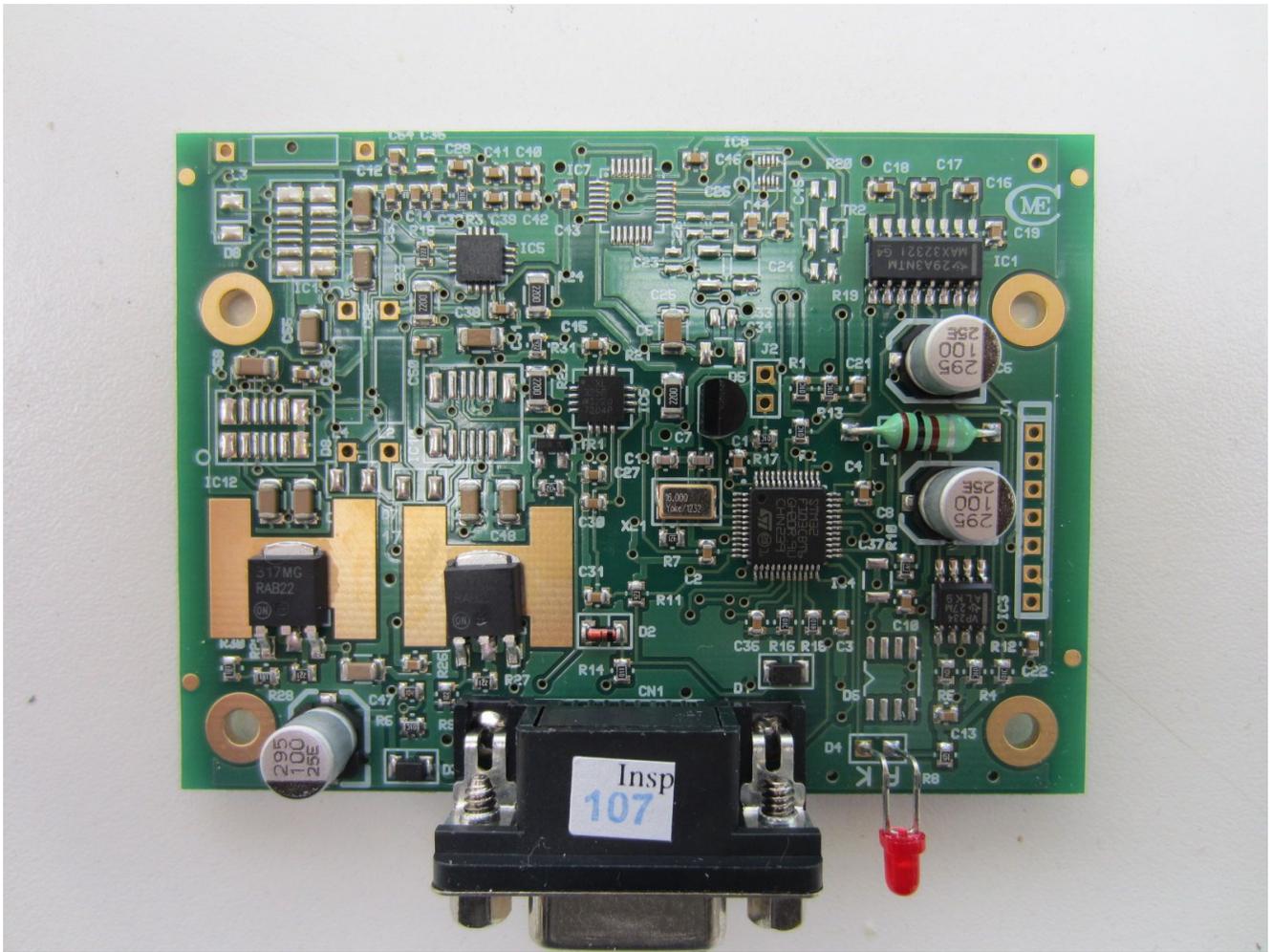
Picture of a current generation SP-7. **Do NOT remove the capacitors.**

Additional setup functions available with new SP-7 firmware

Using the iEFIS as example, entering the horizon setup menu gives you the following functions:
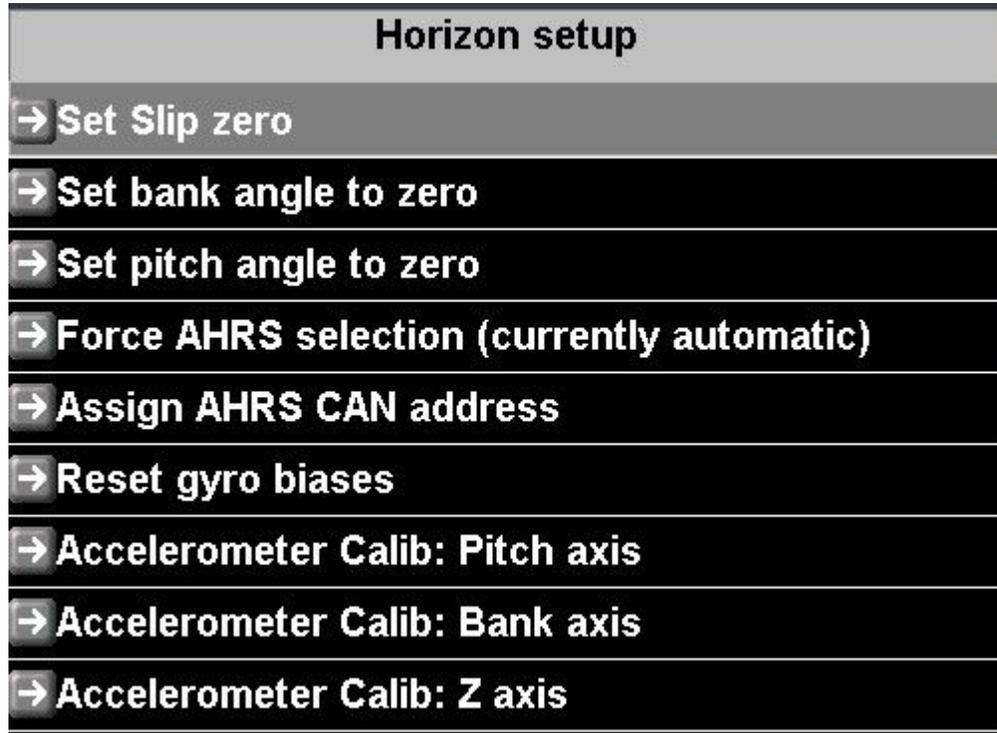
"Set Slip Zero", "Set bank angle to zero" and "Set pitch angle to zero" are unchanged from previous releases. These functions are intended to be used to to "fix" slight installation miss-alignment of the SP-7. Any corrections are stored in the EFIS, the actual SP-7 is not affected.

Force AHRS selection

This can be used to force the system to use a particular AHRS if you have more than one connected to the CAN bus. Normally, the EFIS will select the AHRS with the lowest bus number (1, 2, 3 or 4) if available and switch to a higher number if there is a failure.

Using this function you can force a selection and this will be remembered after a power cycle.

Note that there is a non-permanent selection as part of the AHRS diagnostics (in the Diagnostics menu). This is usually used during installation or fault diagnosis.

Assign AHRS CAN address

This function will not show in active flight.

Fundamental to the correct operation of the CAN bus is that every node has a unique address. Using this function you can assign one of 4 addresses to **ONE** attached SP-7. Note that this command will set the addresses on any attached SP-7 device to the one requested so in normal installations, connected **ONE** SP-7 at a time and set the address. The function provides a convenient display to show you the corrected SP-7 devices. Note that you have a more elaborate diagnostics function for AHRS systems in the Diagnostics menu.

We recommend that after you have set the AHRS address on a SP-7, attache a sticker with that address onto the device.

Note: If you are planning to use a single SP-7, you can ignore this function. It is only relevant for multiple SP-7 units on a single CAN bus.

Reset Gyro Biases

This function will not show in active flight.

Gyroscopic devices tend to have good long term stability so it is likely very rare that you will want to use this function.
A gyro "Bias" is a term that is used if a gyro outputs a turn rate when it is in fact not turning. The two most common reasons for bias "drift" are temperature changes and aging of the device. The SP-7 is temperature compensated and controlled (it has a mild internal heater that is used to avoid the system running at very cold temperatures). This leaves aging as the long term issue.

To use this function, ensure that the SP-7 is at best operating temperature (wait 15 minutes or more after applying power) and then select the function. Proceed after confirmation.

Ensure that the SP-7 is not subject to any movement at all during the calibration which lasts about 5 seconds.

Accelerometer calib (pitch, bank, Z axis)

These functions will not show in active flight.

To cater for effects of aging on the accelerometer it is possible to calibrate it using Earth's gravity as reference.

This calibration cannot be done with the SP-7 mounted, you need to be able to rotate it.

To use this function, ensure that the SP-7 is at best operating temperature (wait 15 minutes or more after applying power) and then select the function.

You need a small spirit level.

Step 1:

Using the spirit level, place SP-7 horizontal very accurately. Wait 15 seconds. Select "Z-Axis" and confirm. Ensure that the SP-7 will not be subject to any movement for 10 seconds after confirmation.

Step 2:

Using the spirit level, place SP-7 at a 90 degree bank angle very accurately (place on its side, does not matter if left or right). Wait 15 seconds. Select "Bank" and confirm. Ensure that the SP-7 will not be subject to any movement for 10 seconds after confirmation

Step 3:

Using the spirit level, place SP-7 at a 90 pitch down angle very accurately (Pitch down is usually easier due to the connector). Wait 15 seconds. Select "Pitch" and confirm. Ensure that the SP-7 will not be subject to any movement for 10 seconds after confirmation

Step 4:

This is a repeat of step 1.

Using the spirit level, place SP-7 horizontal very accurately. Wait 15 seconds. Select "Z-Axis" and confirm. Ensure that the SP-7 will not be subject to any movement for 10 seconds after confirmation.

Note that the SP-7 will only store the calibration if it has been done in the sequence shown above (you may swap step 2 and 3 but no other steps).

AHRS Diagnostics
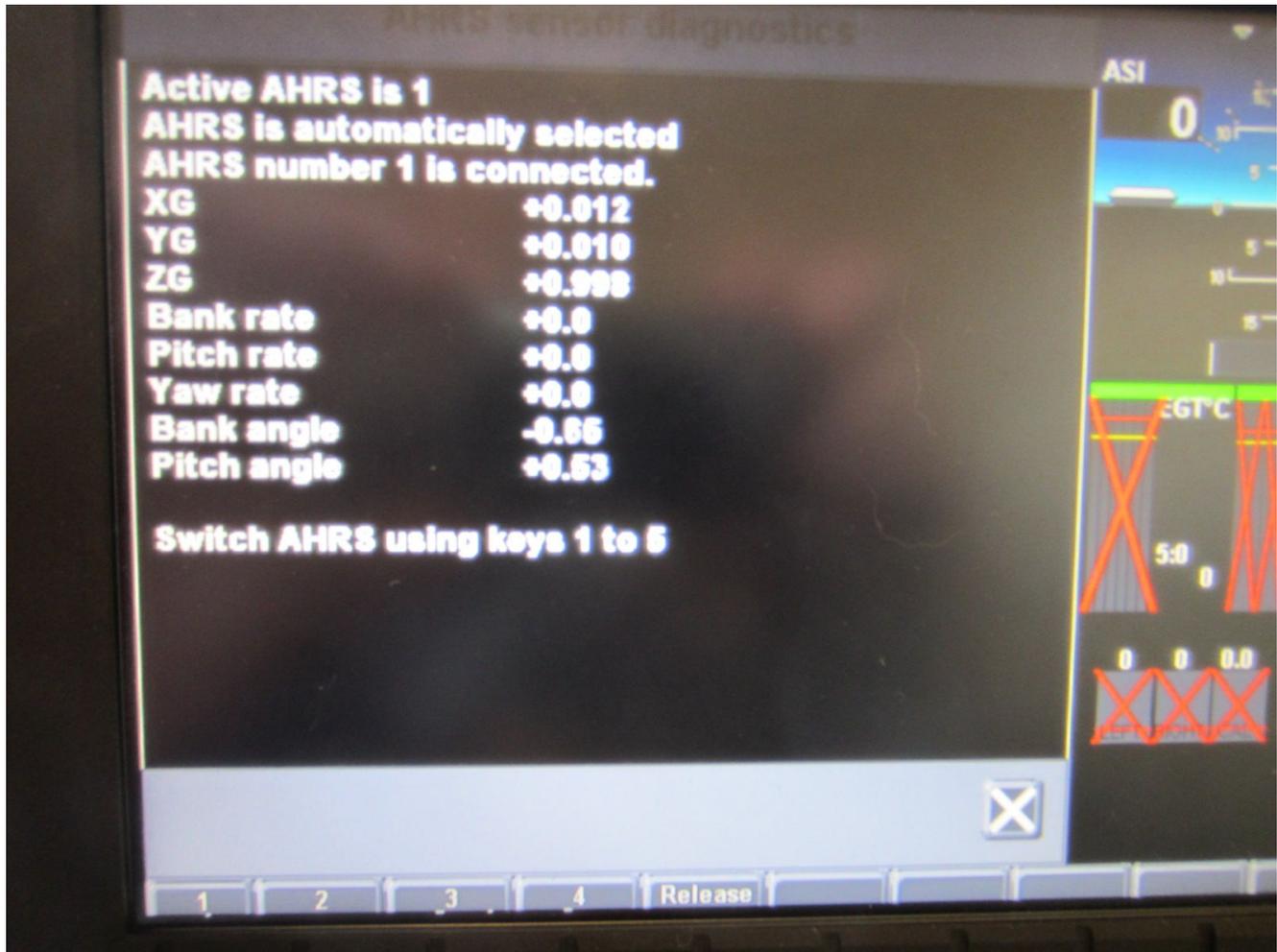
Picture showing AHRS diagnostics (Diagnostics menu, iEFIS).

This allows a basic check of the vital hardware parts of the attached AHRS. Accelerometer axis are shown as G-forces. Gyro rates are shown in degrees/second. Bank and Pitch angle are shown in degrees.

If multiple AHRS devices are connected you can switch between them. The selection is lost after a power cycle or if "Release" is selected (in which case automatic selection takes over).

Electrical connections for SP-7

Pin Number Pin Description

1,2   Ground (GND) / Battery minus
3   RS-232 Receive (RX)
4   RS-232 Transmit (TX)
5   Airtalk
6,7   Vin / Battery positive / +12V
8   CAN Low
9   CAN High

The SP-7 is intended to be supplied by a 12V DC power source. Voltage range from 8V to 16V is normally used.
Please consider a pre-regulator or an MGL Avioguard if you would like to operate the SP-7 from a 24V DC power source.

Newer MGL Avionics devices use the CAN bus for data transmission. This is a dual wire, twisted pair communications bus that can be shared with many devices on the same bus.
In order for the bus to operate, it needs to be terminated with two 60 ohm resistors (68 ohms is often used as it is an easy to obtain standard value) Relatively short CAN buses (6 feet or less can use a single 120 ohm resistor placed anywhere between the two CAN wires) . One resistor is fitted to each end of the CAN bus and any device not at the end points of the CAN bus connects to the CAN bus using a **SHORT** wire stub.

Older devices use the airtalk bus. This is a single wire connection that can support a few devices on the same link (typically SP-7 plus a compass). Normally a single core shielded wire is used with the shield connected to ground. This bus does not require termination resistors.

The RS-232 link is not used with MGL devices. It is intended mainly for third party applications but is also used to load the firmware.