Electronic Throttle-by-Wire

Yamaha’s throttle-by-wire systems, are called Yamaha Chip Controlled Throttle (YCC-T®) on motorcycles and Electronic Control Throttle Valve (ETV) on WaveRunners®. These systems allow the Engine Control Unit (ECU) to actively control engine airflow independently of fuel metering. The ECU can maximize air speed in the intake manifold based on engine operating conditions in a far more effective manner than a cable-operated system. This also allows for other technologies, such as traction control and cruise control to be easily integrated.

Components

Throttle-by-wire (TBW) systems have very few components; a DC servo motor is used to operate the throttle plates and is directly controlled by the ECU. Two potentiometers are used, the Throttle Position Sensor (TPS) monitors the throttle plate angle while the Acceleration Position Sensor (APS) monitors the rider input. Both of these sensors produce two signals that are monitored by the ECU. Many models also use other sensors or switches that are monitored by the ECU to determine how the TBW behaves, such as limited throttle opening during reverse operation on WaveRunners or reduced engine braking during deceleration on sport motorcycles.

Testing

While the TBW systems seem complex, simple systematic testing will quickly isolate a failure.

1. **Duplicate the problem.** Attempting to troubleshoot without duplicating the problem is like playing darts with the parts diagram. Get detailed information from the customer about when and under what exact condition the failure is occurring. If possible, use a diagnostic tool to log data while testing. Having log data of a difficult-to-duplicate failure goes a long way when trying to isolate an intermittent issue.

2. **Battery Voltage.** Always start with a fully charged, good battery. A variety of problems can occur on modern units when they experience low battery voltage. Don’t waste time trying to repair a unit with a low battery, you may just be chasing a ghost. Also, don’t assume that just because the starter motor works that the battery is fully charged.
3. **Work smart, start simple.** Fuses, wires, and connections. Quick simple tests, never make assumptions. If you are testing a circuit, test all of it. Take notes; results from your tests can provide valuable information for review or may serve as reference data for future diagnostic work.

4. **Codes.** Both current and stored codes are gigantic “look at me” indicators. But remember just because a unit has a “TPS code” that it doesn’t mean that the TPS itself has failed. It just means that the ECU is not getting the expected value from that sensor. Test all portions of the sensor’s circuit before replacing the sensor itself.

5. **Check the servo motor.** Throttle bodies are too often needlessly replaced when the throttle plates do not open as the technicians expects. If the system is shut down due to a failure, the ECU will not open the throttle plates. Use two C cell batteries in series (3VDC) to power the servo motor. This will not open the plates fully, but will give an indication if the wiring and motor are complete and operational.

6. **No codes, but it acts weird.** Some TBW complaints can be a high or low idle speed, occasional stalling, or poor performance. Check the basics first. Low compression or high leakdown down will cause any engine to perform poorly, even ones with advanced electronics. Check for aftermarket modifications, fuel controllers often need to be tapped into one of the TPS wires. If done improperly, the installation can damage the wire and cause intermittent failures. Remove the controller, repair the damage and retest. Make sure other circuits that can affect TBW operation are working correctly; the reverse circuit on WaveRunners and the clutch, sidestand, and neutral circuits on motorsports units can all affect TBW operation.

7. **Use diagnostics intelligently.** Using either the built-in diagnostic mode or computer-based Diagnostic Tool, such as YDIS or YDT can help a technician quickly test and eliminate potential sources of failure. Using these tools it is possible to “see” what information the ECU is getting, but a failure may not always be obvious. Some ECU values must be within a defined range; if not, the system will produce a fault code. However, depending on sensor function, the ECU’s defined range for many circuits can be very broad. In cases like this, the ECU may use whatever value it is given, regardless of whether it reflects actual conditions or not.

8. **What does that number mean?** As technicians, we need to have a basic understanding of what is normal and what isn’t. When a value isn’t what it should be, what could be the cause? A bad wire, a corroded connection, or a damaged sensor?

9. **The ECU.** An ECU failure is extremely rare and when it does occur, it is normally caused by another failed component. If you think an ECU is failing, repeat all your tests again. Chances are you missed something.

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There is no good reason to dive this deep. Testing a TBW system is simple when you understand how it operates and properly test its component parts.

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Watch the YCC-T Troubleshooting Video and refer to Tech Bulletin M2013-018 for more testing information.

http://youtu.be/2fial7VpNyA

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What is Pulse Width Modulation? Hint: the ECU uses it to operate the DC servo motor. Look it up!

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