Snowmobile Plug-In ECU

Installation Manual

Contents

Quick Start Guide

Throughout this manual we use the following icons to indicate information only valid for a particular Snowmobile:

🐺 Yamaha

🅢 Ski-Doo

Installation

The Snowmobile Plug-In ECUs are supplied as a complete replacement kit including a Base Map to provide a tune for the vehicle that will result in direct power gain.

> **WARNING:**
>
> Your dealer must ensure that your M400 Marine ECU has the correct firmware loaded (currently V3.53C or later) and that a suitable configuration file (Base Map) is loaded, **before** you fit the kit to your Snowmobile.
>
> Failure to do this may result in a Snowmobile which **may not power up, may not start, or may permanently damage the ignition coils.**

Detailed installation instructions can be found in the section relevant for your Snowmobile.

You should read:

Data Logging

To take full advantage of the possibilities of the system, data logging can provide you with valuable knowledge about the performance and reliability of the engine and vehicle.
Note: The Snowmobile Plug-In ECU systems provide data logging for a free evaluation period of the first 8 hours engine running time. After this evaluation period data logging is available as an Upgrade.

This manual will explain how to obtain the logged data from your Snowmobile.

Expanding the System

To get even more out of your Snowmobile, you will find information in this manual on how you can expand your system.

More Information

If you would like to explore more in depth information for your installation, you will find tips and links for further reading in the last appendix.

Introduction

The Snowmobile Plug-In ECUs are direct replacements for factory ECUs on a select number of popular Snowmobile models. They are based around the M400 Marine ECU.

Note: ECUs (Engine Control Units) are often referred to as Ignition Systems.

Complete with a wiring loom and mounting brackets, Snowmobile Plug-Ins are convenient and cost effective to install because they eliminate the need to rewire the vehicle. They simply plug into the factory wiring harness using the original sensors, fuel system and factory dash.

Features

The M400 Marine ECU comes with a range of features as standard and several options available as upgrades to customise and grow your system. These additional features are activated through a simple password acquired from your local MoTeC dealer, at any time when you need it. See *Upgrades*.

Engine Tuning Features

- Windows based ECU Manager tuning software with user definable screen layouts.
- Individual cylinder tuning of both fuel delivery and ignition timing.
- Selectable channels for table axes.
- Fully configurable axis points on all tables.
- Free access to wideband Lambda and data logging for initial tuning. Available for the first 8 hours engine running time.
- Possibility to communicate directly with OEM dash.
- Suitable for engines requiring the latest complex control functions, such as drive by wire throttle control.
- Capable of all other modern control functions, such as:
    - o Launch control
    - o Overrun boost enhancement (anti-lag)
    - o Boost control
    - o Nitrous injection
- Fully configurable sensor inputs including custom calibrations.
- Configurable receiving and transmitting data via the CAN bus.

- Capable of receiving data from multiple Lambda measurement devices via CAN.
- Integrated advanced diagnostics, including injector and crank trigger diagnostics.
- Switchable between multiple configurations.
- Ref/Sync capture displayed on the built-in digital oscilloscope.

Data Acquisition

- Internal data logging (500 KB) with fast download via CAN.
- Three engine histogram logs including a tell-tale log.
- State of the art *i2 Standard* or *i2 Pro* data analysis software.

Compatibility

🔱 Yamaha Apex 2006-2010.

🅢 Ski-Doo 1200 4-Tec 2009-2012.

Required Accessories

UTC (only required to connect the ECU to a laptop).

System Overview

Each system is tailored to the specific Snowmobile and consists of

- M400 Marine ECU.
- Installation Set, including adaptor loom and required devices.
- Mounting Set, including brackets to install the ECU in your desired location.

Yamaha Apex Installation

☷ *System*

ECU

- M400 Marine ECU

Installation Set

- 1 x Adaptor Loom
- 1 x IGN4 Ignition Module
- 1 x Waterproof Relay
- 1 x KTC (K-Line to CAN module)

Mounting Set

- 2 x ECU mounting brackets
- 4 x mounting bolts
- 1 x rubber backing pad

On request the Yamaha Snowmobile
Plug-In ECU is available with the M800 Marine ECU.

⊽ *Installation*

ECU and KTC

The M400 Marine ECU replaces the factory ECU in the forward compartment of the engine. This is the most convenient location for mounting the ECU because it can also be used for supercharged and turbo applications without intercooler interference .

⊽ *Configuration File*

The Yamaha Apex Snowmobile Plug-in ECU is compatible with Apex models from 2006 to 2010. There are two OEM ECU variants shown below.

If your OEM ECU number is not shown, contact your MoTeC dealer.

To mimic all original Apex functions including dashboard alerts, the Apex Snowmobile Plug-In ECU requires M400 firmware version 3.53C or higher.

8FP-8591A-00-00

For 2006-2010 Apex, Apex RTX, RTX ER, GT, ER, LTX, LTX GT.

8FS-8591A-00-00

For 2006-2007 Apex Mountain, Mountain SE.
And 2008-2010 Apex MTX, MTX SE.

♦ *Snowmobile Operational Differences*

The Snowmobile Plug-In ECU closely mimics the standard OEM operation. However, MoTeC would like to draw your attention to some operational differences when a Snowmobile Plug-In ECU is installed.

♦ *ECU Operation*

The M400 Marine ECU engine control functionality is the same as the standard factory ECU; all normal operations of the Snowmobile are possible, with the exception of Thumb Warmer and Grip Warmer operation, which are fully functional but slightly different in operation – see below.

♦ *Instrument Cluster Operation*

The M400 Marine ECU will control the Yamaha instrument clusters and mimic 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.

The fixed CAN address and the CAN messages custom data set are provided in the Base Map and should not be changed.

To prevent engine damage the following dash alarms and rev limits are provided:

Sensor	Value	Dash alarm	Rev Limit
Engine Temperature	approx. 92 °C (194 F)	yes	None
Oil Pressure	None	yes	4500 rpm

Note: These alarms and rev limits are similar to the factory settings.

♦ *Power Control Strategy*

The standard Yamaha Apex uses an Ignition Key and Kill Switch to power up the vehicle. If the Kill Switch is raised, turning the Ignition key to the Start position will start and run the engine.

⬢ *Thumb Warmer and Grip Warmers*

The standard Yamaha Apex uses Up/Down buttons on the handle bars to control the Thumb Warmers and Grip Warmers. The Snowmobile Plug-In ECU does not mimic this operation, rather it uses each of the 'Up' switches to increase the settings, and then cycles back to the 'off' setting if the 'Up' button is pressed when the indicated setting is at maximum. When the vehicle is powered up the initial settings are to provide 100% heat. Customers can adjust from this default position.

Warmers will not operate below engine RPM of 1250.

Ski-Doo 2009-Current Installation

⑤ *System*

ECU

- M400 Marine ECU

Installation Set

- 1 x Adaptor Loom
- 1 x STC-K (Ski-Doo Serial to CAN module)
- 1 x IGN4 Ignition Module

Mounting Set

- 2 x ECU mounting brackets
- 4 x mounting bolts
- 1 x rubber backing pad

On request the Ski-Doo Snowmobile
Plug-In ECU is available with the M800 Marine ECU.

⑤ *Installation*

Note – the Ski-Doo connectors are labelled A and B and are keyed so that only the correct plug can be inserted. If the slide-lock on the plug will not slide shut, then the plug is fitted into the wrong connector.

For the ECU to function normally all supplied devices must be connected:

- STC-K device plugged into 6 pin socket labelled 'STC'
- IGN4 device plugged into 6 pin socket labelled 'COIL' and 4 pin socket labelled 'IGN'.

These devices can all be secured by zip-ties.

⑤ *Configuration File*

The Ski-Doo Snowmobile Plug-in ECU is compatible with 1200 4-Tec models from 2009 to 2012.

All year models of the Ski-Doo Snowmobile Plug-in ECU use the same configuration file.

To mimic all original Ski-Doo functions including dashboard alerts, the Ski-Doo Snowmobile Plug-In ECU requires M400 firmware version 3.53C or higher.

Output Test Function

To test if all outputs are correctly wired to the relevant injectors and coils, the ECU Manager software has an output test function available. If you would like to use this function in a Ski-Doo installation refer to the notes in the Appendices (⑤ Output Test Function).

☉ *Snowmobile Operational Differences*

The Snowmobile Plug-In ECU closely mimics the standard OEM operation. However, MoTeC would like to draw your attention to some operational differences when a Snowmobile Plug-In ECU is installed.

☉ *ECU Operation*

The M400 Marine ECU engine control functionality is the same as the standard factory ECU; all normal operations of the Snowmobile are possible.

☉ *Instrument Cluster Operation*

The M400 Marine ECU will control the Ski-Doo Instrument cluster and mimic the original factory dash operation.

The ECU controls the dash via the STC (Serial to CAN) data adaptor; the STC receives serial RS232 messages from the ECU, and then transmits CAN messages to the instrument cluster.

The serial RS232 transmit settings and the CAN custom data set are provided in the Base Map and should not be changed.

To prevent engine damage the following dash alarms and rev limits are provided:

Sensor	Value	Dash Alarm	Rev Limit
Fuel Tank Level	< 10% capacity	Yes	None
Battery Voltage	<11.6 V or >15.2 V	Yes	None
Engine Temperature	110°C	Yes	4000 rpm
Oil Pressure	No Oil Pressure and RPM > 3300	Yes	4000 rpm

Note: These alarms and rev limits are similar to the factory settings.

⑧ *Power Control Strategy*

The standard Ski-Doo 1200 4-Tec models use an Ignition Lanyard with an immobiliser function to power up the vehicle. If the Ignition Lanyard is inserted, pressing the Start/Reverse Button on the left handlebar will start the engine.

The installation of the Snowmobile Plug-In ECU solution still uses the Ignition Lanyard but without the immobiliser function.

- Power is continuously applied to the ECU while the Lanyard is connected. Tuning adjustments, log downloads, and ECU configuration file downloads may all be performed without interruption.

- Power is removed from the ECU **only** by removing the Ignition Lanyard.

⑧ *Security*

The Ski-Doo 1200 4-Tec uses an encoded Ignition Lanyard which is paired with the factory ECU.

The Snowmobile Plug-In installation does not include the immobiliser function. It is important to secure the vehicle when not in use for example by removing the IGN4 device from the wiring harness. MoTeC dealers can also assist in setting up anti-theft systems that will meet your needs if this is a requirement that must be met for your particular application.

⑧ *Idle Stepper Motor Setting (V3.52P or later)*

If the Snowmobile shows stalling behaviour when the throttle is closed suddenly, it may help to reset the throttle stop screw for a higher base idle RPM setting.

The standard throttle stop screw has a tamper-proof cover and is very securely glued to the throttle body with loctite. The screw can be very carefully removed (warning - risk of breakage), and replaced with an M5 set screw with M5 lock nut.

To reset a newly installed stop screw

- Connect to the ECU Manager program on a PC.
- Observe the Throttle Position (TP%) in the Sensors list, or press 'V' for the Sensor View screen.
- Wind in the stop screw until the throttle position reads just over zero.
- Wind back until exactly zero is shown.

To set the new idle stop position

- Wind in the stop screw an additional 1.5 turns.
- Altered this setting as required to achieve 1850 RPM idle on the sled **, once the engine has been warmed up**.

Note: TP HI and TP LO settings should not be changed, regardless of where the stop screw is positioned.

Software Installation

PC Recommendations

MoTeC recommends a dedicated laptop for your Snowmobile with the following specifications:

- 32 bit operating system: Windows XP, Vista or Windows7
- Screen size: 1024 x 768
- Processor speed: 1-2 GHz Pentium
- 2 GB RAM
- 256 MB graphics card
- 2 USB ports
- Ethernet port

Most current laptops will meet the specifications above and this will ensure all

MoTeC software will run on it.

ECU Manager Software (V3.53C or later)

To install ECU Manager Software

- Go to the MoTeC website at *www.motec.com* and navigate to downloads/software/latestreleases
  - OR -
  Locate the Manager software on the MoTeC Resource Disc.
- Save the selected file in your preferred location (for example desktop).
- When downloading is finished, double click on the file and select run.
- Follow the instructions on the InstallShield Wizard.
- To start the program after installation, click on the new Manager icon on the desktop or click **Start > All Programs > MoTeC > M400 M600 M800**.

Updating ECU Manager Software

Software updates are made available to give access to the latest features. Download the latest software version from the website and follow the software installation instructions to update to the new version.

Connecting the ECU to a PC

The PC communicates with the ECU via the CAN bus and connects to the USB port on the PC.

This requires a MoTeC UTC (USB to CAN) device. The UTC plugs into the CAN connector provided on the adaptor loom (5 pin connector) and includes a standard USB cable to connect to the PC.

i2 Data Analysis Software

i2 data analysis software is used to analyse the logged data that has been recorded by the ECU. A combination of graphs, gauges and reports can be analysed simultaneously. The *i2* environment can be customised to specific user requirements.

The software can be downloaded for free from the website.

To install the i2 software

- Go to the MoTeC website at *www.motec.com* and navigate to downloads/software/latestreleases
  - OR -
  Locate the software on the MoTeC Resource Disc.

- Save the selected file in your preferred location (for example desktop).

- When downloading is finished, double click on the file and select run.

- Follow the instructions on the InstallShield Wizard.

- To start the program after installation, click on the new *i2* icon on the desktop or click Start > All Programs > MoTeC > *i2 Standard*.

There are two levels of analysis functionality available; *i2 Standard* which is included, and *i2 Pro* which requires the optional Pro Analysis upgrade. See *Upgrades* for more information.

Data Logging

To take full advantage of the possibilities of the system, data logging can provide you with valuable knowledge about the performance and reliability of the engine and vehicle. The Snowmobile Plug-In ECU systems have the data logging option enabled for a free evaluation period of the first 8 hours of engine running time. After this, the Data Logging upgrade is required. See *Upgrades*.

In the Base Map, a logging configuration is supplied. This configuration will log diagnostic channels needed for trouble shooting and will allow for 5 to 15 minutes of logging.

To download the log file

Ensure you have ECU Manager software installed.

The M400 Marine ECU must stay powered while downloading the data. In most instances the log file can be downloaded within the normal ECU shut down period. However, for very large files it might be necessary to manually power up the ECU. See the relevant *Power Control Strategy* section for more information.

1. Connect the ECU to the PC. See *Connecting the ECU to a PC.*
2. Open ECU Manager software.
3. On the **Utilities** menu, click **Get Logged Data.**
4. Click **Yes** to confirm you would like to clear the logging memory.
5. Click **OK** when prompted for vehicle details.
6. The next screen contains three tabs: **Events**, **Venue** and **Vehicle.** The details on the events tab are essential; the other two tabs are optional.
   Tip: It is good practice to fill in all relevant details as this will be your reference to the circumstances under which this file was recorded when you refer to this file in the future,
7. Enter a **Vehicle ID** to identify your Snowmobile.

Important:

There are two files created; one with extension .ldx and one with extension .ld. The .ldx file is smaller than 1 KB (<1000 B), while the .ld file is much larger. If you would like somebody else to look at your log file, please make sure you provide the **.ld** file.

The default location for the files is C:MoTeC/Logged Data.

Tip: The log files are named using a time stamp. When selecting the log files using *i2* (see next section), all details you have entered will be listed. This is often the easiest way to select the required file.

To select the log file - using i2

Ensure you have *i2* data analysis software installed.

1. Open *i2* Data analysis software and open a **Circuit** project.
2. Double click on the file you would like to view.
   All details you entered when downloading the logged data will be listed in the middle window.

   Tip: To get started with using *i2* to analyse your own logged data, there are extensive help files included in the software. You can also download seminar notes on the use of *i2* from the MoTeC website. See *How to Get More Information.*

To send a log file by email

1. On the **File** menu, click **Open Log File.**
2. Right click on the file you would like to send.
   Note: This file must be open, indicated with a green tick on the file icon.
3. Click **Copy**, open your email recipient (e.g. MS Outlook) and paste the file into the email
   - OR -
   Click **Send To** and then click **Mail Recipient.**

Change the Logging Settings

The provided logging configuration in the Base Map will provide 5 to 15 minutes of logging. If you would like to increase this time, you need to reduce the number of channels logged, or reduce the logging rate for the logged channels.

To change the logging configuration

See the relevant Power Control Strategy section to ensure the M400 Marine ECU stays powered while downloading the data.

1. Connect the ECU to the PC. See *Connecting the ECU to a PC.*
2. Open ECU Manager software.
3. On the **File** menu, click **Save As** and choose a new file name.
   This will save the changes you are going to make in a new file and prevent accidentally overwriting the standard Base Map.

> **Tip:** It is good practice to add an incrementing number to the file name to keep track of the files you are creating.

4. On the **File** menu, click **Edit Comments.**
    Tip: Filling in comments will help to identify the file when you refer to it in the future.

5. On the **Adjust** menu, click **Data Logging Setup.**

6. Click **Engine Sensors** and select the sensor you would like to change.

7. To include the sensor in the logging, enter a value for the **Samples per Second** at which you would like to log this sensor
    - OR-
    To exclude the sensor from the logging, enter **0** for the **Samples per Second.**
    As you are changing the settings a new logging time will be calculated. This is shown in the bar under the logging parameters.

8. Press **N** to browse through all the pages with the other available logging settings until finished.
    A maximum of 64 items can be selected for logging.

9. On the **File** menu, click **Save.**

10. On the **File** menu, click **Send File to ECU**.

Tips:

- While changing the logging settings, actual logging will be disabled until you disconnect the ECU from the PC. To guarantee that logging will resume MoTeC suggests that after you have finalised your logging settings in ECU Manager you select another table, for example a fuel or spark map. For a quick way to do this, press **F5** to display the fuel map.

- Ensure that a maximum of 64 channels are selected for logging.
  If more channels are selected, only the first 64 selected channels are logged.

Options to Expand the System

GPS

The M400 Marine ECU can receive GPS data via RS232 communication, which allows wiring MoTeC's 5 Hz GPS-G1 (#41300) direct into the ECU's existing RS232 receive port. This GPS feature is an extremely useful addition for Snowmobiles because conventional speed detection methods are inaccurate.

The following GPS based channels are available: Speed, Time, Longitude, Latitude, Altitude, Satellites, Quality, HDOP (Range Error).

For wiring information see the relevant calibration notes in the appendices.

To configure the GPS in ECU Manager software

1. On the **Adjust** menu, click **General Setup**.
2. Click **Communications** and then **RS232 Telemetry Setup**.
3. Enter Telemetry Baud Rate **19201**.
4. Enter Telemetry Data Set **0** to turn the dataset **Off**.

Upgrades

The M400 Marine ECU comes with a range of features as standard and several options available as upgrades to customise and grow your system. These additional features are activated through a simple password acquired from your MoTeC dealer, at any time when you need it.

Data Logging

To take full advantage of the possibilities of the system, data logging can provide you with valuable knowledge about the performance and reliability of the engine and vehicle.

The Snowmobile Plug-In ECU systems have the data logging option enabled for a free evaluation period of the first 8 hours of engine running time. After this, the Data Logging Upgrade is required which allows recording of all ECU data to the 500 kB internal logging memory.

Wideband Lambda

Additional tuning of all Snowmobile Plug-In ECU installations is best performed with a Lambda sensor.

The Snowmobile Plug-In ECU systems have the Lambda option enabled for a free evaluation period of the first 8 hours of engine running time. After

this, the Lambda Upgrade is required which allows the use of a single on-board wideband Lambda controller for NTK UEGO or Bosch LSU sensors.

For wiring information see the relevant Pin List in the appendices.

Suitable mounting positions for Lambda sensors are shown in the appendix *Lambda Sensor Installation.*

Pro Analysis

This upgrade provides access to advanced *i2 Pro* data analysis software with multiple graph overlays, X-Y plots, advanced maths functions, synchronised video (manual alignment), and flexible layouts to accommodate virtually any user preference. Requires the Data Logging upgrade.

You can try the *i2 Pro* software by downloading it from the website *www.motec.com.au* and use the included demo file.

Appendices

M400M Specifications

Outputs

- 4 x Injector outputs — high or low ohm
- 4 x Ignition outputs
- 8 x Auxiliary outputs — for functions such as camshaft control, drive by wire throttle, boost control, nitrous injection, idle speed stepper motor and many more.

Inputs

- 8 x Analogue voltage inputs — fully configurable including custom calibrations, e.g. to use for:
  - o longitudinal G force
  - o fuel pressure
  - o steering position
  - o lateral G force
- 6 x Analogue temperature inputs — fully configurable including custom calibrations, e.g. to use for:
  - o multiple configuration maps
  - o extra air temperature
  - o extra water temperatures
  - o exhaust temperature
- 1 x Wideband Lambda input — for Lambda measurement and control.
- 4 x Digital/speed inputs — for use with OEM factory speed paddle wheel and function activation e.g. launch control, anti lag and dual RPM limit.

Communications

- 1 x CAN
- 1 x RS232 — e.g. to use with GPS. For accurate logging of speed and position, wire the 5 Hz MoTeC *GPS-G1* direct to M400 Marine ECU.

Physical

- Case size 147 x 105 x 40 mm
- Weight 900 gram
- 1 x 34 pin and 1 x 26 pin waterproof connector with gold plated contacts.

Yamaha

Connectors

M400 Marine ECU Connector
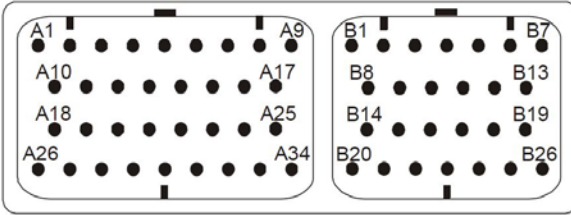
Looking into the connector on the ECU

Yamaha Factory Connector

Connector K
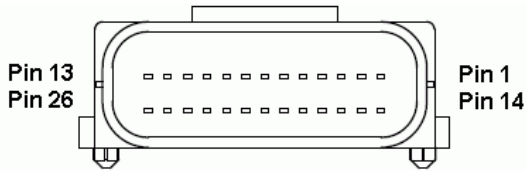
Connector J
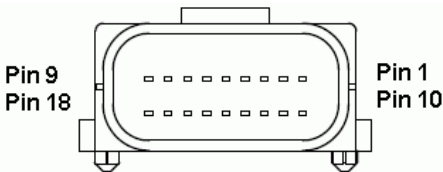
Looking into the connector on the ECU

♦ *Pin List by Function*

M400 Pin		Yamaha Pin	Function
Power			
VBAT	A26	K09, K11, K24, S06, L05	12 V Switched (ECU Relay) Lambda Heater Supply
GND	A10	J05, J14, C05	ECU Earth, IGN4 Earth
GND	A11	J05, J14, C05	ECU Earth, IGN4 Earth
8V ENG	A12	not used	*Optional: 8 V to SKM Module*
5V ENG	A02	K22	5 V Sensor Supply
0V ENG	B16	K26	0 V Sensor Supply
8V AUX	A13	E03	8 V to CAN Connector
5V AUX	A09		*Optional: GPS Power*
0V AUX	B15	K13, L01	0 V Sensor Supply, Lambda Sensor Ground
0V COMM	B14	S01, E01	0 V for CAN and KTC devices
Output			
Inj1	A19	J06	Injector Cylinder 1
Inj2	A20	J15	Injector Cylinder 2
Inj3	A21	J17	Injector Cylinder 4
Inj4	A22	J08	Injector Cylinder 3
Inj5	A27	not used	Not Available in M400
Inj6	A28	not used	Not Available in M400
Inj7	A29	not used	Not Available in M400,M600
Inj8	A30	not used	Not Available in M400,M600 *Optional: Available for Knock Module SKM - Knock Window*
Ign1	A03	D01, to J07	Ignition Cylinder 1
Ign2	A04	D02, to J16	Ignition Cylinder 2

M400 Pin		Yamaha Pin	Function
Ign3	A05	D03, to J18	Ignition Cylinder 4
Ign4	A06	D04, to J09	Ignition Cylinder 3
Ign5	A07	not used	Not Available in M400
Ign6	A08	not used	Not Available in M400
Aux1 [1]	A18	L04	Lambda Sensor Heater Control
Aux2 [1]	A01	J03	Grip Warmer
Aux3 [1]	A23	R85	Power Supply Bypass Relay
Aux4 [1]	A24	J11	Load Relay (headlight etc.)
Aux5	A31	J12	Thumb Warmer
Aux6 [1]	A32	J10	Fuel Pump Relay
Aux7	A33	not used	
Aux8 [1]	A34	J04	Fan Relay
Inputs			
Ref	B01	K14	Ref Sensor (Magnetic)
Sync	B02	K23	Sync Sensor (Hall)
AT1 [2]	B03	K02	Air Temperature
AT2 [2]	B04	K15	Engine Temperature
AT3 [2,5]	B05	K05	Grip Warmer Switch (Up)
AT4 [2]	B06	K03	Throttle Ice Switch
AT5 [2]	B07	K08	Oil Pressure Switch
AT6 [3,5]	B19	K07	Thumb Warmer Switch (Up)
AV1	A14	K01	Throttle Position
AV2	A15	K06	Manifold Pressure Sensor
AV3	A16	K19	Barometric Pressure Sensor
AV4	A17	Not used	
AV5 [5]	A25	Not used	
AV6 [2]	B20	K21	Oil Level Switch

M400 Pin		Yamaha Pin	Function
AV7 [5]	B21	Not used	
AV8 [5]	B22	Not used	
DIG1	B08	K04	Speed [4]
DIG2 [5]	B09	Not used	
DIG3 [1]	B10	Not used	
DIG4	B11	Not used	
La1S	B25	L02	Lambda Sensor
La1P	B26	L08	Lambda Sensor
La2S	B12	not used	*Optional: Available for Knock Module SKM - Knock Signal*
La2P	B13	not used	
Communications			
RS232-TX	B17	Not used	
RS232-RX	B18	not used	*Optional: Available for GPS Receive Data* [4]
CAN-LO	B24	E04, S04	CAN line to KTC dash adaptor
CAN-HI	B23	E05, S05	CAN line to KTC dash adaptor
0V COMM	B14	E01, S01	0 V for CAN and KTC devices
Additional Yamaha Loom Pins			
Unused		J01, J02, J13	
Unused		K10, K16, K17, K18, K20, 25	
K-Line (S2)		K12	K-Line to KTC adaptor pin S2

1 – 5: See Calibration and Wiring Notes

♦ *Calibration and Wiring Notes*

♦ *Note 1 – Calibration Functions*

The following pins are calibrated in the *Base Maps* with the function and parameters as mentioned in the table.

M400 Pin		Yamaha Pin	Function	Parameters
Aux2 Aux5	A01 A31	J03 J12	3: Aux Table	PWM/Switched 1 Output Mode 1 Polarity 1 Frequency 10 Minimum Duty Cycle 0 Maximum Duty Cycle 100 Hysteresis 0
Aux3 Aux4	A23 A24	R85 J11	3: Aux Table	PWM/Switched 1 Output Mode 0 Polarity 0 Frequency 10 Minimum Duty Cycle 0 Maximum Duty Cycle 100 Hysteresis 0
Aux6	A32	J10	101: Fuel Pump	Delay 3.0 Polarity 0 Output Mode 0
Aux8	A34	J04	102: Thermo Fan	On Temp 96 Off Temp 91 On Speed 0 Off Speed 0 Speed Channel 0 Time Out 0 Frequency 0 Polarity 0 Output Mode 0 Min Duty 0.00

❖ *Note 2 – Calibration Tables*

For the following pins the calibration table is available in the provided *Base Maps*.

M400 Pin		Yamaha Pin	Function
AT1	B03	K02	Air Temperature
AT2	B04	K15	Engine Temperature
AT4	B06	K03	Throttle Ice Switch
AT5	B07	K08	Oil Pressure Switch
AV6	B20	K21	Oil Level Switch

❖ *Note 4 - Speed*

The Snowmobile speed sensor is wired directly to the ECU. The supplied Base Map includes a speed calibration . For more accurate speed measurements, MoTeC recommends the use of a GPS system.

MoTeC's 5 Hz GPS-G1 (#41300) can be wired directly into the ECU's RS232 receive port.

GPS wiring

M400 Pin		GPS Pin	Function
0V AUX	B15	1	Bat —
RS232-RX	B18	2	RS232 GPS Data
	N/C	3	
5V AUX 5V ENG	A09 A02	4	5 V

Ski-Doo 2009-Current
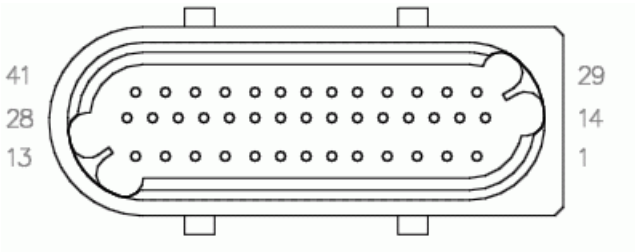
🔧 Connectors

M400 Marine ECU Connector
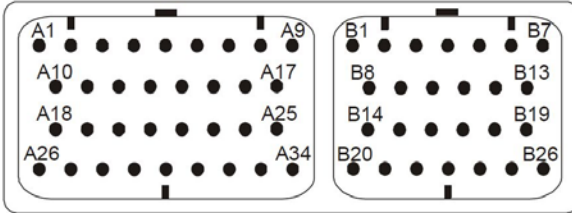
Looking into the connector on the ECU

Ski-Doo Factory Connectors

1200 4-Tec A Connector (top view)

1200 4-Tec B Connector (top view)
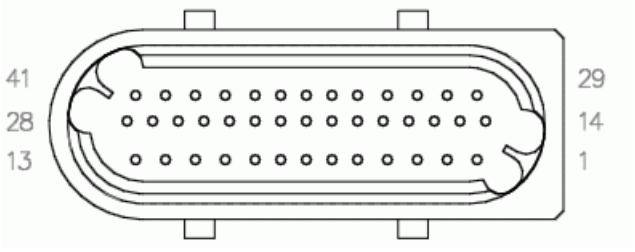
Looking into the plugs on the adapter loom

⊗ *Pin List by Function*

M400 Pin		Ski-Doo Pin	Function
Power			
VBAT	A26	B11,S06,L05, V02	12 V Switched (System Relay), Lambda Heater Supply, Boost Solenoid Supply
GND	A10	B1,B2,B32,B39, B41,R85,R87, T85, T87	ECU Earth
GND	A11	B1,B2,B32,B39, B41,R85,R87, T85, T87	ECU Earth
8V ENG	A12	E03	8V to CAN Connector
5V ENG	A02	A39,A40	5 V Sensor Supply
0V ENG	B16	Not used	
8V AUX	A13	K04	8 V to SKM Module
5V AUX	A09	G04	5 V GPS Power
0V AUX	B15	A19, A20, A25, A27, A28, L01, K01	0 V Sensor Supply, Lambda Sensor Ground, SKM Knock Ground
0V COMM	B14	E01,S01,G01	0 V for CAN, GPS and STC devices
Outputs			
Inj1	A19	A15	Injector Cylinder 1
Inj2	A20	A33	Injector Cylinder 2
Inj3	A21	A14	Injector Cylinder 3
Inj4	A22	not used	
Inj5	A27	not used	Not Available in M400
Inj6	A28	not used	Not Available in M400
Inj7	A29	not used	Not Available in M400, M600
Inj8	A30	K03	Knock Module SKM - Knock Window

M400 Pin		Ski-Doo Pin	Function
Ign1	A03	D01	Coil 1 Trigger to IGN4 Module
Ign2	A04	D02	Coil 2 Trigger to IGN4 Module
Ign3	A05	D03	Coil 3 Trigger to IGN4 Module
Ign4	A06	not used	
Ign5	A07	not used	Not Available in M400
Ign6	A08	not used	Not Available in M400
Aux1[1]	A18	L04	Lambda Sensor Heater Control
Aux2[1]	A01	R86	Fuel Pump Relay
Aux3[1]	A23	B16	Relay 2
Aux4[1]	A24	V01	Boost Control Solenoid
Aux5[1]	A31	A36	Idle Stepper Motor
Aux6[1]	A32	A35	used for Idle Stepper Motor
Aux7[1]	A33	A38	used for Idle Stepper Motor
Aux8[1]	A34	A37	used for Idle Stepper Motor
Inputs			
Ref	B01	A05	Ref Sensor (Magnetic)
Sync	B02	A34	Sync Sensor (Hall)
AT1[2]	B03	A07	Air Temperature
AT2[2]	B04	A11	Engine Temperature
AT3[2]	B05	Not Used	
AT4[2]	B06	Not used	
AT5[2]	B07	A06	Oil Pressure Switch
AT6[1]	B19	Not used	
AV1[2]	A14	A24	Throttle Position
AV2[2]	A15	A12	Manifold Pressure Sensor
AV3[2]	A16	Not used	
AV4[2]	A17	Not used	
AV5	A25	not used	

M400 Pin		Ski-Doo Pin	Function
AV6	B20	not used	
AV7	B21	not used	
AV8	B22	not used	
DIG1[1]	B08	Not used	
DIG2[1]	B09	B09	Tip over Switch (option)
DIG3[1]	B10	B07	Reverse Position Switch
DIG4[1]	B11	B21	Stop Switch
La1S	B25	L02	Lambda Sensor
La1P	B26	L08	Lambda Sensor
La2S	B12	K02	Knock Module SKM - Knock Signal
La2P	B13	not used	
Communications			
RS232-TX	B17	S03	Serial line to STC dash adaptor S03
RS232-RX	B18	S02 or G02	Serial line to STC dash adaptor S02, OR GPS Receive Data
CAN-LO	B24	E04	Used only for CAN Comms to PC @1000 kbit/s
CAN-HI	B23	E05	Used only for CAN Comms to PC @1000 kbit/s
0V COMM	B14	E01,S01,G01	0 V for CAN , GPS and STC devices

M400 Pin	Ski-Doo Pin	Function
Additional Ski-Doo Loom Pins		
Unused	A02, A03, A04, A08, A09, A10, A16, A17, A18, A21, A22, A23, A26, A30, A31, A32	

M400 Pin	Ski-Doo Pin	Function
Additional Ski-Doo Loom Pins		
Unused	B03, B04, B05, B06, B08, B10, B12, B13, B14, B15, B18, B20, B22, B23, B24, B25, B30, B33, B34, B35, B36, B37, B40	
Coil 2	A01	Coil2 Drive from IGN4 Module C02
Coil 3	A29	Coil3 Drive from IGN4 Module C03
Coil 1	A41	Coil1 Drive from IGN4 Module C01
ECU Power Relay	B17	Relay Drive - not used as Lanyard controls ECU power
Lanyard	B26	Lanyard Sense - not used as Lanyard controls ECU power
Start Switch	B19	Wired to Relay T
Start Solenoid	B31	Wired from Relay T
Dash CAN Hi	B27	STC CAN to Dash @250 kbit/s S04
Dash CAN Lo	B28	STC CAN to Dash @250 kbit/s S05
DESS Immo	B38	DESS Comms - not used
K-Line	B24	K-Line - not used
FWD REL	A13	Forward Relay Drive (not used)
REV REL	B33	Reverse Relay Drive (not used)

1-3: See Calibration and Wiring Notes

⊗ *Calibration and Wiring Notes*

⊗ *Note 1 – Calibration Functions*

The following pins are calibrated in the *Base Maps* with the function and parameters as mentioned in the table.

M400 Pin		Ski-Doo Pin	Function	Parameters
Aux1	A18	not used	9: Lambda Heater	
Aux2	A01	R85	101: Fuel Pump	Delay 3.0 Polarity 1 Output Mode 1
Aux3	A23	B16	3: Aux Table	PWM/Switched 1 Output Mode 0 Polarity 0 Frequency 10 Minimum Duty Cycle 0 Maximum Duty Cycle 100 Hysteresis 0
Aux4	A24	V01	1:Boost	Frequency 16 Polarity 0 Output Mode 0
Aux5	A31	A36	8: Idle Stepper	Max Step Rate 200 Polarity 0
Aux6	A32	A35	0: Off	
Aux7	A33	A38	0: Off	
Aux8	A34	A37	0: Off	
DIG2	B09	B09	29: Monitor	Polarity 0
DIG3	B10	B07	4: Dual RPM	Logic Polarity 0 Low RPM Limit 4000 RPM Rise Rate 500 Ignition Retard 0.0

M400 Pin		Ski-Doo Pin	Function	Parameters
DIG4	B11	B21	8: Ignition Switch	Logic Polarity 0 Delay 1.0 Latch 0

❺ *Note 2 – Calibration Tables*

For the following pins the calibration table is available in the provided *Base Maps*.

M400 Pin		Ski-Doo Pin	Function
AT1	B03	A07	Air Temperature
AT2	B04	A11	Engine Temperature
AT5	B07	A06	Oil Pressure Switch
AV1	A14	A24	Throttle Position
AV2	A15	A12	Manifold Pressure Sensor

✪ *Note 3 – Speed*

The Ski-Doo vehicles have a speed channel in the Dash which is transmitted to the M400 ECU via the STC device. For accurate speed measurements, MoTeC recommends the use of a GPS system. MoTeC's 5 Hz GPS-L5 (#41305) can be wired directly into the ECU's RS232 receive port.

The existing harness is pre-wired for a GPS device if preferred. However the physical wiring must be changed to suit:

Speed Input mode	M800 pin B18
From Dash (standard)	From connector S02
From GPS (option)	From connector G02

✪ *Output Test Function*

To test if all outputs are correctly wired to the relevant injectors and coils, the ECU Manager software has an output test function available (on the **Utilities** menu, click **Test Outputs**).

For protection of the Ignition coils, the IGN4 ground signal is routed via the Fuel Pump Relay. If you wish to test Ignition coils 1 – 3 in a Ski-Doo installation, the Fuel Relay control pin must be powered, by removing it from the M400 ECU plugs and jumping to +12V.

1. Unplug the M400 ECU connectors.
2. Press the single white tab on the underside of the plug until it clicks   to unlock the pin locking plate from Connector A (white plastic inserts in the plug),
3. Extract pin A01 (white 18AWG) from the rear of the connector using firm pressure.
4. Press the dual white tabs on the top side of the plug until it clicks to lock the pin locking plate,
5. Re-insert the ECU plugs into the M400.
6. When ready to power up the ECU and test the Ignition outputs, jumper the A01 wire to +12V.

Once testing is completed, reverse the above procedure to re-insert the A01 wire into the M400 connector.

Lambda Sensor Installation

⚑ *Yamaha Lambda Sensor*

Suitable sensor mounting position is towards the rear of the exhaust , 2cm to 10cm before the muffler. It is also possible to mount the sensor after the junction of the 2 "Y" exhaust pipes, where they connect to the main single exhaust pipe leading the rear muffler. In any case, mounting a lambda sensor will require minor tunnel cutting to clear the sensor itself and the wiring.

⑤ *Ski-Doo Lambda Sensor (all model years)*

Suitable sensor mounting position is easily found on the main exhaust pipe that connects between exhaust manifold mounted on the cylinder head and the muffler.

Base Maps

These are available from the MoTeC website at *www.motec.com/Snowmobileplugin/basemaps*.

Glossary

MoTeC Devices

ACL	Advanced Central Logger
ADL2	Advanced Dash Logger - second generation
ADL3	Advanced Dash Logger - third generation
BR2	Beacon Receiver
BTX	Beacon Transmitter
CIM	Computer Interface Module
CLS	Central Logging System
DBW4	Drive By Wire expander
E816	Input/Output Expander
E888	Input/Output Expander
i2	MoTeC data analysis software, standard version
i2 Pro	MoTeC data analysis software, professional version
IEX	Ignition Expander
LTC	Lambda to CAN module
LTCD	Lambda to CAN Dual module
M2R	ECU dedicated to run 2 rotor engines
M4	ECU for engines with up to 4 cylinders or up to 2 rotors
M400	ECU for modern engines with up to 4 cylinders or up to 2 rotors
M48	ECU for engines with up to 8 cylinders and 2 rotors
M600	ECU for modern engines with up to 6 cylinders or up to 3 rotors
M800	ECU for modern engines with up to 12 cylinders or up to 4 rotors
M880	ECU for modern engines with up to 12 cylinders or up to 4 rotors
MDC	Mitsubishi Diff Controller
MDD	Mini Digital Display
MLS	ECU dedicated to run Chevrolet LS1 and Lexus/Toyota V8s
PCI cable	PC Interface cable

PDM15	Power Distribution Module with 15 outputs
PDM16	Power Distribution Module with 16 outputs
PDM30	Power Distribution Module with 30 outputs
PDM32	Power Distribution Module with 32 outputs
PLM	Professional Lambda Meter
Plug-In ECU	ECU for direct replacement of a factory ECU
RTC	Real Time Clock
SDC	Subaru Diff Controller
SDL	Sport Dash Logger
SGA	Strain Gauge Amplifier
SLM	Shift Light Module
SUU	Software Update Unit
TCM	Traction Control Module
VIM	Versatile Input Module

Other

Calibration	The process of converting an electrical value into a physical value e.g. Volts into kilometres per hour
CAN	Controller Area Network - communication protocol
CDI	Capacitive Discharge Ignition
ECU	Engine Control Unit
GPS	Global Positioning System
MAF	Mass Air Flow
MAP	Manifold Absolute Pressure
PID	Proportional, Integral and Derivative gain
PWM	Pulse Width Modulated.
RPM	Revolutions Per Minute
RS232	Recommended Standard 232, communication protocol
RX	Receive
TDC	Top Dead Centre
TX	Transmit

How to Get More Information

A good place to start is the website at *www.motec.com*

In the Product area of the website you will find information on engine management, data acquisition and Lambda measurement.

In the Downloads area of the website you will find:

- Manuals including the general M400 ECU Manual.

- Latest software where you can download ***i2 Standard*** data analysis software, or a trial version of the ***i2 Pro*** version.

- Seminar notes from the training seminars MoTeC runs on ECU installation and tuning and ***i2*** data analysis software.