# Using the *How High RT* Digital Output Modes

The *How High RT* can act as a real-time altitude sensor. Currently four output formats support the **Spektrum DX8***, the **Hitec Aurora 9***, and two serial formats for do-it-yourself (and **FrSky***) systems. These instructions explain how to configure the output mode and how to make connections. Before proceeding, familiarize yourself with the basic operation of the *How High RT* as described in the main instructions. Normal stand-alone features including peak altitude capture, flashing display, and *See How* compatibility are still available even when an output mode is active.

Mode Display

Yellow LED

Each time you turn on the *How High RT* the operating mode is displayed for **2 seconds**. The main Red LED and a Yellow LED (on the circuit board) indicate modes as shown in the table:
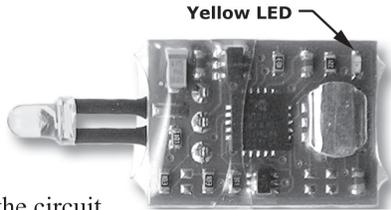
Red LED (2 sec.)	Units
On Steady	Feet
Flickering	Meters

Yellow LED (2 sec.)	Output Mode
OFF	No output (R/C Input Mode)
One Flash	**Spektrum** Output Mode (DX8)
Two Flashes	**Hitec** Output Mode (Aurora 9)
Three Flashes	Serial Output Mode (DIY)
Four Flashes	Inverted Serial Output (FrSky)

Changing Modes

Each output mode has a unique data format. The *How High RT* must be set to your desired output mode. This is done using a series of On/Off power cycles (turning off the power at a specific time). This is the same method described in the main instructions to select feet or meters units.

1. Turn the power on (the Red LED will come on steady or flicker).
2. **As soon as the Red LED turns off, switch the power off** (within ½ second).
3. Repeat the process the number of times listed in the table below to select your desired mode:

On/Off Cycles	Mode
3-cycles	Clear Output Modes (R/C Input Mode)
4-cycles	Toggle Between Feet and Meters
6-cycles	**Spektrum** Output (Feet/Meters returns to previous state)
7-cycles	**Hitec** Output
8-cycles	Serial Output Mode
9-cycles	Inverted Serial Output Mode (FrSky)

Mode Change Notes (read before changing modes)

- It is best to connect the *How High RT* directly to a battery and switch when changing modes. You can plug it into your receiver or telemetry system, but capacitors in the system may delay power down and make timing difficult.
- Change the Meters/Feet units (if needed) **before** changing the output mode. Don't be alarmed when the Red LED indicates a change to Meters or Feet when setting the output mode, it will return to your previous setting.
- If you do not turn off the power within ½ second of the Red LED turning off, the cycle counter will reset to zero and the whole process must be repeated. (This prevents accidental mode changes.)
- If you turn off the power too early, the cycle counter will not advance – not a problem, but it may confuse your count.
- Although you must turn off the power within ½ second of the LED turning off, it does not matter how long the power is off before the next cycle – relax and take your time.
- Instead of counting cycles, it is easier to watch the Red and Yellow LEDs for the desired indication.
- When the desired mode is reached, leave the power on (beyond the ½ second period) to save the setting.
- Once the mode setting is saved it will not change unless this procedure is repeated. You never need to repeat this setup unless you want to change output modes.

Using the *How High RT* with a Spektrum DX8

The *How High RT* mimics the operation of an RPM (rotation) sensor. This allows easy plug-in compatibility without modifying your **Spektrum** system.

Connections

The required cable has a black servo-style connector at one end and a small white JST ZH connector at the other end (see photo on back). Plug the black connector into the *How High RT* (be sure to observe the polarity marked on the circuit board). Plug the white connector into the RPM port on the **Spektrum** telemetry unit.

DX8 Settings

Setting the RPM ratio and poles values will allow the altitude to display in feet (or meters) in the RPM field of the telemetry screens.

- Press and hold the DX8 roller while turning on the transmitter to enter System Setup.
- Scroll down to **Telemetry**, press the roller
- Scroll to **RPM** and press
- Make sure the **Display** field is set to **Act**
- Scroll to **Ratio** and press – Adjust the ratio value to **20.00 : 1**
- Scroll to **Poles** and press – Adjust the poles value to **10**
- On this screen you can set a **Max** altitude alarm (and choose Tone or Vibrate) if you wish
- Press the **Back** button to exit setup.

If you haven't done so already, connect the TM1000 or TM1100 to your receiver and bind the system to the transmitter as described in the DX8 instruction manual.

Displaying Altitude

The *How High RT* must be in "**Spektrum** Output Mode" to send compatible data to the telemetry unit. When you apply power the Yellow LED on the circuit board should give a single one-second long flash. The Red LED will blink to indicate the max altitude of the last flight (this can take several seconds). The unit will then begin normal altitude sampling and briefly flash the Red LED every two seconds. The Yellow LED will briefly flash every half second – indicating that it is sending data to the telemetry unit.

When the transmitter is on and linked with the telemetry unit,

scrolling the roller will display several telemetry related screens. The RPM data on these screens is actually altitude. The Min/Max screen will display the maximum altitude for your flight. The DX8 will display altitudes from 11 to 9999 feet (11 to 3050 meters) above ground level. When the reading is below 11, the DX8 will display "-----" (five dashes). As you descend below 11 the display will stop updating for 3 to 5 seconds then display the five dashes.

Using the *How High RT* with the Hitec Aurora 9

The *How High RT* mimics the operation of an RPM (rotation) sensor. This allows easy plug-in compatibility without modifying your Aurora system. A **Hitec** Sensor Station (HTS-SS or HTS-SS Blue) is required to connect sensors to the receiver.

Connections

The required cable has a black servo-style connector at one end and a small white JST ZH connector at the other end. Plug the black connector into the *How High RT* (be sure to observe the polarity marked on the circuit board). Plug the white connector into either RPM port (R1 or R2) on the Sensor Station.

Aurora 9 Settings

To set the sensor parameters on the Aurora 9 transmitter you must power up both the transmitter and the receiver with the Sensor Station connected. Refer to the instructions from **Hitec** (note that there are two cables (data and power) between the receiver and the Sensor Station). Power up your transmitter and receiver and establish communication.

- Enter the **System** menu and select **Sensor**
- Choose **RPM**
- There are two RPM channels (1 or 2). Highlight the channel you are using with the *How High RT*.
- Choose **Rename** at the lower right.
- We recommend that you change the name to **ALTx10** (Altitude x 10)
- Use the arrow to the right to select **Prop-2**

Note: Currently the Aurora 9 always displays a zero as the last digit of the RPM value. To avoid any loss of resolution, the *How High RT* multiplies the altitude by a factor of 10. So an altitude of 125 feet (or meters) will display as 1250. **Hitec** has indicated that their system will allow custom RPM ratios in the future. When available, you should be able to define a **Prop-M** ratio to provide a 1:1 readout. Additional features such as alarm thresholds and max/min display may also become available with future Aurora updates from **Hitec**.

Displaying Altitude

The *How High RT* must be in "**Hitec** Output Mode" to send compatible data to the Aurora. When you apply power the Yellow LED on the circuit board should give two flashes. The Red LED will blink to indicate the max altitude of the last flight (this can take several seconds). The unit will then begin normal altitude sampling and briefly flash the Red LED every two seconds. The Yellow LED will briefly flash every half second – indicating that it is sending data to the Sensor Station.

With the transmitter and receiver on and linked, select **Sensor** from the **System** menu. Live altitude data will appear in the
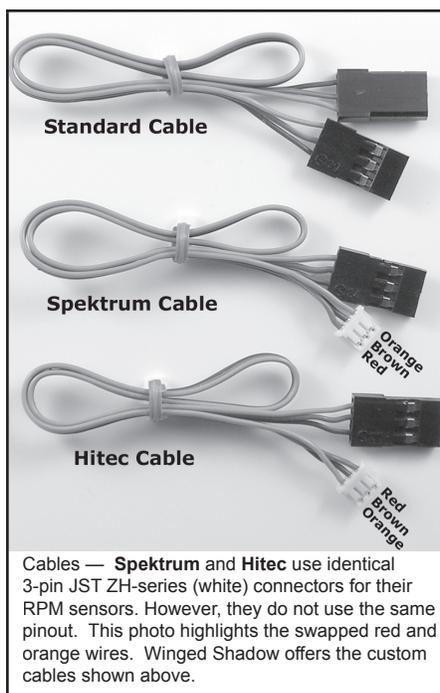
ALTx10 field on the **RPM**, **Cockpit**, or **EZ View** screen. Data can also be output to a computer or voice module via the transmitter's data port. The altitude range is 11 to 5000 feet (11 to 3050 meters) above ground level. These will display times ten as 110 to 50000 (110 to 30500). When your altitude is below 11, zero will be displayed.

Using the *How High RT* Serial Data Output

The *How High RT* can be used as an altitude sensor in do-it-yourself and experimental telemetry, data loggers, or other electronic systems that can accept serial data. The document "Using the *How High RT* with **FrSky**" is available on the 'downloads' page of our website. It contains tips for this special use of the serial output.

Connections

The standard *How High RT* cable can be used to connect to standard 3-pin headers. Your system must provide a supply voltage between 3.0V and 7.0V. Note that the maximum voltage is 7.0V when using the serial output mode (not 12.0V). Current requirements are modest at less than 2.0mA average, with 6.5mA peaks when the LEDs flash.
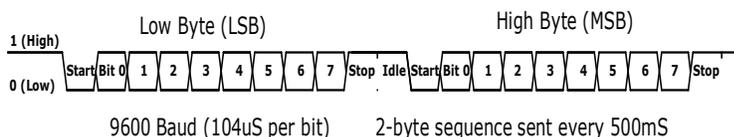
The signal (ORANGE) line has an open-drain driver with an on-board 10K pull-up to the supply voltage. This provides output signal voltages that match your system. So the *How High RT* works with 3.0, 3.3, 5.0, and 6.5-volt systems and requires no level-shifting interface circuits.

Reading Altitude

When the *How High RT* is in "Serial Output Mode" the Yellow LED will give three flashes at power up. There is also an "Inverted Serial Output Mode". It is indicated with four flashes. The Red LED will blink to indicate the max altitude of the last flight (this can take several seconds). The unit will then begin normal altitude sampling and briefly flash the Red LED every two seconds. The Yellow LED will briefly flash every half second – each time it outputs data. The serial data altitude range is 0 to 9999 feet (0 to 3050 meters) above ground level (AGL).

Data Format

A 16-bit altitude value is output as two 8-bit bytes using a simple 9600 baud (8,N,1) serial protocol. The figure illustrates the serial output waveform. For the inverted output mode all levels are inverted. The data can easily be decoded using a microcontroller with a UART or by common software methods. The least-significant (low) byte is sent first followed by the most-significant (high) byte. A new altitude is sent twice per second (every 500mS). The 16-bit altitude value = (256 * high byte) + low byte.

Cables — **Spektrum** and **Hitec** use identical 3-pin JST ZH-series (white) connectors for their RPM sensors. However, they do not use the same pinout. This photo highlights the swapped red and orange wires. Winged Shadow offers the custom cables shown above.

1 (High)
Low Byte (LSB)   High Byte (MSB)
0 (Low)
| Start | Bit 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Stop | Idle | Start | Bit 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Stop |

9600 Baud (104uS per bit)   2-byte sequence sent every 500mS

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