

MoTeC

2020 FORD MUSTANG GT500 SOLUTION



The MoTeC 2020 FORD MUSTANG GT500 solution provides a complete replacement for the factory Ford ECU in the GT500. The MoTeC M150 ECU solution delivers fully programmable engine control to the platform while maintaining stock vehicle systems functionality including integration with the Tremec TR-9070 DCT 7 speed TCM. The M1 ECU is supplied with firmware preloaded that is based on the MoTeC USA Drag package with additional motorsports enhancements and features unique to the 2020 Ford Mustang GT500.

The solution comprises of the M150 ECU, two MoTeC IGN4 ignitors, a MoTeC LTCD and two LSU 4.9 lambda sensors. Currently no wiring is included in the solution. Patch looms require a header to be removed from a factory ECU. Contact your local MoTeC dealer for details.

This package supports the following OE ECU features with user definable parameters:

- Tremec TR-9070 7-Speed TCM integration
- Push button start
- Remote start
- Air conditioner control
- Variable displacement AC compressor control
- Variable speed coolant fan control
- Fuel lift pump control
- Cruise control
- Alternator control
- Differential pump control

- Fully functional fuel level gauge with low fuel warning
- Ghost Cam mode – Provides aggressive idle note with no drivability side effects.
- Fuel Economy VTC settings
- Hill Start Assist
- Immobilizer integration
- Continued function of odometer and trip meter
- Oil life meter
- Datalogging of Tremec TCM CAN channels.

The supplied start file provides a real-world example of calibrating a 2020 Mustang GT500 equipped with an aftermarket twin turbo kit including aftermarket fuel injectors. It also contains all the calibrations and settings for the OEM sensors, ignition coils, throttle servo, cam control, alternator control, AC control, fuel lift pump control and charge cooler pump control. Settings for fuel delivery, ignition timing and camshaft phasing have been calibrated on an OEM vehicle equipped with the twin turbo kit.

A significant amount of time will be saved by the user with this initial setup completed and users can begin tuning to their desired power and modifications right.

Included are many ancillary features commonly found on race vehicles such as anti-lag, rolling launch, driver switches, knock control, intercooler spray-bars, launch control, and traction control.

The product fully integrates with other MoTeC devices, providing pre-defined CAN messaging for all current Displays/Loggers, LTC's, E888, GPS and SLMs.

► SOLUTION CONTENTS (2020 FORD MUSTANG GT500)

• Hardware

- **M150** – M150 ECU
- **M IGN4** – IGN4 (x2)
- **M LTCD** – LTCD LSU 4.9
- **M 0258 001** – LSU 4.9 Sensor (x2)
- **RG.DV.0255.01** – Dual Output Switch

(Customer may opt NTK lambda system at time of purchase)

Licenses

- **23633** – M1 LIC – MOTEC USA FORD MUSTANG

The license is required to run the MoTeC USA Ford Mustang GT500 package in the M150 ECU.

► FEATURES

- Configurable Launch Control with anti-lag containing tables for engine speed, throttle limit, boost aim and closed loop ignition timing control as well as Spool Mode to optimize turbocharger response at the starting line.
- Pre-stage settings for Launch Control.
- Traction Control closed loop system with the ability to control engine torque using ignition timing, fuel cut, ignition cut and drive by wire throttle using a flexible user-configurable strategy.
- Pre-configured OE coolant fan control.
- Pre-configured OE charge cooler pump control.
- Pre-configured OE alternator control.
- Pre-configured OE fuel lift pump control.
- Pre-configured air conditioner control.
- Tremec TR-9070 DCT integration with the factory TCM.
- Pre-configured Drive by Wire throttle servo control.
- Factory Ford drive mode control and integration for Boost Aim, Idle Mode, Engine Overrun Mode, Ghost Cam Activate, Launch Mode, and Throttle Pedal Translation available in the Driver section.
- Configurable driver switches for various systems.
- Factory Gauge override to convert the factory oil life read out to display Flex Fuel Alcohol Content.
- Mode switching via factory cruise control dial using the engine speed read out as the mode indicator.
- Configurable pulsed tachometer output.
- Pre-configured vehicle speed measurement using factory output shaft speed sensor. May be reconfigured to use any sensor including wheel speed readings received from the factory ABS unit.
- Pre-configured warning system that activates the factory MIL indicator on the dash to indicate faults.
- Adjustable fuel economy gauge calibration.
- Differential pump control
- Test settings for injection and ignition outputs
- Exhaust Pressure Based engine efficiency compensation
- Data acquisition of numerous factory sensors off the factory CAN Bus, including TCM data, Longitudinal Acceleration, Lateral Acceleration, Yaw Rate, Steering Angle, Wheel Speeds, Tire Pressures.
- Pre-configured calibrations for Original Equipment sensors.
- Pre-configured reference mode for engine synchronization.
- Pre-configured physical settings for engine displacement, fuel density, stoichiometric ratio, fuel pressure and injector characterization which allows for simplified engine start-up prior to tuning.
- Flex Fuel support utilizing the RaceGrade M FF-394 fuel composition sensor, or equivalent.
- Powerful Efficiency Model with configurable load axis that allows for flexibility in Engine Efficiency mapping for a wide array of modifications from single throttle body with intake plenum to boost over trumpets.
- Pre-configured Engine Efficiency map that allows for quick and easy tuning.
- Secondary Injection (16 injector) capable with expansion devices or rescheduled / reduced outputs
- Pre-configured throttle rate of change based transient fuel for simplified transient fuel tuning.
- Engine Load Average channel with tables for engine speed limit, ignition trim, fuel mixture aim and throttle limit.
- Pre-configured ignition output and coil settings.
- Pre-configured individual cylinder knock system.
- Pre-configured camshaft control of inlet and exhaust cams
- Pre-configured fuel economy settings for camshaft control (VTC Aim Economy).
- Pre-configured engine start fuel, idle and ignition settings.
- Pre-configured Closed Loop Idle control systems using ignition and drive by wire actuation, including active adjustments for coolant and air conditioning activation.
- Boost control system with targets based on Engine Speed, Gear, Fuel Alcohol Content, Throttle Position, Driver Mode Switch, Coolant Temperature, Engine Load Average, Exhaust Temperature, Race Time, Inlet Air Temperature and Vehicle Speed.
- Rolling launch ("rolling anti-lag").
- Auxiliary outputs with generic configurable axes and activation parameters.
- Supports nitrous with four activation stages using a progressive Mass Flow based model with bottle pressure-based compensations.
- Nitrous system triggers for additional fuel pumps and bottle heater control
- Ghost Cam idle mode for aggressive exhaust note
- Configurable turbocharger boost and bypass control
- Intercooler temperature and spray control
- Turbocharger Speed measurement with Inlet/Outlet Temperature using optional sensors
- Wastegate Pressure and Position with optional sensors
- Race time system with tables for ignition trim, fuel mixture aim and throttle limit.

► MoTeC FEATURES

- Engine run time total for engine hour logging
- GPS acquisition and logging via CAN or RS232 with optional equipment
- Support of MoTeC expansion devices: E8XX, SLM.
- ECU CAN Receive from other MoTeC devices.
- ECU CAN Transmit of most common channels using standard MoTeC CAN templates for data logging and display
- Configurable security for multiple users with differing access options.

► OPERATION

Reference Mode

The M1 Reference Mode in this Package is locked to the Ford GEN3 pattern.

ECU Power

The M1 ECU will be powered when the ignition switch is on via the factory ignition switch. The ECU will hold power on key off for a short time to provide a graceful shutdown when M1 Tune is not connected to it.

Engine Start

The Ford Push Button section contains settings to maintain the OEM style engine start control. Integrated with the factory BCM for remote start via the key fob.

Driver Switches

Various in-car dials and switches are acquired over the CAN Bus and assigned to Firmware resources to allow for mode switching in the ECU. See the Help for the main Ford group in M1 Tune.

Spares

Available are CAN1, PH11, PH12, AT06, AV17, UDIG07, and HB08 and can be configured to the users unique needs

Ignition Coils

Ford OEM coils require an ignitor. The solution provides two MoTeC IGN4 units that must be integrated into the conversion wiring. Failure to do so will cause a no-start condition. Improper connection could damage the coil, ECU, or the ignitor.

Dual Bank Lambda Measurement

The solution provides a MoTeC LTCD with two lambda sensors that need to be installed. The LTCD can be mounted at the firewall where both lambda sensor connectors will reach it.

Coolant Fan

The GT500 has a single pulse width modulated coolant fan. The fan is configured to operate with factory functionality. Refer to the help in M1 Tune under Coolant Fans for a more detailed description.

Selectable Source Vehicle Speed

The Ford instrument cluster displayed speed can be derived from any speed data in the M1 ECU. The default setting is to transmit the vehicle speed derived from the output shaft speed.

VTC Aim Economy

This subsystem contains settings to allow you to run camshaft position settings that improve fuel economy at steady state conditions. The package is pre-configured with example settings the user can easily begin experimenting with it.

► OPERATION

Rolling Launch

Designed to assist in building boost for a rolling start, it can be activated when Driver Rolling Launch Switch is On or by holding the Cruise Decel button when Cruise Control is disabled. The system is active once Rolling Launch Activate thresholds are met.

Mode Switching

While mode switching for numerous systems can be done via the Driver Switch system, Boost Aim and Traction Aim have been given special consideration and you can select those modes on the fly via the Cruise Control buttons. This does not interfere with the function of Cruise Control as this type of mode switching is only active when Cruise Control is disabled. Once activated, the tachometer on the gauge cluster indicates the current mode: 1000 rpm is mode 1, 2000 rpm is mode 2 and so on. To change modes for **Traction Aim**, hold the Cruise Cancel button for 2 seconds. The tachometer will jump to the active mode, and you can tap the Cruise Accel and Cruise Decel buttons to change up and down through the modes. No activity for 2 seconds or tapping Cruise Cancel will turn off the mode select. The function of these two special modes can be seen in the help for Driver Traction Control Switch and Driver Boost Aim Switch. If you want to use a normal switch to change modes, the Input can be assigned, causing it to override Cruise Control based mode selection for that option.

Ford Fuel Pump Control

Integration and control of the factory fuel pump controller is provided with base settings. This system can be run in open loop, however installation of a fuel pressure sensor at the rail is recommended to provide a differential pressure reading for the fuel model and closed loop pressure control.

LTCD

CAN High/Low as well as power and ground are needed for the LTCD connection. The installer will need to make a small interconnection loom between the spares connector and the LTCD for it to be deployed. CAN termination rules must be followed. This allows for flexibility in mounting and location of the LTCD in the engine bay. Lambda sensors must be installed after any turbocharger or other exhaust restrictive devices to ensure accurate information.

Differential Pump

The factory differential pump is configured in the Ford Differential Pump section. Base settings are provided.

Exhaust Modes

Fully integrated with the active valve exhaust that the GT500 is equipped with. Factory settings are mimicked in the Ford Exhaust Valves section.

► OPERATION

Air Conditioner

The MoTeC ECU will drive the variable displacement AC compressor on the GT500. Base settings are provided. Refer to Air Conditioner Displacement in M1 Tune for more information.

Launch Control

The MoTeC launch system is integrated with the Tremec TR9070 TCM that controls the dual clutch shifting operation on the GT500. The TCM has indicators when it will allow the vehicle to enter Launch mode, and this is recognized by the MoTeC ECU. Example settings for launching a twin turbo equipped GT500 are provided. See the Launch section for more information.

Water-To-Air Charge Cooler Pump

The GT500 is equipped with a water-to-air cooling system with a pulse width modulated charge cooler pump. Base settings are configured in the Intercooler Pump section.

Inlet Air Temperature Sensors

The GT500 has an inlet air temperature sensor in the intake pipe as well as a charge temperature sensor in the intake manifold. The charge temp sensor is assigned to the 'Inlet Air Temperature' input in M1 Tune and the inlet temperature sensor is assigned to 'Airbox Temperature'. This is intentional.

Torque Model

The ECU provides a torque model the user can tune to interface with the Tremec TR-9070 TCM. The tuning provided in the base file can be used as a reference and adjusted as required by the user. It has been tuned for an 1100whp twin turbo car.

Gear Shift

The gear shift group contains tuning and settings for manipulating the torque reduction the TCM will request on upshifts as well as engine speed matching on downshifts.

► M150 PINOUT

M150 Connector A – 34 Way

A1	AT5	Analogue Temperature Input 5	-
A2	AT6	Analogue Temperature Input 6	SPARES DTM12-6
A3	AV15	Analogue Voltage Input 15	MAP
A4	AV16	Analogue Voltage Input 16	CACCT
A5	AV17	Analogue Voltage Input 17	SPARES DTM12-7
A6	IGN9	Low Side Ignition 9	ALT CONTROL
A7	IGN10	Low Side Ignition 10	PARK SWITCH
A8	IGN11	Low Side Ignition 11	EVC RIGHT
A9	IGN12	Low Side Ignition 12	EVC LEFT
A10	SEN_5V0_C	Sensor 5.0V C	SPARES DTM12-10
A11	LA_NB1	Lambda Narrow Input 1	-
A12	LA_NB2	Lambda Narrow Input 2	-
A13	KNOCK3	Knock Input 3	KNOCK SENSOR 1 BANK 2
A14	KNOCK4	Knock Input 4	KNOCK SENSOR 2 BANK 2
A15	DIG2	Digital Input 2	THROTTLE POSITION
A16	DIG3	Digital Input 3	BPS
A17	DIG4	Digital Input 4	BPP
A18	SEN_5V0_C	Sensor 5.0V C	-
A19	SEN_5V0_B	Sensor 5.0V B	OEM 5V B
A20	LIN	LIN Bus	-
A21	RS232_RX	RS232 Receive	-
A22	RS232_TX	RS232 Transmit	-
A23	DIG1	Digital Input 1	OIL LEVEL SWITCH
A24	BAT_NEG	Battery Negative	Ground
A25	BAT_NEG	Battery Negative	Ground
A26	SEN_0V_C	Sensor 0V C	SPARES DTM12-2
A27	SEN_0V_C	Sensor 0V C	-
A28	CAN3_HI	CAN Bus 3 High	TCM CAN HIGH
A29	CAN3_LO	CAN Bus 3 Low	TCM CAN LOW
A30	CAN2_HI	CAN Bus 2 High	OEM CAN HIGH
A31	CAN2_LO	CAN Bus 2 Low	OEM CAN LOW
A32	BAT_NEG	Battery Negative	Ground
A33	SEN_0V_B	Sensor 0V B	OEM 0V B
A34	SEN_0V_A	Sensor 0V A	OEM 0V A

► M150 PINOUT

M150 Connector B – 26 Way

B1	HB9	Half Bridge Output 9	AC COMPRESSOR
B2	HB10	Half Bridge Output 10	FUEL PUMP RELAY +
B3	UDIG8	Universal Digital Input 8	EVM LEFT
B4	UDIG9	Universal Digital Input 9	EVM RIGHT
B5	UDIG10	Universal Digital Input 10	FPM 2
B6	UDIG11	Universal Digital Input 11	FPM
B7	UDIG12	Universal Digital Input 12	START
B8	INJ_LS5	Low Side Injector 5	FUEL PUMP CONTROL
B9	INJ_LS3	Low Side Injector 3	COOLANT FAN CONTROL
B10	AV9	Analogue Voltage Input 9	ECT
B11	AV10	Analogue Voltage Input 10	TCIP
B12	AV11	Analogue Voltage Input 11	OIL PRESSURE
B13	BAT_POS	Battery Positive	BATTERY POSITIVE
B14	INJ_LS6	Low Side Injector 6	FUEL PUMP RELAY -
B15	INJ_LS4	Low Side Injector 4	AC RELAY
B16	AV12	Analogue Voltage Input 12	BATTERY MONITOR
B17	AV13	Analogue Voltage Input 13	FUEL PRESSURE
B18	AV14	Analogue Voltage Input 14	CRANKCASE PRESSURE
B19	BAT_POS	Battery Positive	BATTERY POSITIVE
B20	HB7	Half Bridge Output 7	STARTER RELAY +
B21	HB8	Half Bridge Output 8	SPARES DTM12-11
B22	PH9	Peak Hold Injector 9	PCM POWER RELAY
B23	PH10	Peak Hold Injector 10	STARTER RELAY -
B24	PH11	Peak Hold Injector 11	SPARES DTM 12-4
B25	PH1	Peak Hold Injector 12	SPARES DTM12-5
B26	SEN_5V_A	Sensor 5.0V A	OEM 5V A

► M150 PINOUT

M150 Connector C – 34 Way

C1	HB2	Half Bridge Output 2	THROTTLE SERVO +
C2	SEN_5V_A	Sensor 5.0V A	OEM 5V A
C3	IGN1	Low Side Ignition 1	COIL 1
C4	IGN2	Low Side Ignition 2	COIL 2
C5	IGN3	Low Side Ignition 3	COIL 3
C6	IGN4	Low Side Ignition 4	COIL 4
C7	IGN5	Low Side Ignition 5	COIL 5
C8	IGN6	Low Side Ignition 6	COIL 6
C9	SEN_5V_B	Sensor 5.0V B	OEM 5V B
C10	NEG1	Battery Negative	Ground
C11	NEG2	Battery Negative	Ground
C12	IGN7	Low Side Ignition 7	COIL 7
C13	IGN8	Low Side Ignition 8	COIL 8
C14	AV1	Analogue Voltage Input 1	THROTTLE PEDAL 1
C15	AV2	Analogue Voltage Input 2	THROTTLE PEDAL 2
C16	AV3	Analogue Voltage Input 3	AC PRESSURE
C17	AV4	Analogue Voltage Input 4	AMBIENT TEMP
C18	HB1	Half Bridge Output 1	THROTTLE SERVO -
C19	PH1	Peak Hold Injector 1	INJECTOR 1
C20	PH2	Peak Hold Injector 2	INJECTOR 2
C21	PH3	Peak Hold Injector 3	INJECTOR 3
C22	PH4	Peak Hold Injector 4	INJECTOR 4
C23	INJ_LS1	Low Side Injector 1	DIFF PUMP CONTROL
C24	INJ_LS2	Low Side Injector 2	CHARGE COOLER CONTROL
C25	AV5	Analogue Voltage Input 5	CHT
C26	BAT_POS	Battery Positive	Battery Positive
C27	PH5	Peak Hold Injector 5	INJECTOR 5
C28	PH6	Peak Hold Injector 6	INJECTOR 6
C29	PH7	Peak Hold Injector 7	INJECTOR 7
C30	PH8	Peak Hold Injector 8	INJECTOR 8
C31	HB3	Half Bridge Output 3	BANK 1 INTAKE CAM CONTROL
C32	HB4	Half Bridge Output 4	BANK 1 EXHAUST CAM CONTROL
C33	HB5	Half Bridge Output 5	BANK 2 INTAKE CAM CONTROL
C34	HB6	Half Bridge Output 6	BANK 2 EXHAUST CAM CONTROL

► M150 PINOUT

M150 Connector D – 26 Way

D1	UDIG1	Universal Digital Input 1	CRANKSHAFT POSITION
D2	UDIG2	Universal Digital Input 2	INTAKE CAMSHAFT BANK 1 POS
D3	AT1	Analogue Temperature Input 1	CHARGE AIR TEMP
D4	AT2	Analogue Temperature Input 2	FUEL RAIL TEMP
D5	AT3	Analogue Temperature Input 3	INLET AIR TEMP
D6	AT4	Analogue Temperature Input 4	-
D7	KNOCK1	Knock Input 1	KNOCK SENSOR 1 BANK 1
D8	UDIG3	Universal Digital Input 3	EXHAUST CAMSHAFT BANK 1 POS
D9	UDIG4	Universal Digital Input 4	INTAKE CAMSHAFT BANK 2 POS
D10	UDIG5	Universal Digital Input 5	EXHAUST CAMSHAFT BANK 2 POS
D11	UDIG6	Universal Digital Input 6	ISPR
D12	BAT_BAK	Battery Backup	-
D13	KNOCK2	Knock Input 2	KNOCK SENSOR 2 BANK 1
D14	UDIG7	Universal Digital Input 7	SPARES DTM12-8
D15	SEN_0V_A	Sensor 0V A	OEM 0V A
D16	SEN_0V_B	Sensor 0V B	OEM 0V B
D17	CAN_HI	CAN Bus 1 High	SPARES/LTC CAN HIGH
D18	CAN_LO	CAN Bus 1 Low	SPARES/LTC CAN LOW
D19	SEN_6V3	Sensor 6.3V	-
D20	AV6	Analogue Voltage Input 6	DIFFERENTIAL TEMP
D21	AV7	Analogue Voltage Input 7	-
D22	AV8	Analogue Voltage Input 8	-
D23	ETH_TX+	Ethernet Transmit+	WHITE/ORANGE
D24	ETH_TX-	Ethernet Transmit-	ORANGE
D25	ETH_RX+	Ethernet Receive+	WHITE/GREEN
D26	ETH_RX-	Ethernet Receive-	GREEN

► M150 PINOUT

DTM-12S from M150 (RECOMMENDED SPARES CONNECTOR ASSIGNMENTS)

Pin	Function
1	Spares Ground
2	Spares 0 Volt 'C' Supply
3	Spares CAN1 Low
4	Spares PH11
5	Spares PH12
6	Spares AT06
7	Spares AV17
8	Spares UDIG 07
9	Spares CAN1 High
10	Spares 5 Volt 'C' Supply
11	Spares HB8
12	Spares Switched 12v Power

DTM-6S for IGN4 BANK 1 OUTPUTS TO COILS

Pin	Function
1	CYLINDER 1 IGNITION COIL
2	CYLINDER 2 IGNITION COIL
3	CYLINDER 3 IGNITION COIL
4	CYLINDER 4 IGNITION COIL
5	IGN4 BANK 1 GROUND
6	IGN4 BANK 1 GROUND

DTM-4S for IGN4 BANK 1 INPUTS FROM ECU

Pin	Function
1	CYLINDER 1 IGNITION COIL (IGN LS1)
2	CYLINDER 2 IGNITION COIL (IGN LS2)
3	CYLINDER 3 IGNITION COIL (IGN LS3)
4	CYLINDER 4 IGNITION COIL (IGN LS4)

DTM-6S IGN4 BANK 2 OUTPUTS TO COILS

Pin	Function
1	CYLINDER 5 IGNITION COIL
2	CYLINDER 6 IGNITION COIL
3	CYLINDER 7 IGNITION COIL
4	CYLINDER 8 IGNITION COIL
5	IGN4 BANK 2 GROUND
6	IGN4 BANK 2 GROUND

DTM-4S IGN4 BANK 2 INPUTS FROM ECU

Pin	Function
1	CYLINDER 5 IGNITION COIL (IGN LS5)
2	CYLINDER 6 IGNITION COIL (IGN LS6)
3	CYLINDER 7 IGNITION COIL (IGN LS7)
4	CYLINDER 7 IGNITION COIL (IGN LS8)

DTM-4S LTCD

Pin	Function
1	GROUND
2	CAN1 LOW
3	CAN1 HIGH
4	POWER

DTM-4S RG 2CH SW

Pin	Function
1	GROUND
2	PCM POWER RELAY
3	ISPR
4	WAKE UP