

VintageTx GTS V1.5 Encoder with “F3A” Firmware for Retro Transmitter Conversions – Draft 1G

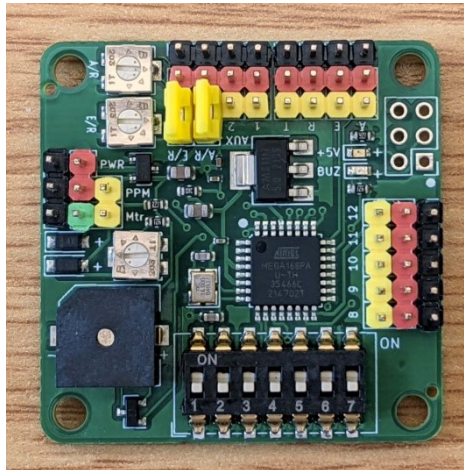


Figure 1. VintageTx GTS V1.5

The GTS boards are Arduino based R/C transmitter encoders with integrated features for converting retro R/C transmitters to 2.4GHz (using a separate 2.4GHz module). It runs the “F3A” firmware which is a modified version of Phil Greens popular encoder modified by Mike Kitchen to give features more suitable for aerobatic models.

Features of the GTS board with F3A firmware include:

- Pre-assembled, programmed and tested – it’s ready to install.
- ATmega168P processor, 5V @ 16MHz.
- Input voltage 6V - 12V, typically a 2S Lipo, 2S Li-Ion, 2S LiFe or 7-8S NiMH battery.
- 40mm x 40mm dimensions (same as the Arduino Pro Mini Strong).
- Pre-programmed with the “F3A” encoder firmware. It can alternatively be loaded with the Phil_G firmware.
- LED power indication (green) and red “sounder/alarm” LED.
- 7-way surface-mounted DIP switch for option selection.
- On-board sounder/buzzer and driver transistor.
- 6.2V and 6.8V zener diode and potentiometer so that the transmitter meter can display battery level. A 5.0V zener can also be fitted in the place of the 6.8V zener for certain Pro Line and Kraft sets that have a higher impedance meter.
- The connectors for the joysticks and potentiometers are split into 2x 4 headers (most servo connectors typically used for wiring are fractionally wider than 0.1” and 8x servo plugs don’t fit properly together in a single block of eight connectors).
- MOSFET reverse voltage protection
- CPPM output compatible with most popular 2.4GHz DIY modules such as the LemonRx DIY, FrSky XHT and DHT, OrangerX and Generic 4-in-1 multi-protocol modules such as Jumper and iRanger (that offer CPPM input compatibility). It can also be used with Futaba modules, such as the TM-7 and TM-8 with an external schottky diode fitted.
- Eight output channels
 - 6+1 proportional channels, Aileron (R), Elevator, Rudder, Throttle Aileron (L) and two auxiliary channels
 - One switched channel (Gear).
- Aileron differential with the Aileron (Right Hand) on the normal channel and Aileron (Left Hand) on channel five. The value is set via DIP-switches to give 0%, 20%, 30% or 40% differential.

- 'Rates/Expo' on aileron and elevator, with one pot setting rates/expo on aileron and the other elevator rates/expo. The rate switches (if fitted) switch between rates and expo.
- Servo reversing by holding the stick over on power up for aileron/elevator/rudder.
- Independent servo reverse for the two aileron channels, holding the aileron joystick to the right reverses the RH aileron servo, holding to the left, the LH servo.
- Throttle reverse by DIP switch.
- Elevon mixing with either 75:25 or 50:50 ratio via DIP switches.
- V-tail mixing with 50:50 ratio via DIP switches.
- Hardware throttle lock switch with alarm sounder.
- Software throttle lock – throttle must be fully closed before it can be opened with alarm sounder.
- Count-down timer (Minute-minder) for timing flights. The number of minutes can be extended or cancelled at any time via the count-down timer push-switch.
- Inactivity alarm to remind you that you've forgotten to switch off.
- Single-handed "range check mode", flick the gear switch three times to start the ailerons moving automatically +75% to -75% and inhibits the throttle. If the aileron joystick is moved it cancels the "range check mode".
- Three-point joystick calibration, saved to EEPROM.
- User selectable primary channel order via DIP switch:
 - A(RH).E.T.R.A(LH) with Futaba "polarity" and 300uS pulse separator.
 - T.A(RH).E.R.A(LH) with JR/Spektrum "polarity" and 400uS pulse separator.
- User selectable secondary channel order via DIP switch:
 - aux1, aux2, Gear
 - Gear, aux1, aux2

Installing the GTS V1.5 Encoder Board

Mounting the GTS Board in a Transmitter

The GTS encoders are relatively compact, 40mm x 40mm ($1\frac{37}{64}$ " x $1\frac{37}{64}$ "), so room should easily be found in the majority of retro transmitters for the GTS encoder, 2.4GHz module and battery

The GTS encoder can be mounted in three main ways, double sided foam tape, self-adhesive stand-off mounts or small headed M3 nylon screws. Note that you should never use metal screws for mounting the GTS encoder or nylon screws with a head with a head diameter larger than 5.5mm.

If mounting with double-sided sticky tape, ensure the GTS and 2.4GHz module are stuck to a non-conducting surface and not directly to an alloy case or metal brackets as the back of the GTS circuit board (and many modules) is not insulated and could easily short out on a metal case, destroying the GTS and also being a fire hazard if Lithium type batteries are used. If it's necessary to stick it to an alloy case, first stick a piece of rigid plastic sheet such as "plasticard" to the case, then double-sided tape the circuit board to the plastic sheet. It may be necessary to lightly sand the plastic sheet on both sides to ensure the double-sided tape adheres correctly.

If mounting with M3 nylon screws (or nylon 1/8" screws), the screw head diameter must not exceed 5.5mm ($7/32$ "), otherwise it will foul on the components on the circuit board. Check before use as many M3 screws have a head diameter of 6mm that is too large.



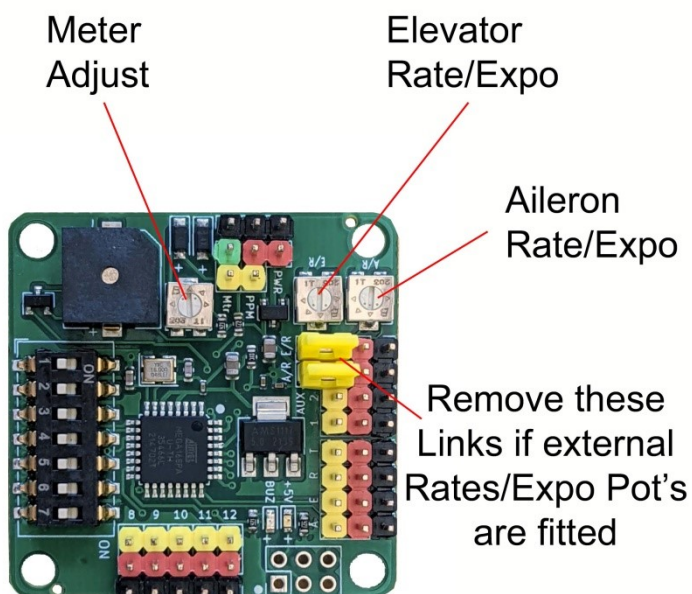
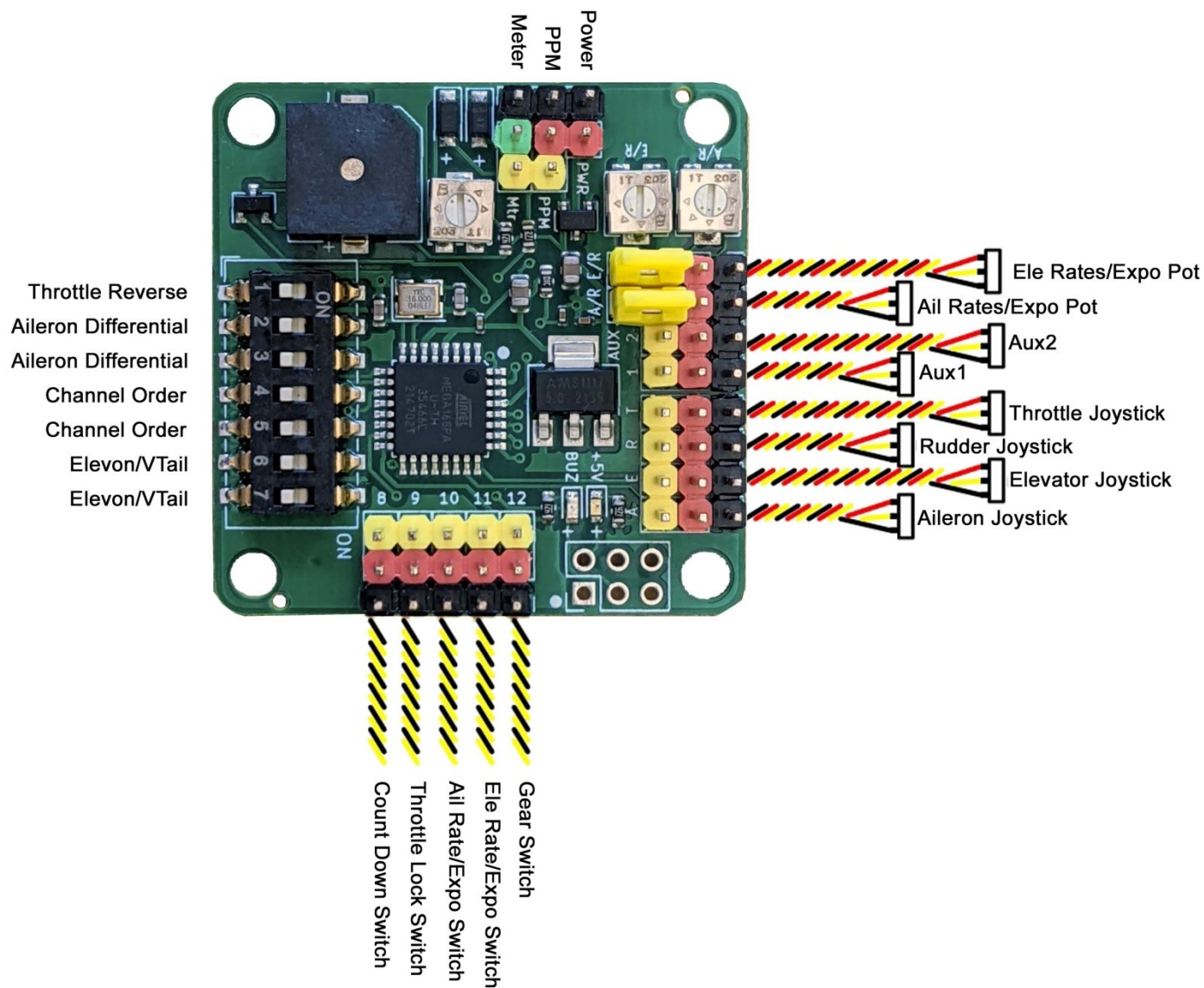
Figure 2 Pad". Typical Self-Adhesive "Stand-Off

If mounting via the M3 holes with nylon M3 or $1/8$ " stand-off mounting pads such as that shown above and is available from various electronic suppliers such as RS, Digi-Key etc. Suitable part numbers are:

RS 220-771

Digi-Key 36-9072-ND

Wiring the GTS V1.5 Encoder with the "F3A" Firmware



What Wiring/Connectors to Use

****picture of servo lead and encoder with servo leads****

The GTS board is designed for servo type connectors and wiring for all connections. Please do not use red JST-style connectors as they do not make reliable connection to the header pins fitted.

Individual Cables to each Potentiometer and Switch or Loop the +5V and 0V (ground)?

To Re-Use the Original Transmitter Wiring or Not?

Using some or all of the existing transmitter wiring depends on a number of factors:

- Personal preference. Some prefer to keep as many original features as possible, others prefer the knowledge that all new wiring should increase reliability.
- The condition of the existing wiring
- Possible damage to delicate pots when unsoldering the existing wiring and re-soldering new wiring

If there is any battery leakage or corrosion, then all the wiring must all be replaced, cables soak up the corrosion by capillary and can cause wires to fail at any point of their length.

The cable insulation may also be getting brittle if low quality cable was used, if there is any cracking of the insulation then the cable will need to be replaced.

But some old joystick potentiometers can very easily get damaged, the Allen Bradley seem particularly easy to damage when replacing the cables and if the existing wiring is intact, it may be better to re-use the wiring.

Power (Battery) Connection

Please use a “servo” type connector, **NOT** a red JST type connector for the Power In/battery connection. They may seem to fit, but are not suitable as they can easily become loose and the encoder and 2.4GHz module will become disconnected (and obviously not work).

Switch Connection

0V/GND straight from battery connector to the GTS Battery connector (black). Take the +Vbatt (battery positive) to the switch, then to the GTS Battery connector (red) *****Add some photo's or a diagram*****

Joystick and Auxiliary Channels Potentiometer connections

Note that you can either wire each pot separately or loop the 5V/GND to each pot' and then wire the individual signals back. *****Add some photo's*****

Throttle Potentiometer connections

It is important to wire the throttle joystick potentiometer the correct polarity, it needs to be wired so that opening the throttle increases the voltage from the joystick. If it's wired in reverse then every time the transmitter is switched on the throttle lock (throttle open when powered on) alarm will sound and you'd have to open the throttle fully to silence it, which is not ideal! Below are photos of the correct wiring:

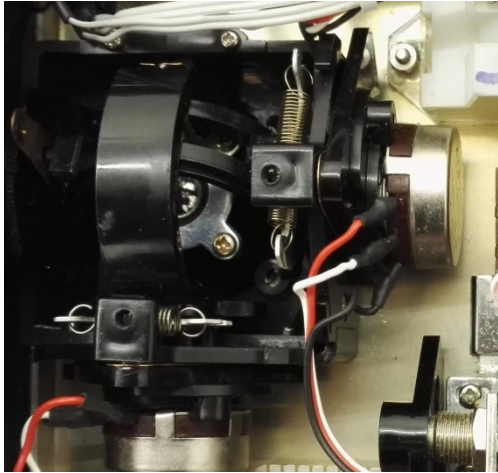


Figure 3. Mode 1 Throttle Wiring

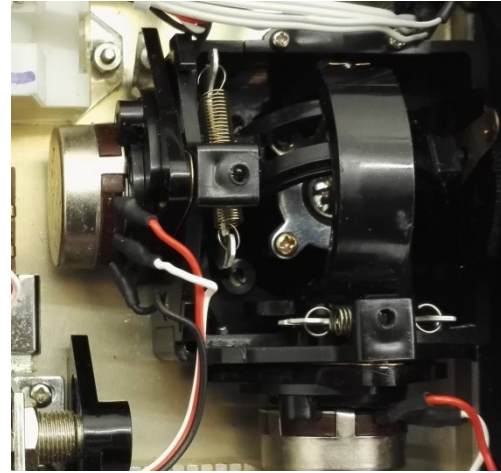


Figure 4. Mode 2 Throttle Wiring

Converting a 2-Channel Set without Throttle

What to do for a 2 channel set with no throttle – fit a temporary pot, set in the middle, then once calibration finished, fit a “Spektrum bind plug” (link 0V to sig)

3-Position Switch as Auxiliary Channel connections

*** 10K resistor from +5V to centre and 10K resistor from 0V/GND to centre ***Add some photo's***

Rates/Expo Pot's

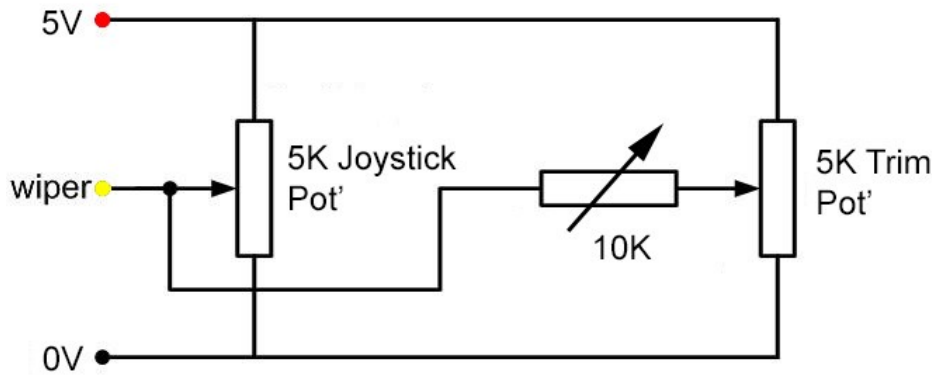
There are on-board potentiometers fitted for adjusting the aileron rates/expo and the elevator rates/expo. Alternatively external pots can be used if preferred, first remove the “jumper” links from the board so the external potentiometer connectors can be fitted (preferably 5K or 10K).

Potentiometer Rotation

All R/C joysticks from retro transmitters use commercial potentiometers that have approximately 300° rotation (depending on the make on model), but most commercial joysticks used in R/C transmitters only moves the potentiometer through approximately 60° rotation, roughly 20%, so even though there is 5 volts across the pot', you only get around 1 volt output swing.

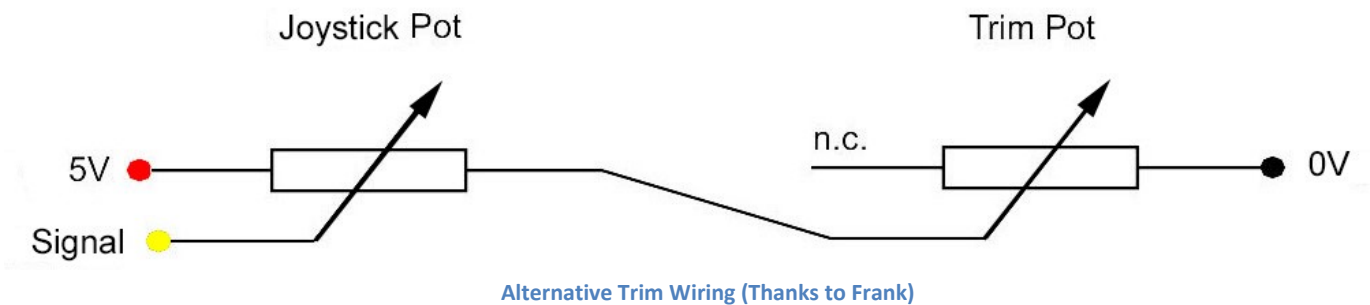
As the microcontroller used in the GTS has an ADC (analogue-to-digital converter) with a resolution of 1024 steps (and there is no op-amp), the resolution measuring the joystick voltage will be 20% of this, probably just over 200. This may sound very low compared to modern transmitters, many with a resolution of 2048 or 4096, but these figures are really driven by marketing, early Futaba and JR PCM sets had a resolution of 256, and won many world championships, so having a high resolution isn't a prerequisite. Most modern servo's have a 90° rotation (+/-45°), so with a resolution of 200, the servo would have around 0.5° rotation resolution, which is better than most analogue servo's dead-band and better than many linkages, so in the real world you lose no resolution or performance. And if expo is used, the rotation resolution around neutral will be better (if the servos and linkages are capable).

Electrical Trims with Separate Potentiometers



The encoder is intended for transmitters with mechanical-trim stick units, there are no separate trim inputs for transmitters with separate trim potentiometers. For joysticks with trims with separate trim potentiometers, you can resistively couple the trim pot's (as some manufacturers did), you can either use a fixed resistor or via a small potentiometer used as a variable resistor, it can then be adjusted to give the required trim authority. With 5K joystick and trim pot's, a "link" resistor with a value of approximately 6K8 will give +/-15% trim authority. The circuit above shows a 10K pot' that can be adjusted to give the trim authority required, then the resistance can be measured and replaced with the nearest fixed value resistor available.

****Pictures of actual pots wired up****



This alternative circuit also works for some sets, if the potentiometers are the same value and they both turn the potentiometers through the same angle.

As a "rule of thumb" for transmitter joysticks with separate electrical trim pots, if the original has two wires on the trim pot, then the alternative Trim Wiring above should work, if the original has three wires connected to the trim pot' then the first scheme needs to be used.

****Pictures of actual pots wired up****

Toggle and Push Switch connections

Only 0V and signal wires need be connected, the “red” middle terminals for the switch connections are not actually connected to 5V

Minimum Conversions without all channels fitted and/or without rates/expo switches or Minute Minder Switches

Unused channels connect to 0V/GND (with a Spektrum bind plug), but otherwise link signal to 5V. Don't leave them floating. Without rate/expo switch fitted it gives 100% movement and expo and if pots fully clockwise will have 0% expo ***picture***

Battery Meter Connection

Picture of the header with 6V2 and 6V8 connections and a meter

Most retro transmitters for conversion have battery or rf meters that have a mA or uA movement (milli-amp or micro-amp) and can't be directly connected to the battery. If the meter is connected to the battery with a series resistor (usually a variable resistor/potentiometer would be used so that it can be adjusted), it can limit the current so the meter can display battery voltage.

Just using a series resistor is not ideal however as with lithium batteries the working range is (for a 2S LiPo) 8.4V fully charged to somewhere between 6.4V and 7.0V minimum useable voltage (e meter drops to 76%, approximately $\frac{3}{4}$ of meter movement, the battery is at minimum, which most people find non-intuitive (most people expect the meter to be down to . To overcome this problem a zener diode can be fitted in series, if say a 6.2V zener is fitted, the meter will be down to 10% at its minimum. The GTS boards all have circuitry so that the meter can be used as a battery indication meter on the majority of transmitters (some Pro Line and later Kraft are not suitable however).

There are two options to connect the meter, a 6V2 (6.2V zener) and a 6V8 (6.8V zener).

The potentiometer is provided to limit the current to the meter. Without a zener diode the meter would be scaled from 0V to the maximum battery voltage, but this is not ideal for lithium type batteries such as 2S Li-Ion or Lipo as their minimum voltage is 3.0V per cell and their minimum safe voltage would still be 71% of the meter movement ($3.0V/8.4V \times 100\%$). The zener diodes drop the battery voltage by either 6.2V or 6.8V, so the meter is now scaled between 6.2V / 6.8V and maximum voltage (8.4V for a 2S Lilon/LiPo), so when the meter gets near the bottom of its movement, its near its absolute minimum working voltage. The choice of two outputs is provided to suit personal preference, some prefer to use 6.2V zener, so minimum meter movement is the lowest battery voltage before the Lilon/LiPo would be damaged, others prefer to use 6.8V zener, so the minimum meter movement is 0.8V above the minimum, which is the level that is advisable to stop flying and re-charge as the battery voltage drops rapidly from this level.

Connect the meter ground to the black (or blue on some boards) bottom pin and the meter positive to either the 6.8V pin (centre pin, red) or the 6.2V pin (yellow or green pin, depending on the batch, the other end to the black pin) ***photo or diagram***

NOTE. On V1.5 boards the adjustment potentiometer works in reverse to what is intuitive and to increase meter movement the pot' needs to be turned anti-clockwise (counter-clockwise) and clockwise to reduce meter movement. This has been rectified on V1.5A release boards to work intuitively.

If the meter still exceeds the full-scale with the pot' at 100% then fit a 10K resistor across the meter and re-adjust.

Picture

F3A Firmware

Background to the F3A Firmware

Phil Green (Phil_G on many forums) programmed the popular 7 channel encoder, designed specifically for an Arduino Pro Mini Strong (an Arduino compatible board made by DM Moore) that with a small ingenious modification to the circuit board provides a convenient 3-pin connector for the ppm output signal and battery power for a 2.4GHz module. This modification does result in losing the reverse polarity protection, but this is included on the GTS.

It has some modern features such as servo reverse, elevon/v-tail mixing, count down-timer and rates/expo (the aileron and elevator have to share the same level of rates adjusted by the rate pot' and expo adjusted by the expo pot') as well as single channel emulation (so you can practice flying rudder only models on a push-switch).

Mike Kitchen (Mike_K) then modified Phil's original firmware to add some different features that were aimed at making the encoder more suitable for transmitter conversions that will be used for flying aerobatic models such as retro aerobatic "F3A" type model that is becoming very popular again (such as Curare, Atlas, Dirty Birdy, Chaos etc) and hence the "F3A" name, but is also just as suitable for any aerobatic, sports or vintage model including gliders.

The rates/expo function has been modified so that you can set the rates/expo independently for ailerons and elevator – it is quite common to want say 30% expo on ailerons, but maybe only 15% on the elevators. Most retro aerobatic type models were originally designed for a single aileron servo with torque rods, but most are now built with two aileron servo's and the program has been modified to provide a second aileron channel (on CH5), independent servo reverse for both aileron channels and aileron differential. The second aileron channel now makes it an eight channel encoder. The elevon mixing has been retained, but proper v-tail mixing between the rudder and elevator channel is added. Finally, throttle reverse has been added by DIP-switch. Obviously there is a cost for these extra features and that is that the single channel features have been removed, sorry Phil!!

The wiring for the two encoder firmware's differ, in Phil_G original two push-switch are used for compound and sequential single channel emulation, on the "F3A" encoder the two inputs are used for the aileron rates/expo and elevator rates/expo switches.

Both the "F3A" and Phil_G original firmware when run on an Pro Mini Strong needed extra components to complete the encoder, an 8-way DIP switch, that had to have its legs bent inwards to fit (and only 7 of the 8 ways are used), a transistor and sounder, a zener diode and a trim pot' if the original meter was to be used as a battery level meter and two potentiometers, one to adjust rates, the other expo. These additional components have all been integrated onto the GTS V1.5 encoder board together with reverse polarity protection.

Commissioning and Testing the GTS V1.5 Conversion

Before Powering Up

Check with a multi- meter set to ohms to check there is not a dead short between the power in 5V and 0V/GND pins. First power up with a power supply set 8V if available in case there is a short (not ideal if a LiPo battery used)

Check the resistance across the 5V/GND (if there is a spare pin – use rates/expo pot's should be spare if the on-board pot's are being used), it should be greater than 100ohm.

Power up and should get the small bleep from the sounder and the green 5V LED should be illuminated

Joystick Calibration

The "F3A" joystick calibration uses the "minute-minder" (count down timer) push-switch, if it's not planned to fit a minute minder (count down timer), then one will have to be temporarily fitted for joystick calibration and then removed afterwards.

- Centre all joysticks trims and auxiliary channels, hold the minute-minder button down and power on. **Do not release** the minute-minder button **until the calibration is complete**.
- Holding the **minute-minder button**, move each of the sticks into all four corners a few times and return to center.
- Move the auxiliary channel levers/knobs fully end to end and leave in the centre.
- Centre all the joysticks including the throttle and the auxiliary channels.
- When done, release the minute-minder button. All calibration values (maximum, minimum and neutral) from each joystick potentiometer are saved to EEPROM (which is memory retentive with the power off).
- Every time you power-up it reads the calibrated values from EEPROM and uses these to give +/-100% movement.
- You can repeat the calibration as often as you like but it only needs to be done once unless you change the stick configurations.
- The 'calibrate' push-button is the minute-minder push button once powered up, it isn't dedicated for joystick calibration.
- The 'three point' calibration automatically corrects for joysticks which don't quite centre accurately, making the encoder far more tolerant of old stick units with their original pots.

If a minute-minder switch isn't fitted or you struggle to move all the joysticks and auxiliary channels while simultaneously holding down the minute minder switch (for joystick calibration), you can temporarily fit a Spektrum bind plug (link signal to 0V/GND) before powering up, calibrate as above then remove the link.

****picture****

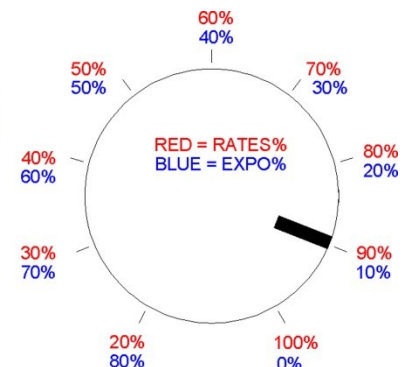
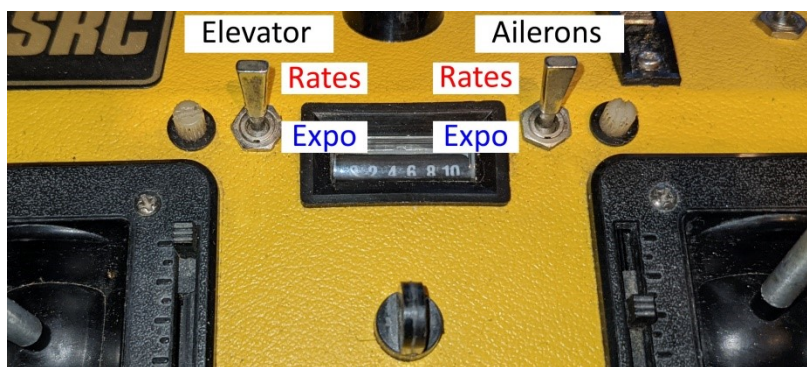
Rates/Expo Potentiometers

The Rates/Expo feature has been fundamentally modified with the F3A encoder from the Phil_G original firmware. The rate/expo switches (and rate/expo potentiometers if external ones are fitted) are now wired directly to the Arduino.

The aileron rates/expo is independent from the elevator rates/expo, with one potentiometer/switch selecting the rates/expo for the ailerons and the other potentiometer/switch selecting the rates/expo for the elevator.

With the Rates/Expo Switch now switches between Rates and Expo. With the Rates/Expo switch OFF you get rates set by the potentiometer "red text", so fully clockwise you get 100% rates, fully anti-clockwise you get 20% rates and the expo is off (0%).

With the Rates/Expo Switch ON you get the expo set by the potentiometer "blue text", so fully clockwise you get 0% expo and fully anti-clockwise 80% expo.



Rates/Expo Potentiometer Settings

So $\text{expo\%} = 100\% - \text{rates\%}$. Expo has a fairly linear response for roughly the first third of the joystick movement proportional to $(100\% - \text{expo\%})$, so with the rates/expo switch either on or off you will have the same servo movement for the first third stick movement, but with expo selected, it will continue to 100% movement, whereas the rates will be limit (to the rates%).

So for example (as in the diagram above), if you set the pot to 90% rates it will be 10% expo and the switch selects either 90% rates (and 0% expo) or 10% expo (and 100% movement). But 10% expo has the same effect as 90% rates for the first third of the joystick movement, so both will give the same feel around neutral (but with expo selected you have 100% movement).

This setup may not seem intuitive at first, but once tried, most will find it preferable to the original method where both ailerons and elevator had to have the same rates and expo set.

Note how you can check you have the rates/expo pot' wired the correct way around. Put it fully anti-clockwise (counter-clockwise) and switch the rates/expo switch on/off, you should go from 100% movement to 20% movement. If you get 100% movement, then the rates/expo pot is connected in reverse. There is no need to reverse it, the rates/expo pot is just working the opposite way around to the above diagram. ***Check which way around the on-board pots work, if they work the "other way around" then update the above picture to suit the V1.5***

Also add close-up picture of the GTS V1.5 rates/expo pots

Servo Reversing

The elevator and rudder channels are reversed by holding the joystick fully over when powering up, once powered up the stick can be released and the movement will be reversed and saved to EEPROM. As there are now two ailerons channels, right and left, to reverse the right hand aileron servo, hold the aileron joystick to the right when powering on and similarly to reverse the left hand aileron servo, hold the aileron joystick to the left at power up.

The throttle servo is reversed by the DIP switch 1 (SW 1), see table below.

DIP switches

The DIP switches descriptions below are for the “F3A” version of firmware running on GTS V1.5 encoder boards. They are only read at power up, so moving them when already powered up will have no effect until the power is cycled off and then back on. The DIP switch on = up and off = down.

SW1. Throttle Reverse

SW1	Throttle Reverse
OFF	Normal
ON	Reversed

DIP switch [SW1](#) Off gives “normal” throttle direction (1mS closed and 2mS open) and with DIP Switch SW1 On it is reversed. Moving DIP-Switch [SW1](#) when powered up will have no effect until the power is turned off and then back on again – the switch is only read at power on for safety.

Having Throttle Reverse does not really pose any additional risk to electric powered models as all modern ESC will not arm until the throttle is in the nominal closed position (“1mS output”), so even with the throttle channel reversed, an electric motor will not start inadvertently at power up. Offering throttle reverse can be a big advantage with I/C powered models and it’s provided by virtually all manufacturers, so this brings the encoder into line.

SW2 and SW3 Aileron Differential

There are four Aileron Differential options using the dipo switches on [SW2](#) and [SW3](#) (D2 & D3):

SW2	SW3	Aileron Differential
OFF	OFF	0%
ON	OFF	20%
OFF	ON	30%
ON	ON	40%

Aileron differential limits the movement of down-going aileron compared to the up-going aileron. The benefit of this is that a down-going aileron creates more drag than the up-going aileron, so by limiting the movement of the down-going aileron, you can get similar levels of drag from both and this creates less adverse yaw and allow more axial rolls. The amount of aileron differential required varies between models, but is typically between 20% and 40% and will have to be determined by trial and error.

If it is found that the aileron differential is negative ie the down-going aileron moves further than the up-going aileron, then swap the right hand and left hand aileron servo’s. You’ll just have to remember they are swapped if you want to reverse the servo direction for one of them.

SW4 and SW5 Channel mapping

DIP Switch **SW4** selects between Futaba and JR/Spektrum and DIP Switch **SW5** selects the order of the auxiliary and gear channels

SW4		Channel Order (Primary) CH1-CH5
OFF		Futaba A(RH).E.R.T.A(LH)
ON		JR/Spektrum T.A(RH).E.R.A(LH)

SW5		Channel Order (Auxiliary) CH6/7/8
OFF		Aux1.Aux2.Gear
ON		Gear.Aux1.Aux2

Where A(RH) = Aileron Right Hand, E = Elevator, R = Rudder, T = Throttle, A(LH) = Aileron Left Hand.

When Futaba channel order is selected, it sets the polarity to match the normal Futaba polarity to and set the “separator” pulse to 300uS. When JR/Spektrum channel order is selected, it sets the polarity to match the normal JR polarity to a module and sets the “separator” pulse to 400uS. These settings have been tested OK with OrangeRx DIY hack modules, FrSky DHT and XHT modules and the Jumper 4-in-1 multi-protocol modules. It can be assumed that other modules should work OK, but no other modules have been tested.

SW6and SW7 Elevon and V-Tail Mixing

SW6	SW7	Elevon and V-Tail
OFF	OFF	Normal
ON	OFF	Elevon (75:25)
OFF	ON	Elevon (50:50)
ON	ON	V-Tail (50:50)

When Elevon mix is selected, it is output on Aileron (RH) and Elevator and is applied after the aileron differential, so ensure differential is set OFF. There are two options, 75% Aileron and 25% elevator for flying wings with a sensitive elevator response (**SW6** ON and **SW7** OFF) and normal 50%:50% Aileron and Elevator (**SW6** OFF and **SW7** ON).

Minute-Minder Switch (count-down timer)

The timer is set by holding the push-switch down and counting pips, each pip representing one minute of flying. For a four-minute flight you would hold the button, count four “pips”, then release it. When the four minutes have elapsed, an alarm sounds. The timer can be extended by holding the switch down again until a “pip”, or cancelled by briefly tapping the switch. The timer starts from the second it’s set, not when the throttle is opened as on many transmitters. This switch is optional and does not need to be fitted if it’s a minimalist conversion.

Using fewer channels, or fewer facilities – say a trad 4-channel set without Rates/Expo Switches:

Any unwanted analogue inputs (say for a 4-channel set) should preferably be connected to 0V/GND but can be alternatively connected +5V or be tied to another analogue input that is used. It’s important that none of the analogue (proportional) channels are left floating. However, any unused switch inputs can be left unconnected as they all have internal 100K pull-up resistors on the ATmega168P microcontroller inputs.

2.4GHz Modules

The operation of the 2,4GHz modules is beyond the scope of this manual, but has been successfully tested with LemonRx DIY, FrSky XHT and DHT, OrangeRx and Generic 4-in-1 multi-protocol modules with no modification and Futaba TM-7 and TM-8 with the insertion of a schottky diode.

If using a second hand module, such as a Futaba TM-7 or Spektrum DM8, test it in a known working transmitter to ensure the module is not faulty, many hours have been wasted trying to get a module working with an encoder, only to eventually find the problem was a faulty module, not a problem with the encoder.

Spektrum DSMX and DSM2

LemonRx DIY Module

Picture of the LemonRx Module

It is recommended that if you want to use Spektrum DSMX™ protocol/receivers then use a LemonRx DIY module, they have proven to be 100% compatible with LemonRx, Spektrum and most other generic compatible receivers and they are also UL approved, so are legal to use in the USA. DO NOT use OrangeRx modules if you are in the USA, they are not UL listed and you will be breaking the law. It is questionable if either LemonRx or OrangeRx are legal in the UK or Europe as both are DSM2 capable, but after extensive testing, neither will adversely affect any other pilot flying on 2.4GHz gear at the flying site.

Plus Points

- Inexpensive and easily available
- Reliable operation
- Small physical size, so usually easy to find room to install
- UL approved so legal for use in the US
- Good manufacturer and community support

Disadvantages

- The 2.4GHz antenna coax is so short it is often not long enough. A longer aftermarket SMA to IPEX lead can be substituted, but keep it as short as possible, as leads of around 10cm (4") can reduce the output by 2dB.
- You cannot change protocols without re-binding, so not practical to use with a multi model memory transmitter with a mixture of DSMX and DSM2 (or 11mS and 22mS) Rx. This is easily overcome by just using modern receivers like LemonRx or Spektrum Rx that are all DSMX 11mS.
- Not CE approved, so questionable if legal to operate in the UK or Europe
- If the modules didn't support DSM2, their output would meet all CE requirements. So if operated with DSMX protocol Rx they meet all CE requirements, but aren't CE approved
- Futaba transmitters re-using their original encoder need a pull-up resistor on the ppm output to work (such as a 10K pull up to +5V) though this obviously doesn't apply to the GTS encoder. It's really surprising that LemonRx didn't modify the module to work with Futaba transmitters.

FrSky

Picture of the FrSky

FrSky XHT and the older DHT modules can both be recommended for use with FrSky receivers, they are both UL approved and CE marked/Tested, so are legal for use in the USA, UK and EU countries (plus many others)

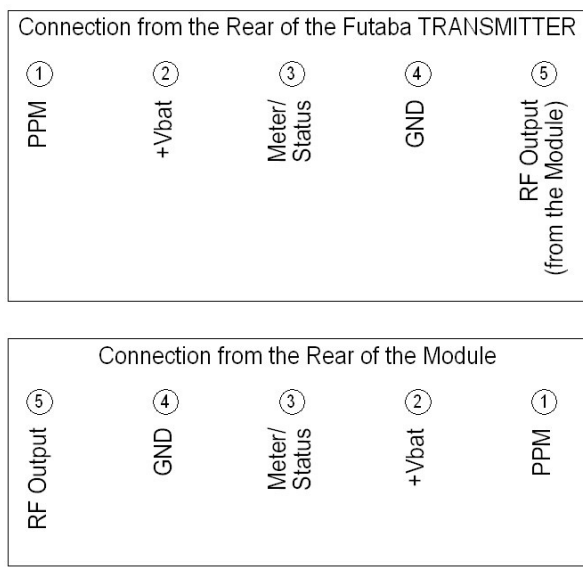
4-in1 Multiprotocol Modules

These modules do most major protocols including DSMX/DSM2, FrSky V8, D8, D16, Futaba FHSS, Hitec AFHSS, Graupner HOTT. The only major protocols missing are Jeti, JR DMSS and Futaba FASST. In OpenTx based transmitters, these modules are highly recommended, but for conversions with an encoder using PPM, they come so close to utopia, but fall short on a critical feature and they can't be readily recommended. Why? Well for any protocol that uses the CC2500 chipset (FrSky, Futaba FHSS, Hitec AFHSS, Graupner HOTT), the module has to be finely tuned to a receiver. Yes, you read that correctly, they have to be individually tuned. In an OpenTx transmitter, this tuning is trivially easy, but in a conversion, special firmware has to be loaded so they can be tuned, which is a laborious task. Once done though, you finish with a very versatile module.

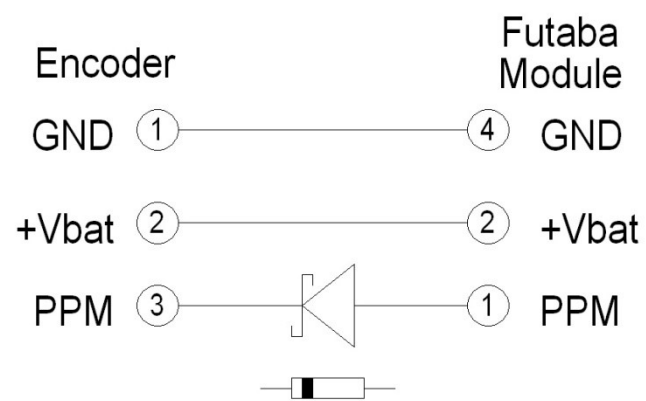
details of how to tune and operate

Futaba FASST

Picture of the DM-7 module



Spektrum DM8 and DM9



Fault Finding

Tools needed:

Multimeter and the ability to know how to use it

PPM meter

GTS Tester

Too many possibilities to cover all – List only the common ones

Faulty Pot

Pot plug connected in reverse with the black (GND) to yellow (signal) and yellow to black

Pot wiper wiring swapped on the pot (same as above)

Battery flat (too low a voltage)

Channel order not set correctly for the module

Use mode-zero.uk forum in the proportional section to ask questions (or the rcgroups.com Vintage & Old Timer Radio Control Systems forum??)

Other VintageTx Encoders and Products

The GTS V1.5 encoder board is the “baby” of the VintageTx encoders, the other models have full computer transmitter functionality and have 10 model memories, with LCD displays/programming switches etc etc with the LCD and programming switches hidden behind the manufacturers label.

pictures of GTA, GTB, GTB-R, GTF + pictures of a converted transmitter + specification