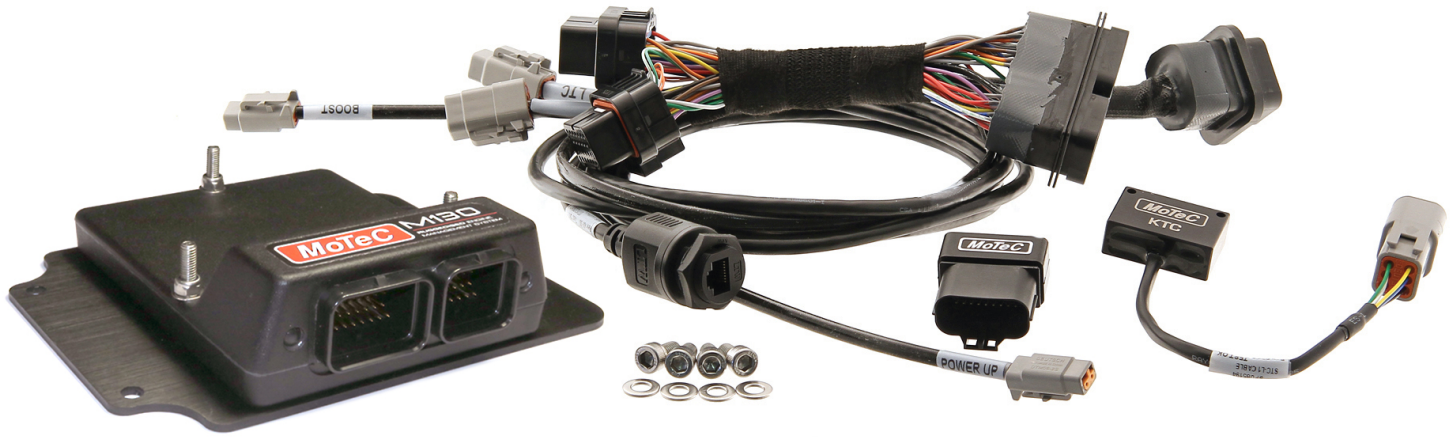


Updates to this document since the previous version have a light yellow background.

MoTeC

M130 YAMAHA FX SHO PWC KIT



MoTeC's Yamaha FX SHO plug-in ECU kit is a fully programmable direct replacement for the factory ECU.

No rewiring is necessary; the kit plugs into the stock wiring harness using the original sensors and fuel system. All essential functions are maintained, including stock dash display.

► 11302 KIT CONTENTS (2008 - 2015 MODELS)

Hardware

13130M – M130 ECU MARINE Preloaded with the Yamaha FX SHO 2008 M1 Package. (A MoTeC M1 Licence is required to run this Package.)

61235 – M130 YAMAHA FX SHO ADAPTOR KIT containing:

- 61401 – M130 YAMAHA FX SHO 2015 ADAPTOR LOOM
- 61140 – KTC - K-LINE TO CAN CONVERTER
- 61138 – YAMAHA IMMOBILISER BYPASS
- 61225 – NETWORK CABLE RJ45 1.5 METRE
- **61244 – M130 YAMAHA FX SHO PWC MOUNTING KIT** containing:
 - Yamaha FX SHO M130 Mounting Plate
 - Nylock Nuts and Stainless Steel Washers
 - Mounting Screws

Licence

- **23001 – M1 LICENCE - PERSONAL WATERCRAFT**

This Licence is required to run the Yamaha FX SHO 2008 M1 Package in the M130 ECU.

► 2016 MODEL UPDATE

- Firmware version 01.01.0017 for M130
- Firmware version 01.00.0011 for M150
- Supports RiDE (Reverse with Intuitive Deceleration Electronics) electric braking as supplied on 2016+ VXR, FX, and GP1800 models
- New 61401 Rev B Adaptor Loom suits early 2008-2015 and late 2016+ models
- 61401 Rev A Adaptor Looms require simple field modification to match Rev B
- Original KTC variant for early 2008 – 2015 models
- New KTC250 variant for late 2016+ models
- Mounting kit modified – no backing pad

► 11307 KIT CONTENTS (2016+ MODELS)

Hardware

13130M – M130 ECU MARINE Preloaded with the Yamaha FX SHO 2008 M1 Package. (A MoTeC M1 Licence is required to run this Package.)

61297 – M130 YAMAHA VXR ADAPTOR KIT containing:

- 61401 – M130 YAMAHA FX SHO 2015 ADAPTOR LOOM
- 61294 – KTC250 - K-LINE TO CAN CONVERTER
- 61138 – YAMAHA IMMOBILISER BYPASS
- 61225 – NETWORK CABLE RJ45 1.5 METRE

- **61244 – M130 YAMAHA FX SHO PWC MOUNTING KIT** containing:
 - Yamaha FX SHO M130 Mounting Plate
 - Nylock Nuts and Stainless Steel Washers
 - Mounting Screws

Licence

- **23001 – M1 LICENCE - PERSONAL WATERCRAFT**

This Licence is required to run the Yamaha FX SHO 2008 M1 Package in the M130 ECU.

► FEATURES

- Improved RPM limiting allows for higher top speed in rough water
- Programmable Launch Control to reduce cavitation
- Tunable fuel and ignition mapping for performance improvements
- Integrated fully tuneable DSP Knock Control on individual cylinders
- Boost Control for Turbo wastegates
- Anti-Lag Control for Turbo systems with Ignition Timing, Fuel Compensation, Engine Speed Limit, and Boost Aim tables
- Anti-Cavitation timer system with Throttle Aim and Ignition Timing Compensation tables
- Race Time system with Compensation tables for Ignition Timing, Fuel Aim, Boost Aim and Throttle Lever
- Auxiliary Timer system with Compensation tables for Ignition Timing, Fuel Volume and Fuel Aim
- Engine Load Average channel with Engine Speed Limit table and Compensation tables for Ignition Timing, Fuel Aim, Boost Aim and Throttle Lever
- Cruise Assist mode allows for speed to be held
- No Wake mode for speed-limited marine zones
- Engine Run Time Total for engine hour logging
- Throttle Dashpot system to prevent engine stalling
- Configurable Security for multiple users with differing access options
- GPS receive configurable via CAN through MoTeC Serial-to-CAN (STC) device for speed and track mapping
- Optional exhaust lambda input via MoTeC Lambda-to-CAN (LTC) or Professional Lambda Meter (PLM) for fuel tuning
- Level 1 logging included in standard Package price (predefined channels at up to 10Hz for diagnostic analysis)

- Level 2 logging available as an upgrade (up to 200 configurable channels at up to 200Hz, 120MB)
- Standard CAN transmit for MoTeC Display Loggers
- Optional inputs for additional sensors, including:
 - Airbox Temperature
 - Ambient Pressure
 - Boost Pressure
 - Engine Oil Temperature
 - Engine Oil Pressure
 - Exhaust Collector Temperature (EGT) via TCA Thermocouple Amplifier
 - Exhaust Temperatures for Cylinders 1, 2, 3 and 4 via TCA Thermocouple Amplifiers
 - Fuel Temperature
 - Jet Nozzle Pressure
 - Jet Nozzle Angle
 - Jet Intake Pressure
 - G-Force (acceleration) - Longitudinal, Lateral, Vertical
- 4 Optional Outputs for PWM Control of added actuators:
 - Duty Cycle tables using Engine Speed and Throttle or Manifold Pressure Axes
 - Activation based on Inlet Manifold Pressure or Throttle Position
 - Aux Output 1 includes Compensation tables for Ignition Timing, Fuel Volume and Fuel Mixture Aim

► COMPATIBILITY

- Yamaha FX SHO, FZS or FZR PWC 2008 - 2015
- Yamaha VXR, FX, GP1800 PWC 2016 +

Yamaha introduced RiDE (Reverse with Intuitive Deceleration Electronics) electric braking in 2016 VXR models. The extra features required an updated Adaptor Loom and a second KTC variant for dash communications.

The new loom is compatible with all model year variants.

2008 - 2015 FX SHO, FZS and FZR models continue to use the existing 61140 KTC device with either the original 61234 loom or the new 61401 Adaptor Loom.

2016+ VXR, FX and GP1800 models use the new 61294 KTC250 device with the new 61401 loom.



Note: 2016+ VXR, FX and GP1800 models are not compatible with the original 61234 Adaptor Loom or 61140 KTC device.

► INSTALLATION

The M130 Marine ECU replaces the factory ECU that is mounted in the electrical box behind the engine.

Step 1:

Assemble the supplied mounting plate - fit the M130 ECU over the three mounting studs and secure with 3 x 5mm stainless washers and 3 x 5mm Nylock Nuts. **Do not over-tighten.**

See following image of assembled ECU and mounting plate.



Step 2:

1. Plug the three stock wiring harness connectors into the Adaptor Loom.
2. Plug the Adaptor Loom into the M130.
3. Ensure all supplied devices are connected, i.e. M130 and KTC or KTC250 (model dependent).

Step 3:

Fit the complete assembly to the Yamaha bulkhead using the supplied M6 x 12 cap screws and M6 x 12 flat washers.

See following image of the kit mounted onto the bulkhead.



The Yamaha Installation Set includes the Immobiliser Bypass, which replaces the original Yamaha Immobiliser and renders the PWC permanently unlocked.

The Immobiliser is located behind the front storage compartment bulkhead, on the right front side of the hull, as shown in the following image.



Step 4:

Install the Immobiliser Bypass:

1. Unplug the Yamaha Immobiliser.
2. Plug the MoTeC Immobiliser Bypass into the Adaptor Loom.

▶ OPERATIONAL DIFFERENCES

The M130 Yamaha FX SHO plug-in ECU closely mimics the standard OEM operation. With the following operational differences when the kit is installed:

- The M130 Marine ECU engine control functionality is the same as the standard factory ECU; all normal operations on the PWC are possible.
- The M130 Marine ECU controls the Yamaha Instrument Cluster and mimics the original factory dash operation. The ECU controls the dash via the KTC (K-Line to CAN) data adaptor. The KTC receives CAN messages from the ECU, and then transmits K-Line messages to the instrument cluster. CAN messaging from the M130 to the KTC is fixed.
- To prevent engine damage, the following dash alarms and revolution limits are provided:

Sensor	Value	Dash Alarm	Rev Limit
Engine Temperature	88 °C	Yes	4500 RPM
Muffler Temperature	96 °C	Yes	4000 RPM
Oil Pressure	None	Yes	4000 RPM

Cooling

When a PWC Plug-In ECU is fitted, the engine power will increase. The standard Yamaha cooling system might not be sufficient in its supply of water to the engine and over-heating can occur. It is important to check that the cooling system is working adequately.

The maximum engine temperature should be 88 °C (190 °F). If your engine overheats, the dash alarm will come on and the revolutions will be limited to 4500 rpm.

⇒ **Note:** There are three separate engine temperature monitors on the Yamaha. The engine temperature switch, mounted on the front right side of the engine block, is used to control the dashboard alerts and RPM limiter. The alarm temperature of this switch is 88 °C and is not adjustable. The engine temperature sensor, mounted on the rear right side of the block, will reduce the Drive-by-Wire throttle when engine temperature exceeds 105 °C.

A further precaution is controlled by the Race Time system. When the engine uses full throttle for extended periods, the engine tuner can adjust Compensation tables to reduce engine temperature. The fuel mixture can be enriched using the Race Time Fuel Mixture Aim Compensation table and the ignition timing can be retarded using the Race Time Ignition Timing Compensation table.

Power Control Functions

The standard Yamaha WaveRunner uses an Immobiliser and Start button to power up the craft. If the Immobiliser is unlocked, press the Start button on the left handlebar will start and run the engine.

The installation of the PWC Plug-In ECU bypasses the Immobiliser, rendering the PWC permanently unlocked.

Otherwise it follows the same strategy with the following provisions:

- If the engine is not started or is stopped for a period longer than 60 seconds, the M130 Marine ECU turns off its own power. Power is not re-applied until the Start button is pressed again for an engine start.
- When making tuning adjustments to the M130 Marine ECU using M1 Tune software, an ECU reset may be required. In this case, power is removed from the ECU and the Ethernet connection to the PC software is halted.

To re-connect, press the Start button for a short time until the engine has cranked, or for a longer time if you want the engine running. The Ethernet connection should re-establish and you may continue with tuning adjustments.

- Using the Power-up Adaptor Plug if the ECU needs to be powered for longer than 60 seconds without the engine running, for example when sending new firmware, the ECU power should be controlled externally. For this purpose, a separate 2 pin plug is fitted to the Adaptor Loom. Connect the two pins in this plug together via a switch to turn on the ECU power relay.

When finished, the switch should be removed to return to normal power control operation so that the ECU has control of the power relay. Failure to do so will cause the battery to go flat.

Security

The standard Yamaha Immobiliser system uses a Key Fob transmitter to Lock/Unlock the PWC. If the immobiliser is locked, the Start button will not crank the engine, thus preventing operation. When the PWC Plug-In ECU is installed, an Immobiliser Bypass device renders the craft permanently unlocked.

It is important to secure the craft when not in use, for example, by removing the Immobiliser Bypass.

RiDE (Reverse with Intuitive Deceleration Electronics)
2016+ VXR, FX and GP1800 Models

In these models, a reverse lever on the left side handlebar is configured similarly to the normal throttle lever.

Yamaha’s original behaviour for these systems is that the reverse lever operates both the reversing bucket and the throttle, unlike competitor Sea-Doo.

Many users prefer the Sea-Doo method where the reverse lever operates the bucket only, with the normal throttle lever always controlling the throttle.

The M1 solution allows either control method. The Reverse Lever Throttle Aim table will take control of the throttle if its value is greater than zero when the reverse lever is used.

Yamaha OE Control Method

Enter values in the table to conservatively open the throttle when the reverse lever is applied.

Example:

Reverse Lever Throttle Aim [%]			
Reverse Lever [%]			
0.0	30.0	100.0	
0.0	0.0	25.0	

Alternate Control Method (Similar to Sea-Doo)

Enter zero values in all table cells so that the reverse lever does not control the throttle when applied. In this method, the reverse lever operates the bucket and the normal throttle lever operates the throttle.

Example:

Reverse Lever Throttle Aim [%]			
Reverse Lever [%]			
0.0	100.0		
0.0	0.0		

Configuring the Package for 2008-2015 FX Models

The following settings are required to operate 2008-2015 FX SHO models using the **Yamaha FX SHO 2008 [01.01.0017, January**

2014] firmware with either the 61234 or 61401 Adaptor Loom and 61140 KTC device:

- Communications Model: FX SHO 2008
- Communications CAN Bus Speed: 1Mbit
- Reverse Switch State Resource: Universal Digital Input 7
- Reverse Lever Sensor Main Voltage Resource: Not in Use
- Reverse Lever Sensor Tracking Voltage Resource: Not in Use

Configuring the Package for 2016+ VXR, FX and GP1800 models

The following settings are required to operate 2016+ VXR models using the **Yamaha FX SHO 2008 [01.01.0017, January 2014]** firmware with the 61401 Adaptor Loom and the 61294 KTC250 device:

- Communications Model: VXR 2016
- Communications CAN Bus Speed: 250kbit
- Reverse Switch State Resource: Not in Use
- Reverse Lever Sensor Main Voltage Resource: Analogue Voltage Input 7
- Reverse Lever Sensor Tracking Voltage Resource: Analogue Voltage Input 8
- Configure the Reverse Lever Throttle Aim as described in the RiDE section

The 61401 Revision A Adaptor Looms require the following update modification to match Revision B:

- Remove the violet wire from M1 connector A07
- Move the yellow wire from M1 connector A24 to M1 connector A07
- Insert the free violet wire into M1 connector A24

Load M1 Package **Yamaha FX SHO 2008 [01.01.0017, January 2014]**.

► M1 OPERATIONAL FEATURES

• **Launch Control:**

This system aids initial take-off by means of ignition retard, engine speed limiting and boost aim control. It also provides fuel volume trimming to assist exhaust cooling.

Engine speed limiting during launch uses the Launch Engine Speed table and Launch Engine Speed Margin. The primary means of control is ignition retard.

While Engine Speed is above Launch Engine Speed, the Ignition Timing Limit Advance system attempts to control Engine Speed using closed loop control of ignition timing. If Engine Speed exceeds (Launch Engine Speed + Engine Speed Margin), a hard limit (ignition cut or/and potentially fuel cut) is applied. This allows turbocharged engines to develop boost pressure prior to launch.

The activation state of the launch system is reported by State and further information about why launch is inactive is reported by Diagnostic.

• **No Wake Mode**

The No Wake Mode system assists in slowly cruising through no-wake zones.

These conditions must be met for no wake mode to enable:

- No Wake Mode Button must be On for 1.0 seconds
- Reverse Switch must be Off
- Throttle Lever must be less than 2.0%
- Engine Run Time must be great than 0 seconds

Once No Wake Mode is enabled it will disable if any of the following occur:

- No Wake Mode Button transitions to On
- Reverse Switch transitions to On
- Throttle Lever exceeds 20%
- Engine Run Time is 0

During operation of the No Wake Mode system ThrottleAim is set to the value of the No Wake Mode Throttle table.

The No Wake Mode Button is also used as the Race Time Reset Switch, regardless of whether the No Wake Mode is enabled.

• **Reverse**

Reverse operation differs between the FX SHO models and VXR Models. On FX SHO models, Reverse activation is via the Reverse Switch. On VXR models, activation is via the Reverse Lever.

► CHANGE FROM VERSION 01.01.0005

The update firmware which handles VXR operation has several changes when compared with the previously released version:

- **Anti-Lag Ignition Timing** is now called **Anti-Lag Ignition Timing Limit Advance**. Behaviour is unchanged.
- **Communications CAN Bus Speed** is now a setting because the VXR vehicle includes a 250kbit/sec CAN Bus, while the FX SHO vehicles had no CAN Bus and the M1 communicated with the KTC at 1Mbit/sec.
- **Communications Boost Scale** allows for correct display of boost pressure on VXR models with boost systems.
- **Fuel Closed Loop Period** table now has an Engine Speed axis added to the Exhaust Mass Flow axis.
- **Ignition Timing Request** has been removed.
- **Ignition Timing Normal** and **Ignition Timing Stop Engine** have been added.
- **Launch Activate Throttle Position** has been replaced by **Launch Entry Throttle Position** and **Launch Exit Throttle Position**.
- **Launch Activate Delay** has been removed.
- **Launch Switch** has been removed. This function is now controlled by the **Race Time Reset Switch**.
- **Launch Ignition Timing** is now called **Launch Ignition Timing Limit Advance**. Behaviour is unchanged.
- **Launch Engine Speed Limit** is now calculated from the **Launch Engine Speed table** plus an additional setting for **Launch Engine Speed Margin**.
- **Launch Ignition Cut Request** has been removed.
- **No Wake Mode Button** may now be used as the **Race Time Reset Switch**.
- **Reverse** group has additions (applies to VXR versions only) for **Lever**, **Position**, **Command** and **State**.
- **Race Time Mode** has been removed.
- **Race Time Reset Switch** is added, using the **No Wake Mode Button** as a source.
- **Race Time Throttle Lever Compensation** has been removed.
- **Throttle Aim** now includes an override from the **Reverse Lever** (where used).

► PINOUT - 61401 REV B - M130 CONNECTOR A - 34 WAY

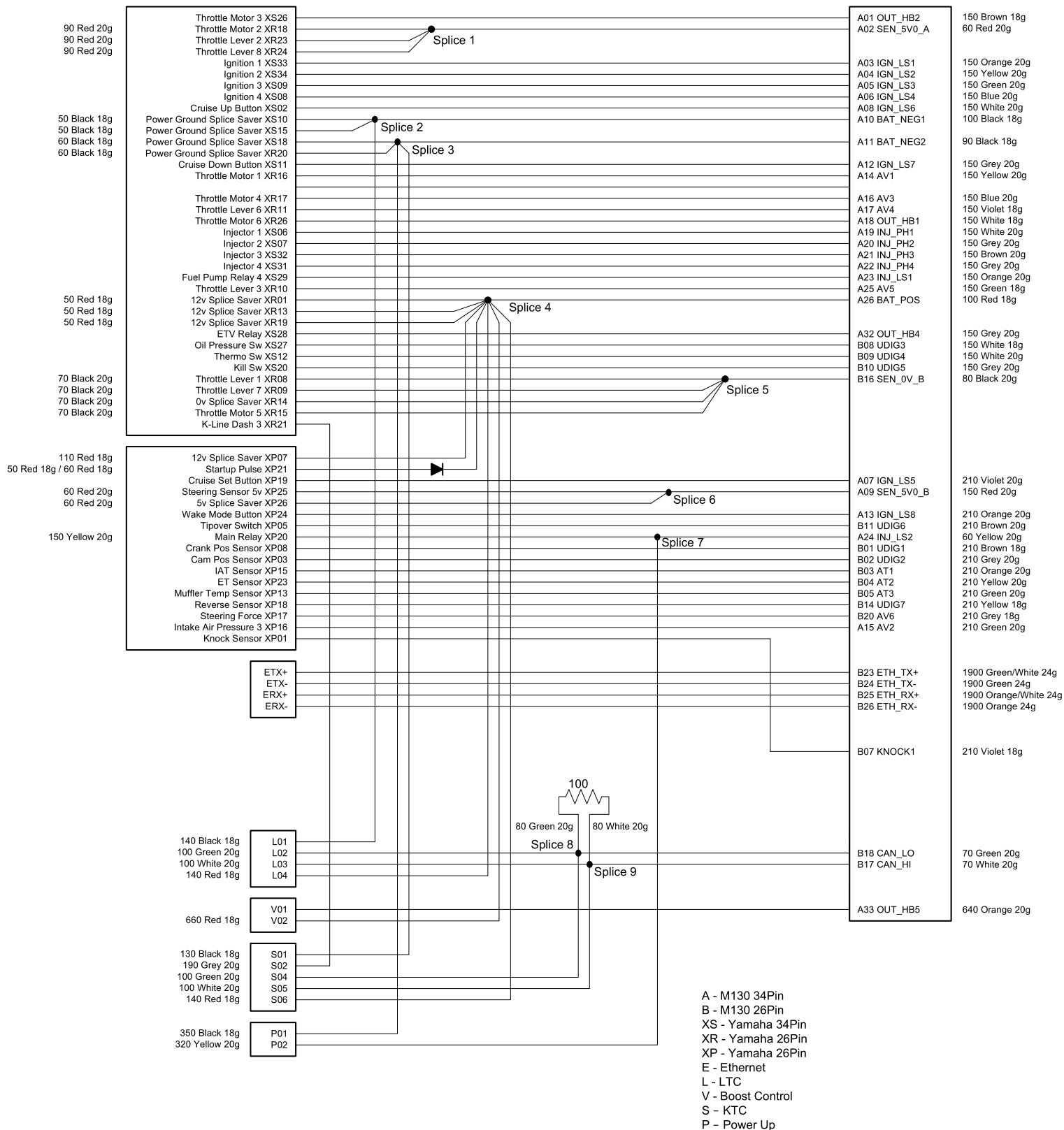
Mating Connector: Tyco Superseal 34 Position Keying 1 (MoTeC #65044)

Pin	Designation	Full Name	OE Pin	Function
A01	OUT_HB2	Half Bridge Output 2	X78	Throttle Motor +
A02	SEN_5V0_A1	Sensor 5.0V A	X44, X49, X50, X51, X28	5V Supply for Throttle, Throttle Lever
A03	IGN_LS1	Low Side Ignition 1	X85	Ignition Cylinder 1 Output
A04	IGN_LS2	Low Side Ignition 2	X86	Ignition Cylinder 2 Output
A05	IGN_LS3	Low Side Ignition 3	X61	Ignition Cylinder 3 Output
A06	IGN_LS4	Low Side Ignition 4	X60	Ignition Cylinder 4 Output
A07	IGN_LS5	Low Side Ignition 5	X20, P02	Power System Relay
A08	IGN_LS6	Low Side Ignition 6	X54	Cruise UP Button
A09	SEN_5V0_B1	Sensor 5.0V B	X25, X26	5V Supply for Steering Sensor
A10	BAT_NEG1	Battery Negative	X62, X67, L01	Ground
A11	BAT_NEG2	Battery Negative	X70, X46, S01, P01	Ground
A12	IGN_LS7	Low Side Ignition 7	X63	Cruise DOWN Button
A13	IGN_LS8	Low Side Ignition 8	X24	No Wake Mode Button
A14	AV1	Analogue Voltage Input 1	X42	Throttle Servo Position Main
A15	AV2	Analogue Voltage Input 2	X16	Inlet Manifold Pressure
A16	AV3	Analogue Voltage Input 3	X43	Throttle Servo Position Tracking
A17	AV4	Analogue Voltage Input 4	X37	Throttle Lever Tracking
A18	OUT_HB1	Half Bridge Output 1	X52	Throttle Motor
A19	INJ_PH1	Peak Hold Injector 1	X58	Fuel Cylinder 1 Primary Output
A20	INJ_PH2	Peak Hold Injector 2	X59	Fuel Cylinder 2 Primary Output
A21	INJ_PH3	Peak Hold Injector 3	X84	Fuel Cylinder 3 Primary Output
A22	INJ_PH4	Peak Hold Injector 4	X83	Fuel Cylinder 4 Primary Output
A23	INJ_LS1	Low Side Injector 1	X81	Fuel Pump Output
A24	INJ_LS2	Low Side Injector 2	X19	Cruise SET Button
A25	AV5	Analogue Voltage Input 5	X36	Throttle Lever Main
A26	BAT_POS1	Battery Positive	X27, X39, X45, X07, X21 via diode, L04, V02, S06	
A27	INJ_PH5	Peak Hold Injector 5	Not Used	No Wake Mode Button
A28	INJ_PH6	Peak Hold Injector 6	Not Used	Cruise Assist Down Button
A29	INJ_PH7	Peak Hold Injector 7	Not Used	Cruise Assist Up Button
A30	INJ_PH8	Peak Hold Injector 8	Not Used	Cruise Assist Set Button
A31	OUT_HB3	Half Bridge Output 3	Not Used	
A32	OUT_HB4	Half Bridge Output 4	X80	ETV Relay
A33	OUT_HB5	Half Bridge Output 5	V01	Boost Solenoid Output (Optional)
A34	OUT_HB6	Half Bridge Output 6	Not Used	

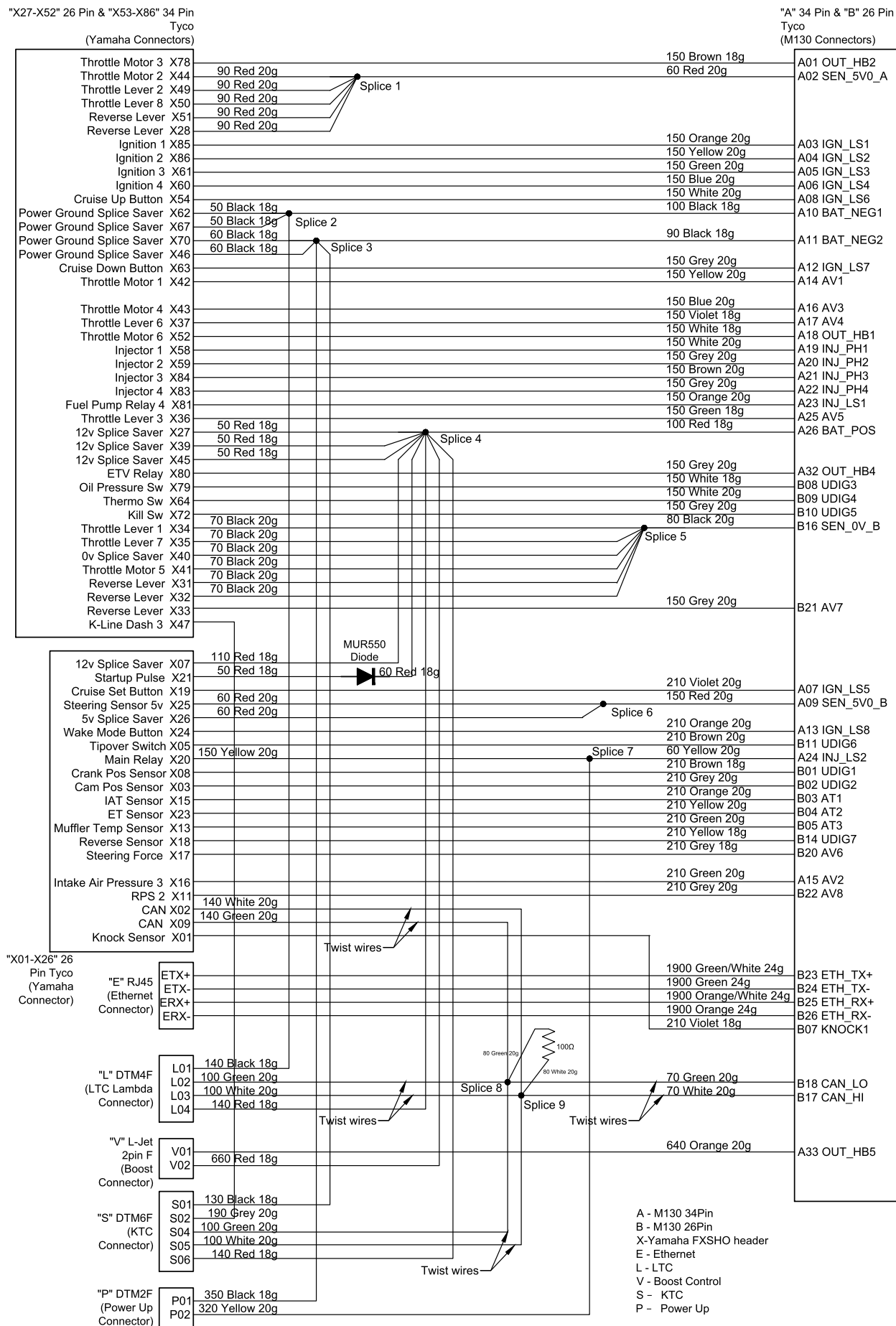
► **PINOUT - 61401 REV B - M130 CONNECTOR B - 26 WAY****Mating Connector: Tyco Superseal 26 Position Keying 1 – MoTeC #65045**

Pin Number	Designation	Full Name	OE Pin	Function
B01	UDIG1	Universal Digital Input 1	XP08	Engine Speed Sensor
B02	UDIG2	Universal Digital Input 2	XP03	Engine Synchronisation Sensor
B03	AT1	Analogue Temperature Input 1	XP15	Inlet Manifold Temperature
B04	AT2	Analogue Temperature Input 2	XP23	Coolant Temperature Sensor
B05	AT3	Analogue Temperature Input 3	XP13	Muffler Temperature
B06	AT4	Analogue Temperature Input 4	Not Used	
B07	KNOCK1	Knock Input 1	XP01	Knock Sensor
B08	UDIG3	Universal Digital Input 3	XS27	Oil Pressure Low Switch
B09	UDIG4	Universal Digital Input 4	XS12	Thermo Switch
B10	UDIG5	Universal Digital Input 5	XS20	Engine Stop Button
B11	UDIG6	Universal Digital Input 6	XP05	Tip Over Switch
B12	BAT_BAK	Battery Backup	Not Used	
B13	KNOCK2	Knock Input 2	Not Used	
B14	UDIG7	Universal Digital Input 7	XP18	Reverse Switch
B15	SEN_0V_A2	Sensor 0V A	Not Used	
B16	SEN_0V_B2	Sensor 0V B	XR08, XR09, XR14, XR15	5V Supply for Throttle, Throttle Lever
B17	CAN_HI	CAN Bus 1 High	L03, S05	250 kbit/sec CAN to KTC, LTC
B18	CAN_LO	CAN Bus 1 Low	L02, S04	250 kbit/sec CAN to KTC, LTC
B19	SEN_6V3	Sensor 6.3V	Not Used	
B20	AV6	Analogue Voltage Input 6	XP17	Steering Force
B21	AV7	Analogue Voltage Input 7	Not Used	Reverse Lever Main
B22	AV8	Analogue Voltage Input 8		Reverse Lever Tracking
B23	ETH_TX+	Ethernet Transmit +	Ethernet Green/White	
B24	ETH_TX-	Ethernet Transmit -	Ethernet Green	
B25	ETH_RX+	Ethernet Receive +	Ethernet Orange/White	
B26	ETH_RX-	Ethernet Receive -	Ethernet Orange	

WIRING SCHEMATIC - 61234: 2008 - 2015 MODELS



► WIRING SCHEMATIC - 61401 REV A: 2016+ MODELS



▶ WIRING SCHEMATIC - 61401 REV B: 2016+ MODELS

