Nissan GT-R R35 Plug-in

USER
MANUAL
Rev 1.0

GT-R R35

1.0 Introduction

The Nissan R35 GT-R's turbo control system and monitoring is different than many turbocharged cars. Commonly turbocharged engines have a common plenum that feeds all the engines cylinders. Each cylinder draws air from a common plenum. On the Nissan R35 GT-R one bank feeds one set of three cylinders(1-3) and the other turbo feeds the other three cylinders (4-6) via separated plenums. There is also a cross over balance pipe between the plenums.

To correctly calculate the fuelling requirements for each bank the ECU uses MAF Meter 1 (Bank 1) to control the fuelling on Cylinders 1-3 and MAF Meter 2 (Bank 2) to control the fuelling on Cylinders 4-6. There are also boost pressure sensors on each bank along with a single manifold pressure sensor on one bank. These pressure sensors allow for various calculations to be made by the ECU, offering a number methods to use for fuel calculations.

The Emtron R35 GT-R Plugin ECU is a replacement engine management system designed to be installed and integrate seamlessly with the vehicle, whilst also allowing extreme flexibility and control from the KV12 based ECU platform.

Some of the main requirements for the ECU that will be explained in more detail later are:

- Accurate air mass modelling which is extremely important to allow for various systems on the vehicle to function correctly.

- Nissan Transmission Control Module Integration (TCM) - The ECU must accurately calculate and perform torque requests assigned by the TCM for the drivetrain to function correctly and smoothly for all driving conditions. Limitations on the transmission torque capacity must also be considered and hence another reason why the torque supplied by the engine must be accurately metered.

- Launch Control – The TCM provides the ECU torque requests during a launch OFF mode and is able to place the ECU into launch mode where the Torque Limit is not requested, allowing the ECU to increase the launch limit through a raised engine speed limit and an ECU determined torque limit.

- Downshift Rev Matching - The ECU must accurately calculate and increase torque to smoothly match the engine RPM in the next gear on downshift. This is done by increasing the throttle mass flow (TMF) during the downshift event until the TCM is satisfied with the engine speed and torque levels.

- Nissan Vehicle Dynamic Control (VDC) – This system employs an extremely complex system of vehicle sensors including wheel speed, steering angle, g-force and yaw which are used to generate various torque requests which the ECU must abide by accurately. This will not only achieve maximum vehicle performance, it is also a safety feature.

1.1 Guide

This manual does not cover ECU installation. A slideshow demonstrating the installation steps is available online at www.emtron.world

2.0 Plugin Features

General

- KV12 ECU based platform.
  - Dual 100MHz Processors
  - 32MB ECU logging Memory
    - Over 1000 channels available
    - 1Hz to 500Hz logging rate
  - Emtune Software for tuning and data analysis
  - Dual Knock Control using digital filtering with Bosch technology

- 6061 Grade Aluminium CNC Billet Enclosure
- Fully compatible with all OEM systems and user programmable This includes:
  - Vehicle Dynamic Control (VDC) using throttle torque reduction
  - Transmission (TCM) Torque and Shift Management
  - Torque Management Launch Control
- Compatible with all Emtron Proven Motorsport features
- Sequential Staged option available through OEM header
- Upgradeable to run the Emtron Fuel model through installation of a Flex Meter, Fuel Temperature and Fuel Pressure Sensor
- Input Expansion Capabilities through DTM connector
  - 2x User Analog Volt Inputs (Fuel Temperature and Pressure)
  - 1x User Digital Input (Flex Meter Input)

Communications

- CAN 2.0B Node 1: User CAN Bus for I/O expansion(Lambda, EGT)
- CAN 2.0B Node 2: 500k Baud Full CAN Bus OEM Integration
- High Speed Ethernet 100Mbps

Operating Temperature

- Operating Temperature Range: -30 to 125°C (-22 to 257°F)

Physical

- Enclosure Size 160 mm x 162 mm x 38 mm
- 890g

3.0 Kit Contents

When purchasing a Nissan R35 plug-in the following items are included:

- GTR R35 Plug-in ECU
- Ethernet Communications Cable
- 12 way DTM to ELC Adapter Loom(120 Ohm CAN Termination resistors preinstalled)
- ELC2 Dual Channel Lambda to CAN controller – LSU4.9 version
- 2 x LSU4.9 Lambda Sensors
- 2 x LSU4.9 Sensor Extension Loom
- ECU Mounting Kit

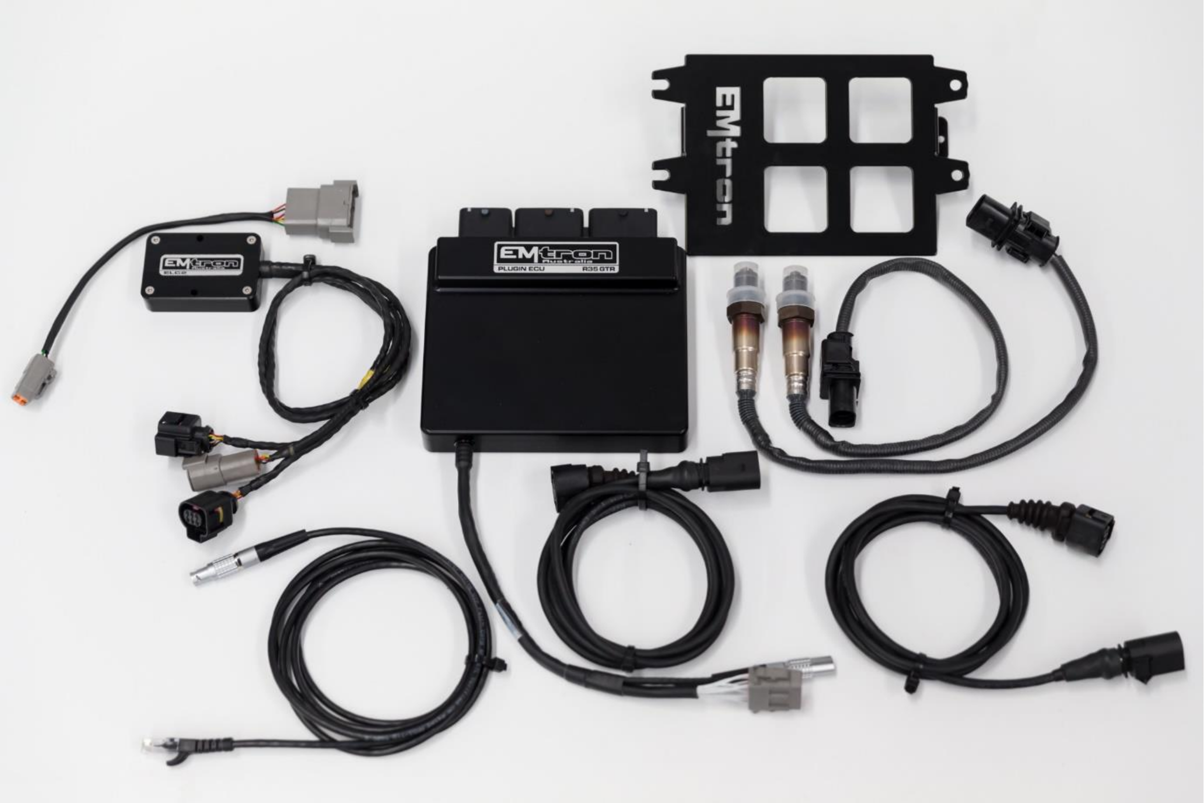


Figure 3.0

3.1 Expansion Loom

The ECU's Input capabilities can be expanded using the expansion connection which is a male DTM 12 Way. See Table 3.0 and Figure 3.1

These additional inputs can be connected to any sensor, but the recommended sensors are indicated in brackets.

Pin Number	Function
1	Analog Sensor 0V Reference
2	5V Aux Supply
3	AN 10 (e.g. Fuel Temp or Inlet Temp)
4	Not Used
5	AN 6 (e.g. Fuel Pressure)
6	DI 6 (e.g. Ethanol Content Sensor)
7	14V Out Protected (ELC2 Power Supply)
8	Ground (ELC2 Ground)
9	14V Out Protected (ELC2 Power Supply)
10	Ground (ELC2 Ground)
11	CAN 1 Hi
12	CAN 1 Lo

Table 3.0 - Expansion Port Pin out

To minimise signal contamination and maximise noise immunity, it is recommended to twist the CAN wire pairs at a minimum one twist per 40mm of cable:

Pair 1		Pair 2
CAN High	<------->	CAN Low

Figure 3.1 - DTM 12 Way (ECU Side)

4.0 ECU Channel Assignment

ECU Channel - Injection	Function
Injection Channel 1	Fuel Injector Cylinder 1
Injection Channel 2	Fuel Injector Cylinder 2
Injection Channel 3	Fuel Injector Cylinder 3
Injection Channel 4	Fuel Injector Cylinder 4
Injection Channel 5	Fuel Injector Cylinder 5
Injection Channel 6	Fuel Injector Cylinder 6
Injection Channel 7	Fuel Injector Cylinder 7
Injection Channel 8	Fuel Injector Cylinder 8
Injection Channel 9	Fuel Injector Cylinder 9
Injection Channel 10	Fuel Injector Cylinder 10
Injection Channel 11	Fuel Injector Cylinder 11
Injection Channel 12	Fuel Injector Cylinder 12

ECU Channel - Ignition	Function
Ignition Channel 1	Ignition Cylinder 1
Ignition Channel 2	Ignition Cylinder 2
Ignition Channel 3	Ignition Cylinder 3
Ignition Channel 4	Ignition Cylinder 4
Ignition Channel 5	Ignition Cylinder 5
Ignition Channel 6	Ignition Cylinder 6
Ignition Channel 7	DBW Relay
Ignition Channel 8	Spare
Ignition Channel 9	Not Used
Ignition Channel 10	Not Used
Ignition Channel 11	Not Used
Injection Channel 12	Not Used

ECU Channel - Analog Inputs	Function
Analog Voltage 1	MAP
Analog Voltage 2	DBW Servo Position Main Bank 1
Analog Voltage 3	DBW Servo Position Sub Bank 1
Analog Voltage 4	DBW Servo Position Main Bank 2
Analog Voltage 5	DBW Servo Position Sub Bank 2
Analog Voltage 6	Fuel Pressure
Analog Voltage 7 (Pull-up Channel)	Engine Temperature
Analog Voltage 8 (Pull-up Channel)	Airbox Temperature
Analog Voltage 9 (Pull-up Channel)	Engine Oil Temperature
Analog Voltage 10 (Pull-up Channel)	IO Expansion loom (Emtron Fuel Temp/IAT)
Analog Voltage 11 (Pull-up Channel)	Pedal Position Sensor (PPS) Main
Analog Voltage 12 (Pull-up Channel)	Pedal Position Sensor (PPS) Sub
Analog Voltage 13	MAF Bank 1
Analog Voltage 14	MAF Bank 2

NOTE: Analog Voltage Channels 7-12 have switchable pull-ups which are suitable for temperature measurement.

ECU Channel - Digital Inputs	Function
Digital Input 1	Cam Position - Inlet RH
Digital Input 2	Brake Switch
Digital Input 3	Neutral Switch
Digital Input 4	Fuel Level
Digital Input 5	Steering Wheel Button
Digital Input 6	IO Expansion Loom (Ethanol Sensor)
Digital Input 7	FP Feedback Sec Pump
Digital Input 8	FP Feedback Prim Pump
Digital Input 9	Power Steering Pressure
Digital Input 10	Evap System Pressure
Digital Input 11	Secondary Air MAF Sensor
Digital Input 12	Boost Pressure Bank 1
Digital Input 13	Boost Pressure Bank 2
Digital Input 14	AC System Pressure

ECU Channel - Auxiliary Outputs	Function
Auxiliary 1	VVT Solenoid Bank 1
Auxiliary 2	VVT Solenoid Bank 2
Auxiliary 3	Purge
Auxiliary 4	Wastegate Solenoid
Auxiliary 5	Sub Fuel Pump
Auxiliary 6	Purge Vent
Auxiliary 7	Fuel Pump Speed Control
Auxiliary 8	Tacho
Auxiliary 9	DBW + Bank 1
Auxiliary 10	DBW – Bank 1
Auxiliary 11	DBW + Bank 2
Auxiliary 12	DBW + Bank 2
Auxiliary 13	Air Pump Relay
Auxiliary 14	Air Cut Solenoid Relay Control (Bank 1 & 2)
Auxiliary 15	Narrow Band Sensor Heater
Auxiliary 16	Not Used

ECU Channel - Crank/Cam	Function
Crank Index	Crank Sensor
Sync Sensor	Cam Position - Inlet Bank 1 (LH)

5.0 Plug-in Specific Information

5.1 Staged Injection.

Injector channels 7 -12 are available in the OEM header and can be used for additional outputs or for Sequential Staged Injection. The locations of these channels are shown in Figure 5.0.

Injector Channel 7 = A11
Injector Channel 8 = A12
Injector Channel 9 = A16
Injector Channel 10 = A35
Injector Channel 11 = A39
Injector Channel 12 = A43

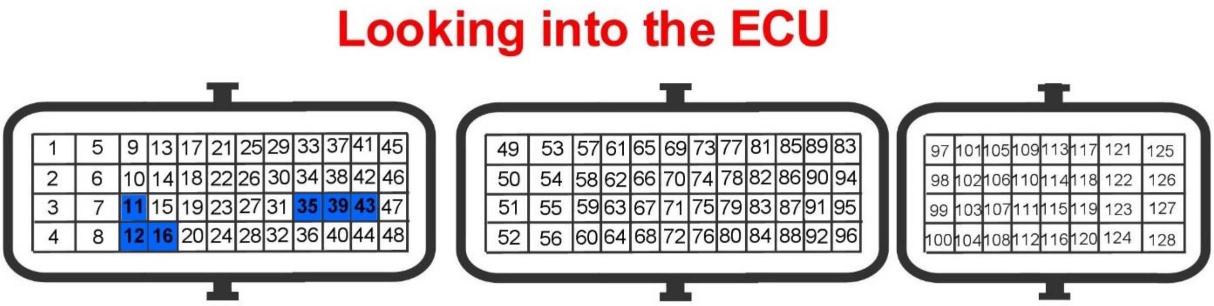
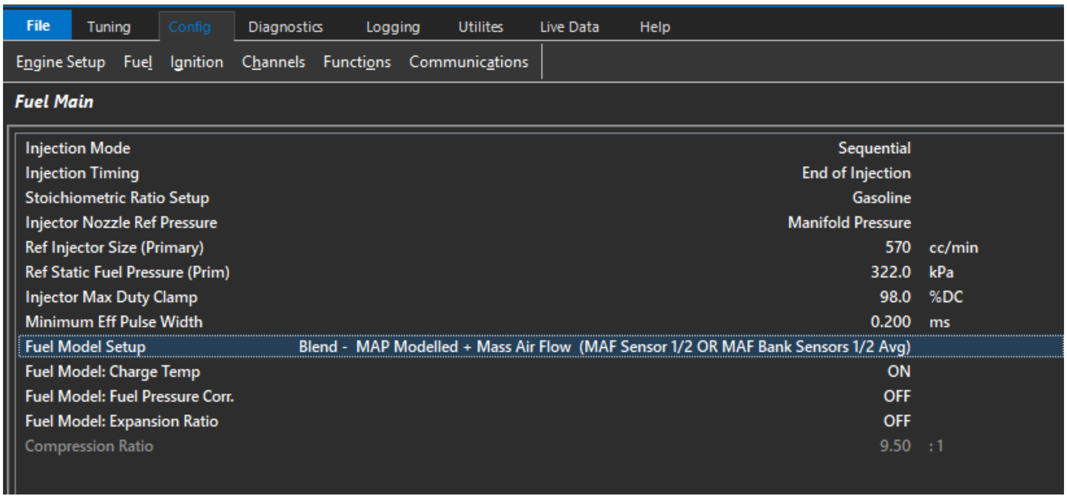


Figure 5.0. ECU Connector

5.2 Fuel Model

The ECU can use many combinations of methods to generate the fuel mass output . The ECU base calibration is supplied with a Blend method of MAP Modelled (MAP Sensor and MAP Estimate) and Mass Air Flow (MAF Sensor) as shown in Figure 5.1. A fully adjustable combination of Throttle Pressure Ratio and Air Mass is used to balance the priority of the two inputs in this example. There are many other fuel modelling methods possible to achieve an excellent result, including the ability to remove the Mass Air Flow Sensors completely. This is a very common implementation where the OEM sensors are simply not allowing for enough flow or when the engine modifications generate intolerable flow measurements from the sensor. Commonly modified camshafts, aftermarket air bypass valves, larger turbochargers and modified intake piping will tend to create unstable Mass Flow Sensor readings. In this case a combination of MAP sensor and Throttle Mass Flow Calculations has proven to achieve more consistent results on modified engines.



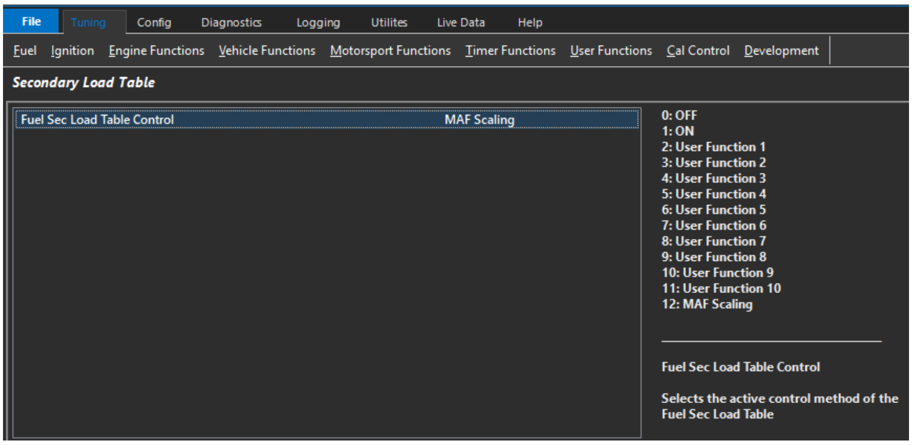
Fuel Main

Injection Mode	Sequential	
Injection Timing	End of Injection	
Stoichiometric Ratio Setup	Gasoline	
Injector Nozzle Ref Pressure	Manifold Pressure	
Ref Injector Size (Primary)	570	cc/min
Ref Static Fuel Pressure (Prim)	322.0	kPa
Injector Max Duty Clamp	98.0	%DC
Minimum Eff Pulse Width	0.200	ms
Fuel Model Setup	Blend - MAP Modelled + Mass Air Flow (MAF Sensor 1/2 OR MAF Bank Sensors 1/2 Avg)	
Fuel Model: Charge Temp	ON	
Fuel Model: Fuel Pressure Corr.	OFF	
Fuel Model: Expansion Ratio	OFF	
Compression Ratio	9.50	:1

Figure 5.1. Fuel Model Setup

Press F1 when you have this setting selected for more detailed help on each Fuel Model.

When MAF is selected the Secondary Load table can be used to scale the MAF if required. The factory calibration should provide good initial air mass calculations but it will be common to modify the intake and therefore this will require re calibration of the MAF meters. This table will need to be switched ON. To do this select Fuel Menu-> Fuel Table Control -> Secondary Load Table. Set to a value of 12 as shown in Figure 5.2.



Secondary Load Table

Fuel Sec Load Table Control MAF Scaling

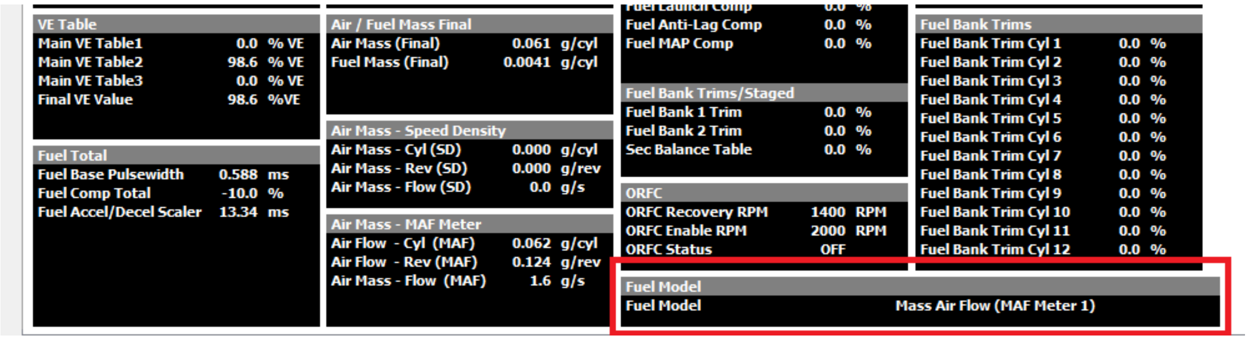
0: OFF
1: ON
2: User Function 1
3: User Function 2
4: User Function 3
5: User Function 4
6: User Function 5
7: User Function 6
8: User Function 7
9: User Function 8
10: User Function 9
11: User Function 10
12: MAF Scaling

Fuel Sec Load Table Control

Selects the active control method of the Fuel Sec Load Table

Figure 5.2. Secondary Load Table - MAF Scaling

There is also a runtime in the F3 Menu -> Fuel Tab showing the current Fuel Model the ECU is running in.



VE Table		
Main VE Table1	0.0	% VE
Main VE Table2	98.6	% VE
Main VE Table3	0.0	% VE
Final VE Value	98.6	%VE

Fuel Total		
Fuel Base Pulsewidth	0.588	ms
Fuel Comp Total	-10.0	%
Fuel Accel/Decel Scaler	13.34	ms

Air / Fuel Mass Final		
Air Mass (Final)	0.061	g/cyl
Fuel Mass (Final)	0.0041	g/cyl

Air Mass - Speed Density		
Air Mass - Cyl (SD)	0.000	g/cyl
Air Mass - Rev (SD)	0.000	g/rev
Air Mass - Flow (SD)	0.0	g/s

Air Mass - MAF Meter		
Air Flow - Cyl (MAF)	0.062	g/cyl
Air Flow - Rev (MAF)	0.124	g/rev
Air Mass - Flow (MAF)	1.6	g/s

Fuel Anti-Lag Comp	0.0	%
Fuel MAP Comp	0.0	%

Fuel Bank Trims/Staged		
Fuel Bank 1 Trim	0.0	%
Fuel Bank 2 Trim	0.0	%
Sec Balance Table	0.0	%

ORFC		
ORFC Recovery RPM	1400	RPM
ORFC Enable RPM	2000	RPM
ORFC Status	OFF	

Fuel Bank Trims		
Fuel Bank Trim Cyl 1	0.0	%
Fuel Bank Trim Cyl 2	0.0	%
Fuel Bank Trim Cyl 3	0.0	%
Fuel Bank Trim Cyl 4	0.0	%
Fuel Bank Trim Cyl 5	0.0	%
Fuel Bank Trim Cyl 6	0.0	%
Fuel Bank Trim Cyl 7	0.0	%
Fuel Bank Trim Cyl 8	0.0	%
Fuel Bank Trim Cyl 9	0.0	%
Fuel Bank Trim Cyl 10	0.0	%
Fuel Bank Trim Cyl 11	0.0	%
Fuel Bank Trim Cyl 12	0.0	%

Fuel Model	
Fuel Model	Mass Air Flow (MAF Meter 1)

Figure 5.3. Fuel Model Runtime

5.3 Inlet Air Temperature

A factory fitted Inlet Temperature Sensor is fitted. This is available on Analog Input 8 and should already be configured in the base calibration shipped with the ECU.

5.4 Check Engine Light

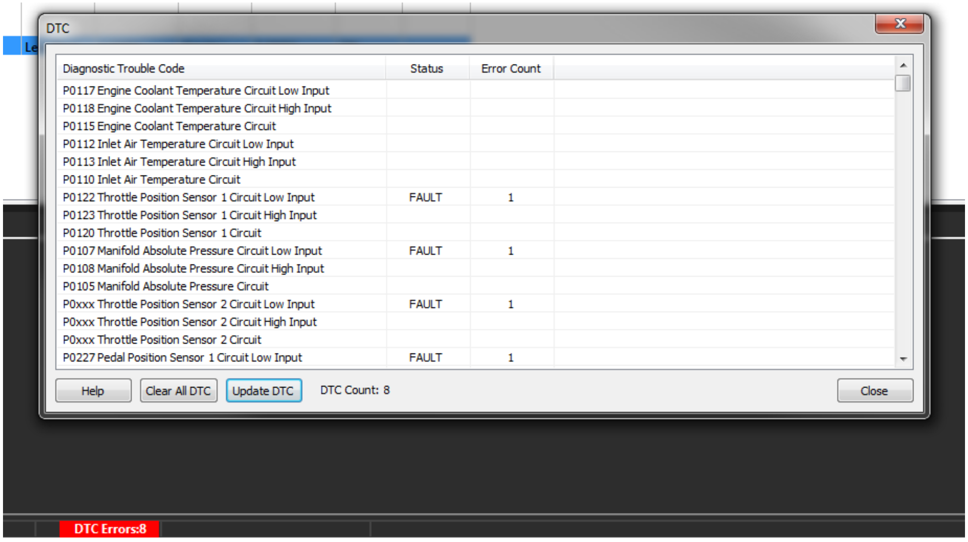
The control of this light is done through the CAN bus. The base calibration file has the output already configured and selected to “CAN Bus OEM”.

5.5 Air-Con Switch

The Air-Con Switch status is read through the CAN bus. The base calibration file has the Input Source selected to “CAN Bus OEM”.

6.0 Diagnostic Trouble Codes (DTCs)

On initial installation it is advised to clear all the DTC's if error(s) are reported. To check: connect to Emtune and look at the DTC status in the bottom toolbar. If there are Errors the status box will be Red as shown in Figure 6.0.

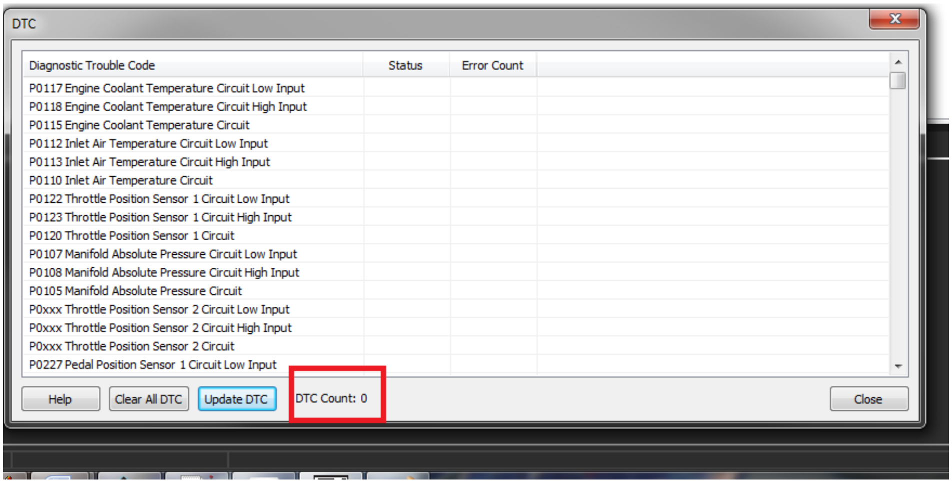


Diagnostic Trouble Code	Status	Error Count
P0117 Engine Coolant Temperature Circuit Low Input		
P0118 Engine Coolant Temperature Circuit High Input		
P0115 Engine Coolant Temperature Circuit		
P0112 Inlet Air Temperature Circuit Low Input		
P0113 Inlet Air Temperature Circuit High Input		
P0110 Inlet Air Temperature Circuit		
P0122 Throttle Position Sensor 1 Circuit Low Input	FAULT	1
P0123 Throttle Position Sensor 1 Circuit High Input		
P0120 Throttle Position Sensor 1 Circuit		
P0107 Manifold Absolute Pressure Circuit Low Input	FAULT	1
P0108 Manifold Absolute Pressure Circuit High Input		
P0105 Manifold Absolute Pressure Circuit		
P0xxx Throttle Position Sensor 2 Circuit Low Input	FAULT	1
P0xxx Throttle Position Sensor 2 Circuit High Input		
P0xxx Throttle Position Sensor 2 Circuit		
P0227 Pedal Position Sensor 1 Circuit Low Input	FAULT	1

DTC Count: 8

Figure 6.0. DTC example showing 8 errors.

To open the DTC window, click on the DTC Status box in the bottom toolbar OR use the File menu -> Open DTC. Next select "Clear ALL DTCs" and confirm all the Error Codes have been removed; the DTC Status box should go Green indicating this as shown in Figure 6.1. Close the DTC window.



Diagnostic Trouble Code	Status	Error Count
P0117 Engine Coolant Temperature Circuit Low Input		
P0118 Engine Coolant Temperature Circuit High Input		
P0115 Engine Coolant Temperature Circuit		
P0112 Inlet Air Temperature Circuit Low Input		
P0113 Inlet Air Temperature Circuit High Input		
P0110 Inlet Air Temperature Circuit		
P0122 Throttle Position Sensor 1 Circuit Low Input		
P0123 Throttle Position Sensor 1 Circuit High Input		
P0120 Throttle Position Sensor 1 Circuit		
P0107 Manifold Absolute Pressure Circuit Low Input		
P0108 Manifold Absolute Pressure Circuit High Input		
P0105 Manifold Absolute Pressure Circuit		
P0xxx Throttle Position Sensor 2 Circuit Low Input		
P0xxx Throttle Position Sensor 2 Circuit High Input		
P0xxx Throttle Position Sensor 2 Circuit		
P0227 Pedal Position Sensor 1 Circuit Low Input		

DTC Count: 0

Figure 6.1. DTC example showing no errors.

If the Error Codes have not all been removed, select "Update DTC" then use the DTC window to locate the sensor that is on fault.

7.0 User CAN Bus 1

The ECU CAN Bus 1 is available for Input/Output expansion allowing a wide range of Emtron CAN devices to be connected into the CAN Bus. This includes the following CAN Modules:

- ELC1/2 (Emtron Lambda to CAN 1/2 channel)
- ETC4/ETC8M (Emtron Thermocouple to CAN 4/8 channels)
- EIC10/EIC16M (Emtron Input to CAN 10/16 Channel)

7.1 Emtron Lambda to CAN

The ELC uses Bosch proven integrated circuit technology to precisely control an LSU4.9 Lambda sensor. The Lambda value is transmitted over the CAN Bus and can be used by the ECU for Tuning and Closed Loop control. More information is available by looking at the Emtron ELC User Manual.

The ELC Power, Ground and CAN wires can be directly connected into the ECU IO Expansion Loom using the supplied 12 way DTM to ELC Adapter Loom. This loom has the 120 Ohm CAN Terminations resistors preinstalled. Pinout information is shown Table 7.0.

Name	ELC 4-Way DTM	ECU IO Expansion 12-Way DTM
Ground	Pin 1	Pin 8
CAN Lo	Pin 2	Pin 12
CAN Hi	Pin 3	Pin 11
Power	Pin 4	Pin 7

Table 7.0 – ELC2 to IO Expansion Port wiring

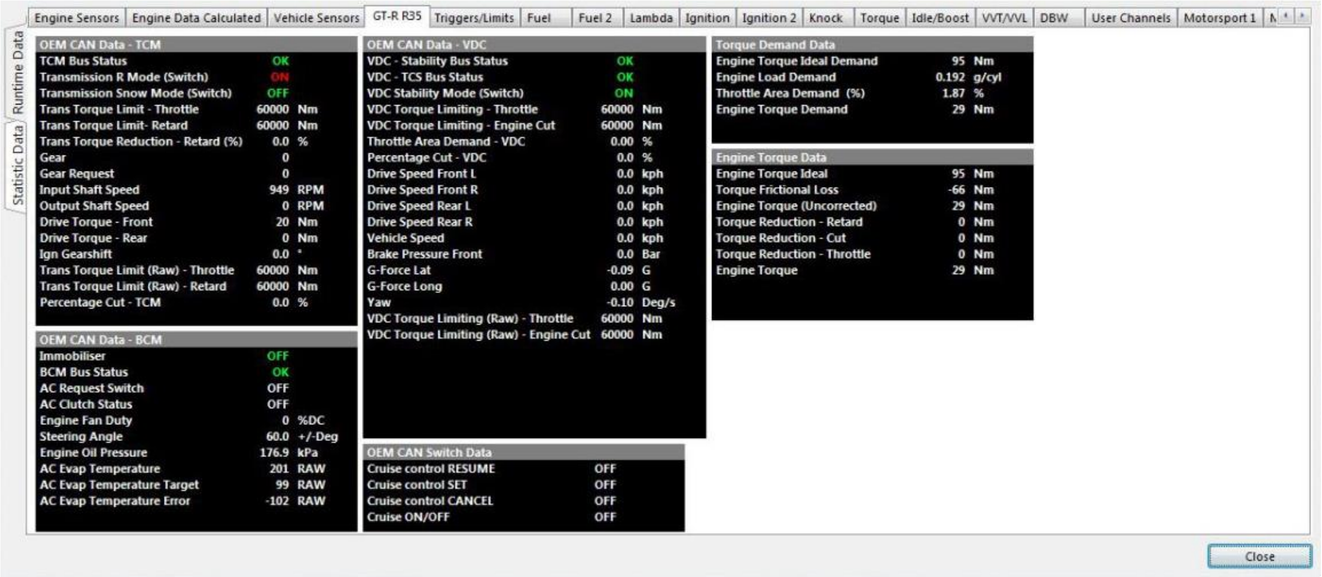
The ECU kit is supplied with a DTM 12 way to ELC Adapter loom. The termination resistors are pre wired so the system is completely plug and play. If other devices need to be wired into the CAN bus it is important not other resistors are introduced into the circuit.

8.0 OEM CAN Bus 2

The ECU Communicates on CAN Bus 2 which is reserved for the R35 GT-R. The ECU maintains full compatibility with all other CAN devices within the vehicle.

The ECU transmits a wide range of raw and calibrated data over the Bus, communicating with other devices, but also receiving data.

Emtune has a runtime tab dedicated to the R35 GT-R as shown in Figure 8.0. These runtimes are available throughout various functions within the ECU along with being viewable in the Emtune logger for data analysis.



```
OEM CAN Data - TCM
TCM Bus Status                          OK
Transmission R Mode (Switch)            ON
Transmission Snow Mode (Switch)        OFF
Trans Torque Limit - Throttle        60000  Nm
Trans Torque Limit- Retard           60000  Nm
Trans Torque Reduction - Retard (%)    0.0  %
Gear                                     0
Gear Request                             0
Input Shaft Speed                      949  RPM
Output Shaft Speed                       0  RPM
Drive Torque - Front                    20  Nm
Drive Torque - Rear                      0  Nm
Ign Gearshift                          0.0  °
Trans Torque Limit (Raw) - Throttle  60000  Nm
Trans Torque Limit (Raw) - Retard    60000  Nm
Percentage Cut - TCM                   0.0  %
```

```
OEM CAN Data - BCM
Immobiliser                            OFF
BCM Bus Status                          OK
AC Request Switch                      OFF
AC Clutch Status                       OFF
Engine Fan Duty                          0  %DC
Steering Angle                        60.0  +/-Deg
Engine Oil Pressure                  176.9  kPa
AC Evap Temperature                    201  RAW
AC Evap Temperature Target              99  RAW
AC Evap Temperature Error             -102  RAW
```

```
OEM CAN Data - VDC
VDC - Stability Bus Status                  OK
VDC - TCS Bus Status                        OK
VDC Stability Mode (Switch)                 ON
VDC Torque Limiting - Throttle           60000  Nm
VDC Torque Limiting - Engine Cut         60000  Nm
Throttle Area Demand - VDC                0.00  %
Percentage Cut - VDC                       0.0  %
Drive Speed Front L                        0.0  kph
Drive Speed Front R                        0.0  kph
Drive Speed Rear L                         0.0  kph
Drive Speed Rear R                         0.0  kph
Vehicle Speed                              0.0  kph
Brake Pressure Front                       0.0  Bar
G-Force Lat                              -0.09  G
G-Force Long                              0.00  G
Yaw                                      -0.10  Deg/s
VDC Torque Limiting (Raw) - Throttle     60000  Nm
VDC Torque Limiting (Raw) - Engine Cut   60000  Nm
```

```
OEM CAN Switch Data
Cruise control RESUME                       OFF
Cruise control SET                          OFF
Cruise control CANCEL                       OFF
Cruise ON/OFF                               OFF
```

```
Torque Demand Data
Engine Torque Ideal Demand           95  Nm
Engine Load Demand                0.192  g/cyl
Throttle Area Demand  (%)          1.87  %
Engine Torque Demand                 29  Nm
```

```
Engine Torque Data
Engine Torque Ideal                  95  Nm
Torque Frictional Loss              -66  Nm
Engine Torque (Uncorrected)          29  Nm
Torque Reduction - Retard             0  Nm
Torque Reduction - Cut                0  Nm
Torque Reduction - Throttle           0  Nm
Engine Torque                        29  Nm
```

Figure 8.0

9.0 Emtron Torque Management

The ECU performs extremely accurate torque calculations provided the engine model configuration is accurate. This section allows the user to calibrate any errors in the torque model whilst also influencing the engine torque delivery characteristics.

9.1 Torque Reduction Ign Retard Clamp

This limits the maximum torque reduction the ECU can perform based on ignition timing retard

9.2 Torque Nitrous Gain

In applications where Nitrous is used to increase torque. The ECU calculates this torque increase however if required the gain of this torque increase can be used to trim the output.

9.3 BSFC

Brake Specific Fuel Consumption torque calculation is not used by the ECU however it can be useful when calibrated correctly to cross check the ECU calculated torque levels.

Engine Torque Setup

Torque Reduction Ign Retard Clamp	40.0	Deg
Torque Nitrous Gain	1.00	
BSFC	278	g/kW.h

Figure 9.0 Engine Torque Setup

9.4 Engine Torque Correction Table

The ECU accurately calculates the Engine Torque, however if any calibration errors lead to incorrect readings, this table allows the user to adjust the gain based on any parameter listed in the axis setup form.

Engine Torque Correction Table (%)

Throttle Area Demand (%) (%)

	0.00	1.00	1.50	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00
	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Figure 9.1 Engine Torque Correction Table

9.5 Torque Demand Correction Table

Torque Demand is calculated based on various parameters in the ECU along with driver controlled pedal inputs. The R35 GT-R requests accurate information on the torque demanded by the driver so decisions can be made in the many systems in the vehicle. The ECU needs to be reporting this correctly. If there is correlation issues between the torque reported and the Torque Demanded the vehicle will not function as intended and can also lead to drivetrain operation issues. This table allows for gain control of this channel and should not require modification unless there are engine model or calibration problems.

Torque Demand Correction Table (%)

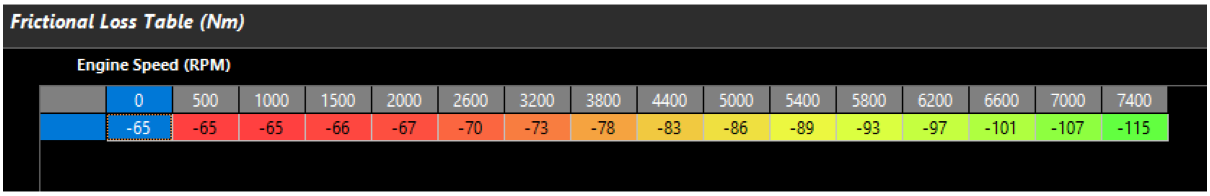
Throttle Area Demand (%) (%)

	0.00	1.00	1.50	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00
	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Figure 9.2 Torque Demand Correction Table

9.6 Frictional Loss Table

The engine torque produced by combustion is calculated by the ECU and commonly referred to as "Torque Ideal". The moving parts inside the engine assembly create drag and therefore limit the torque available. This table allows for entry of the frictional loss and is represented in Nm. Figure 9.3 shows the default setting provided with the base calibration.



Frictional Loss Table (Nm)

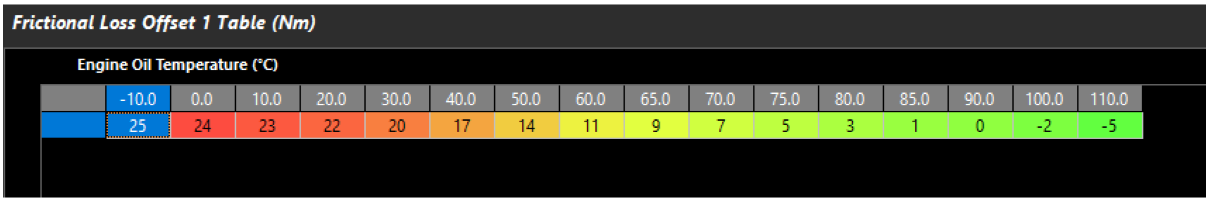
Engine Speed (RPM)

	0	500	1000	1500	2000	2600	3200	3800	4400	5000	5400	5800	6200	6600	7000	7400
	-65	-65	-65	-66	-67	-70	-73	-78	-83	-86	-89	-93	-97	-101	-107	-115

Figure 9.3 Frictional Loss Table

9.7 Frictional Loss Offset 1 Table

There are two (2) tables that allow offsetting of the frictional loss. Figure 9.4 shows the default offset table setting spanned against Engine Oil Temperature.



Frictional Loss Offset 1 Table (Nm)

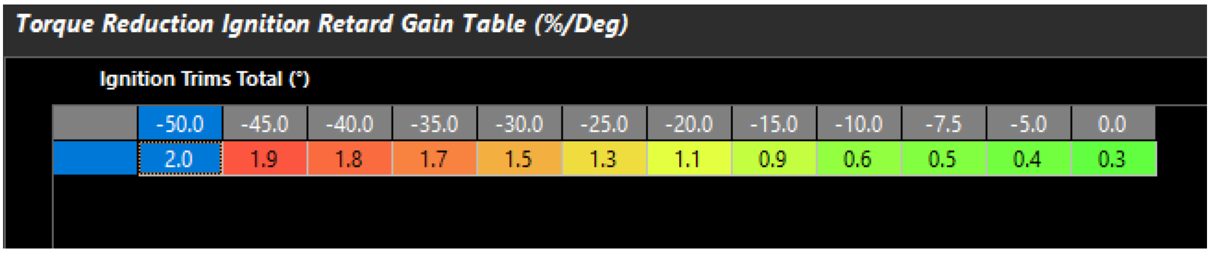
Engine Oil Temperature (°C)

-10.0	0.0	10.0	20.0	30.0	40.0	50.0	60.0	65.0	70.0	75.0	80.0	85.0	90.0	100.0	110.0
25	24	23	22	20	17	14	11	9	7	5	3	1	0	-2	-5

Figure 9.4 Frictional Loss Offset 1 Table

9.8 Torque Reduction Ignition Retard Gain Table

This table calibrates the torque reduction % per degree. When a torque request is applied the ECU will calculate how much retard is required to achieve this torque request. Figure 9.5 shows the default table settings.



Torque Reduction Ignition Retard Gain Table (%/Deg)

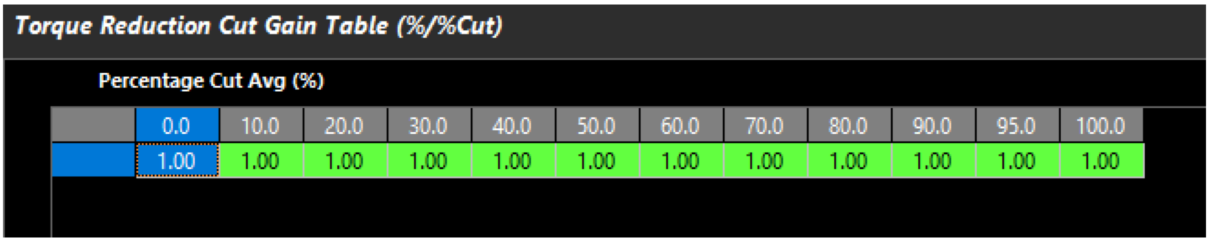
Ignition Trims Total (°)

-50.0	-45.0	-40.0	-35.0	-30.0	-25.0	-20.0	-15.0	-10.0	-7.5	-5.0	0.0
2.0	1.9	1.8	1.7	1.5	1.3	1.1	0.9	0.6	0.5	0.4	0.3

Figure 9.5 Torque Reduction Ignition Retard Gain Table

9.9 Torque Reduction Gain Table

This table calibrates the torque reduction % per %cut. When a torque request is applied the ECU will calculate how much cut is required to achieve this torque request. Figure 9.6 shows the default table settings.



Torque Reduction Cut Gain Table (%/%Cut)

Percentage Cut Avg (%)

0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	95.0	100.0
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Figure 9.6 Torque Reduction Cut Gain Table

10.0 Nissan Vehicle Dynamic Control (VDC)

The Nissan Vehicle Dynamic Control (VDC) uses various sensors to monitor driver inputs and vehicle motion. The system takes control of braking and control of the engine output to achieve optimal performance, whilst keeping the vehicle on the steered path. It is extremely important that the engine management system integrates seamlessly to achieve the correct functionality. The Emtron R35 GT-R Plugin ECU is designed to replicate the OEM engine torque output by accepting and abiding by torque requests from the VDC system. Figure 10.0 demonstrates the ECU performing a torque reduction event request. Via the CAN bus the VDC system will request a torque reduction through Cutting and Throttle Mass Flow (TMF) reduction. Both requests are generated through separate channels “VDC Torque Limiting – Throttle (Nm)” and “VDC Torque Limiting – Engine Cut (Nm)”. The ECU will close the throttle as per the Throttle Area Demand which is constantly calculated to achieve the torque request. Figure 10.1 showing menu item “VDC Torque Limiting – Throttle (Nm)” allows the user to enable control where the throttle component may be enabled or disabled. Simply turning the throttle component off will not disable the function. It will simply perform all the torque requests by cutting. Many race applications will require no throttle closing events.

Engine Torque (Uncorrected) is the torque that the engine would be producing without cutting (or retarding events). As the throttle closes the cutting will decay naturally. In this example the cutting request is removed by the VDC when the uncorrected torque meets the throttle torque request. Cutting is much more effective at reducing torque quickly. Throttle plate reductions take longer to generate a torque reduction.

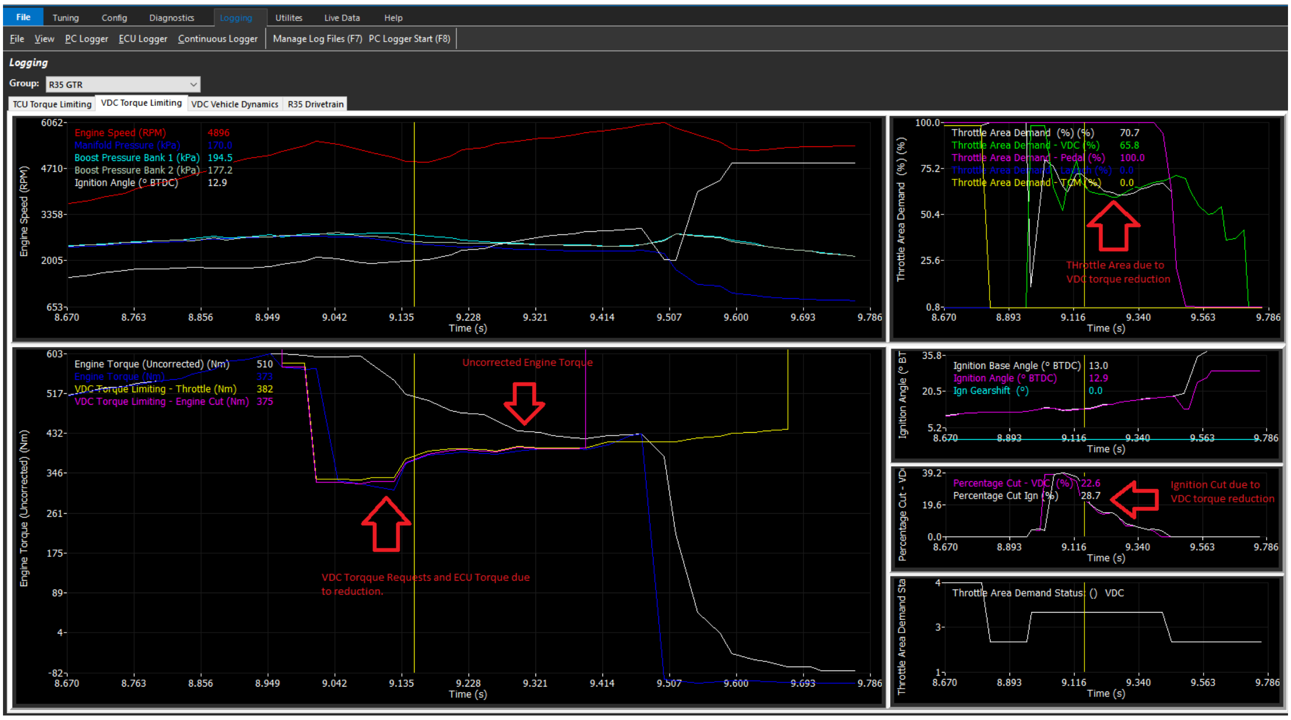
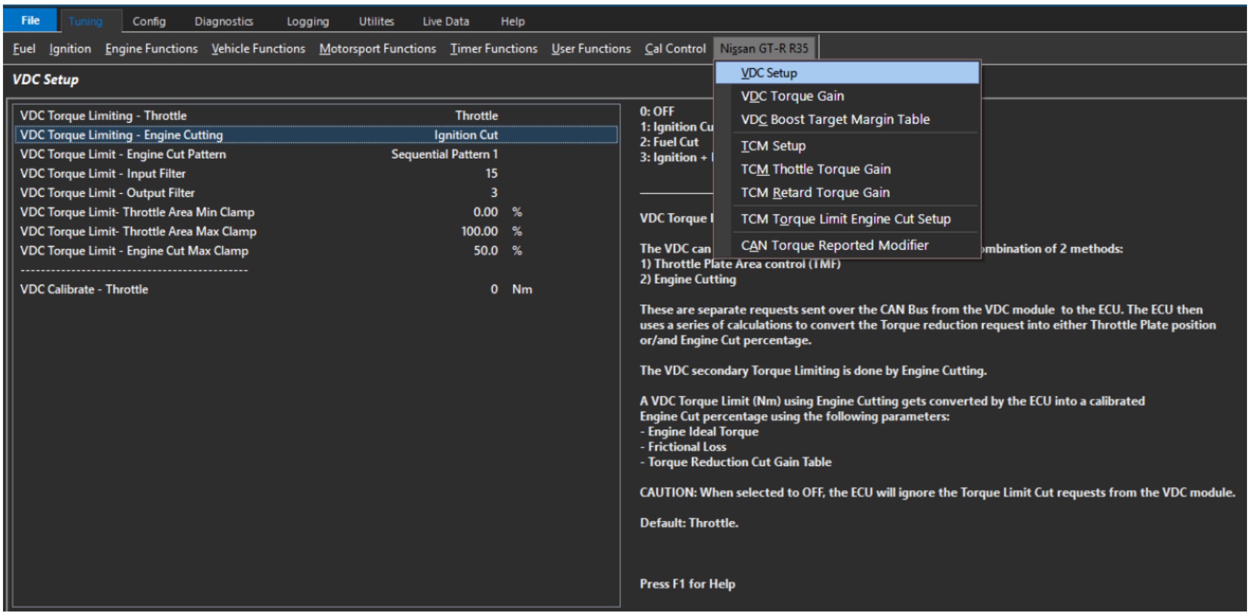


Figure 10.0 VDC Torque Output

The engine cutting request is to cut ignition however Emtron allows for user control of what will be cut. Options are – Ignition Cut, Fuel Cut, Ignition and Fuel Cut modes. Figure 10.1 shows the dedicated menu which is assigned to the Nissan GT-R R35. The highlighted menu “Torque Limiting – Engine Cutting” allows for cutting settings to be selected.



VDC Setup

VDC Torque Limiting - Throttle	Throttle	
VDC Torque Limiting - Engine Cutting	Ignition Cut	
VDC Torque Limit - Engine Cut Pattern	Sequential Pattern 1	
VDC Torque Limit - Input Filter	15	
VDC Torque Limit - Output Filter	3	
VDC Torque Limit- Throttle Area Min Clamp	0.00	%
VDC Torque Limit- Throttle Area Max Clamp	100.00	%
VDC Torque Limit - Engine Cut Max Clamp	50.0	%
--		
VDC Calibrate - Throttle	0	Nm

0: OFF
1: Ignition Cu
2: Fuel Cut
3: Ignition +

VDC Torque l

The VDC can mbination of 2 methods:
1) Throttle Plate Area control (TMF)
2) Engine Cutting

These are separate requests sent over the CAN Bus from the VDC module to the ECU. The ECU then uses a series of calculations to convert the Torque reduction request into either Throttle Plate position or/and Engine Cut percentage.

The VDC secondary Torque Limiting is done by Engine Cutting.

A VDC Torque Limit (Nm) using Engine Cutting gets converted by the ECU into a calibrated Engine Cut percentage using the following parameters:
- Engine Ideal Torque
- Frictional Loss
- Torque Reduction Cut Gain Table

CAUTION: When selected to OFF, the ECU will ignore the Torque Limit Cut requests from the VDC module.

Default: Throttle.

Press F1 for Help

Figure 10.1 Nissan GT-R R35 Tuning View Tab

10.1 VDC Torque Limit – Engine Cut Pattern

Allows the cutting pattern to be selected. All patterns will achieve the calculated torque and will simply affect the cylinder order of cutting.

10.2 VDC Torque Limit – Input Filter

This is used to smooth the input torque requests.

10.3 VDC Output Filter

This can be used to smooth the throttle area demand %. Increasing the filter will smooth the throttle demand, however it is important to understand that any filter will reduce the response of the system.

10.4 VDC Torque Limit – Throttle Area Min Clamp

This is the minimum throttle area % that the system can apply during the VDC event. Increasing this will cause the VDC system to favor more cutting to reduce torque to the request target. An extreme of this setting would be 100% which means the throttle is not able to reduce.

10.5 VDC Torque Limit – Throttle Area Max Clamp

This should be set to 100% and require no adjustment in all known applications.

10.6 VDC Torque Limit – Engine Cut Max Clamp

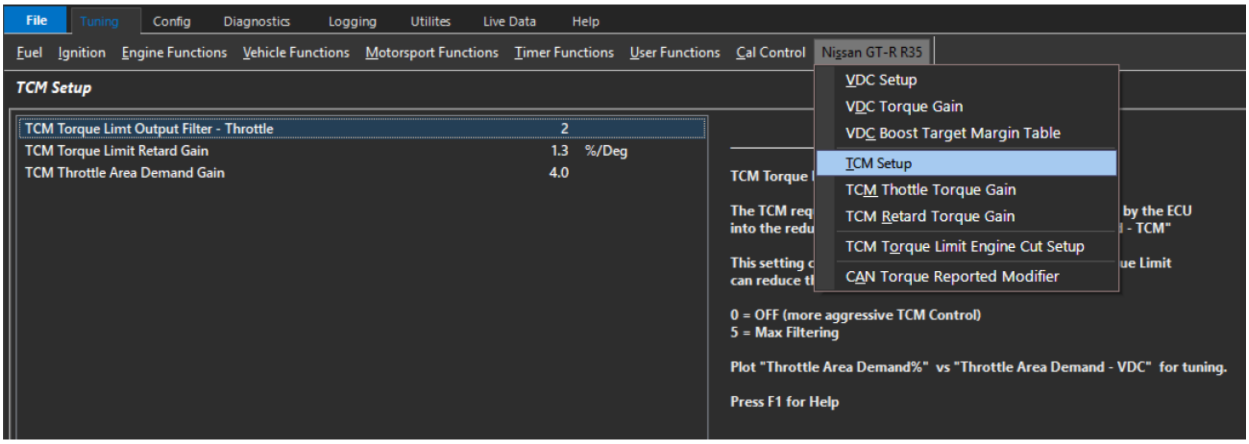
This is set to 50% by default however in situations where the torque is unable to meet the request target fast enough or at all, this setting would need to be increased. Lowering this setting will cause the VDC system to favor more throttle reduction.

10.7 VDC Calibrate – Throttle

CAUTION The setting will override the Throttle Plate control and reduce the Throttle Area to achieve the entered Torque value. The setting allows the VDC system to be calibrated and should be done so in a controlled environment only and preferably on a dynamometer.

11.0 Nissan Transmission Control Module (TCM)

The transmission control module is responsible for anything related to the transmission. The ECU does not control any part of the transmission, however, it is responsible for obeying torque requests accurately which are sent to it via the CAN bus. The ECU is responsible for reducing torque by closing the throttle and by retard. Emtron has the ability to adjust torque requests requested by the TCM. Figure 11.0 shows the menu section that is assigned to the “TCM Setup”.



TCM Setup

TCM Torque Limt Output Filter - Throttle	2	
TCM Torque Limit Retard Gain	1.3	%/Deg
TCM Throttle Area Demand Gain	4.0	

TCM Torque

The TCM req by the ECU
into the redu - TCM"

This setting ue Limit
can reduce t

0 = OFF (more aggressive TCM Control)
5 = Max Filtering

Plot "Throttle Area Demand%" vs "Throttle Area Demand - VDC" for tuning.

Press F1 for Help

Figure 11.0 – TCM Setup

11.1 TCM Torque Limit Output Filter

The TCM requests a Torque Limit (Nm) which gets converted by the ECU into the reduced Throttle Area called "Throttle Area Demand - TCM"
This setting controls the rate at which the TCM Throttle Torque Limit
can reduce the Throttle Area Demand.

0 = OFF (more aggressive TCM Control)
5 = Max Filtering

Typical Value – “2”

Plot "Throttle Area Demand%" vs "Throttle Area Demand - VDC" for tuning.

11.2 TCM Torque Limit %Cut Gain

During a TCM Torque Reduction request the ECU can cut the engine to reduce Torque. This setting indicates to the ECU the percentage of Torque reduced for every 1% of Engine Cut.

Example.:
- Engine Torque at 600Nm.
- 200Nm Torque Reduction is requested.
- This is a 33% Reduction in Torque

1.0 %/ %Cut. ECU will cut engine at 33%
0.8 %/ %Cut. ECU will cut engine at 41%
1.2 %/ %Cut. ECU will cut engine at 27%

The factory setting of 1.00%/%Cut should be optimal.

11.3 TCM Torque Limit Retard Gain

During a TCM Torque Reduction request the ECU can retard the timing to reduce Torque. This setting indicates to the ECU the percentage of Torque reduced for every degree of Ignition Retard.

Example 1.5%/ Deg.
The Engine is running at 600Nm and a Torque Reduction to 400Nm is requested.

This is a 33% reduction in Torque so at 1.5%/Deg the ECU will Retard the Ignition 22 Degrees.

(33% / 1.5%/deg = 22 Deg)

11.4 TCM Throttle Area Gain

When the current Engine Torque is less than the TCM Torque Demand the Throttle Area will need to be increased. To overcome inertia and other factors the plate needs to be momentarily increased before it comes back to its calculated position. This setting is primarily used in Launch Control to ensure the ECU tracks the TCM Torque Demand

Gain 0 = OFF
Gains up to the maximum of 5 can achieve good results.

Figure 11.1 shows a typical Trans Torque Limit being invoked by the TCM. The ECU will calculate the Throttle Area Demand to achieve the requested torque.

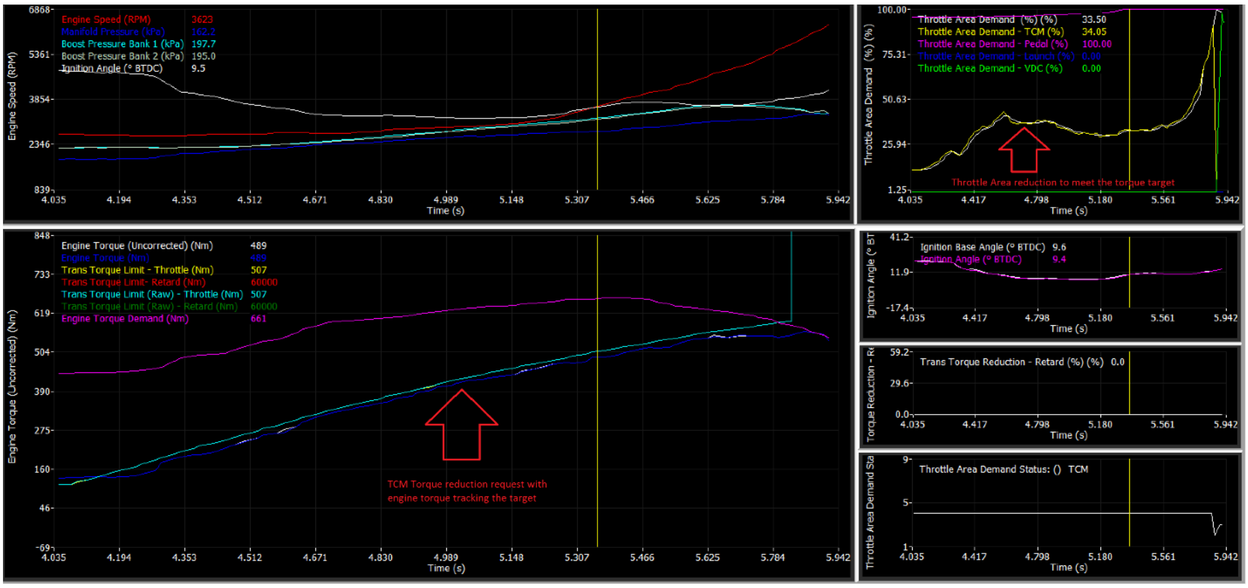
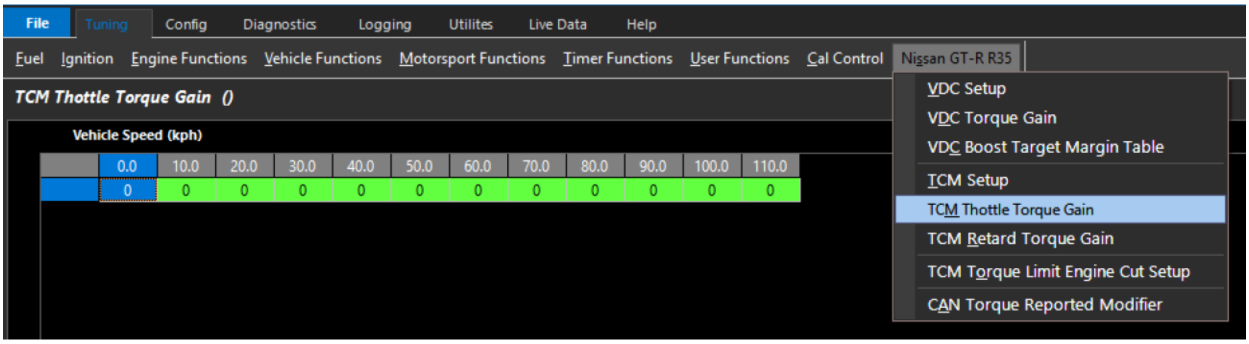


Figure 11.1

The ECU has the ability of adjusting the ECU's targeting of the TCM torque request due to throttle torque reduction and retard torque reduction. The tables are shown in Figure 11.2 and 10.3. The base calibration is supplied with the 0 gain in both tables. This means the ECU will perform the torque reduction exactly how the TCM requests it.

TCM request of 200Nm
Gain = -50%. Scaled TCM Torque = 300Nm (Reducing TCM Torque Reduction)
Gain = +50%. Scaled VDC Torque = 50Nm (Increasing TCM Torque Reduction)

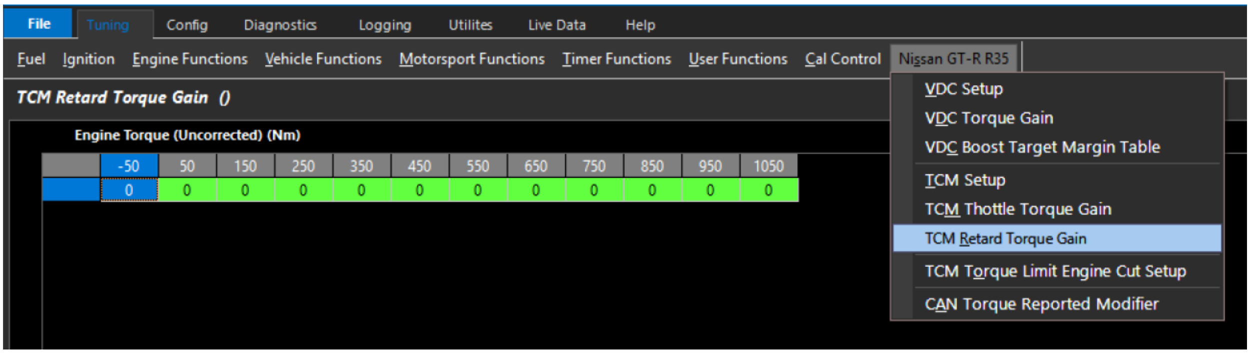


TCM Throttle Torque Gain ()

Vehicle Speed (kph)

0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0
0	0	0	0	0	0	0	0	0	0	0	0

Figure 11.2 TCM Throttle Torque Gain



TCM Retard Torque Gain ()

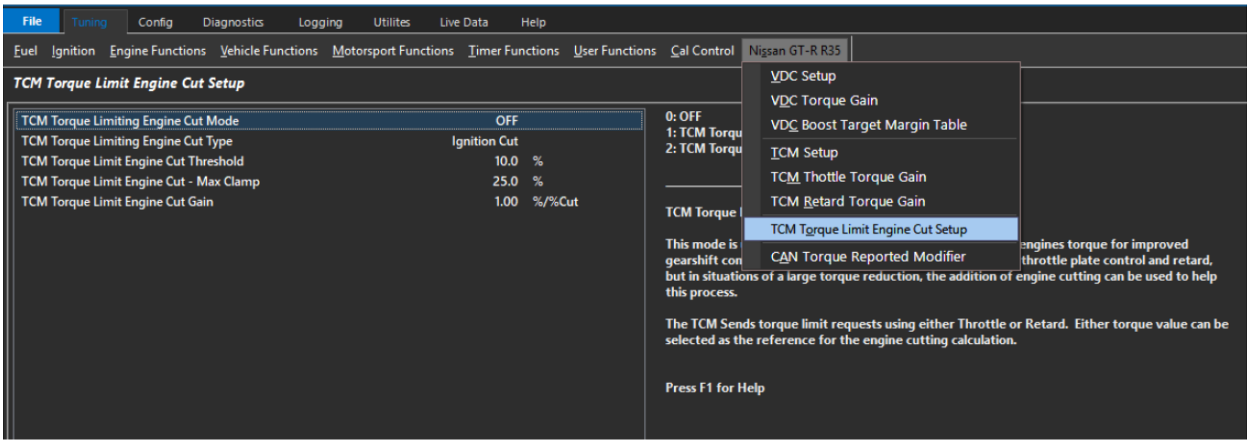
Engine Torque (Uncorrected) (Nm)

	-50	50	150	250	350	450	550	650	750	850	950	1050
	0	0	0	0	0	0	0	0	0	0	0	0

Figure 11.3 TCM Retard Torque Gain

12.0 TCM Torque Limit Engine Cut

In some motorsport environments and extremely high-end applications the OEM Torque Reductions may not be sufficiently suitable for maximum performance. This has been addressed by allowing the user the ability to leverage the factory torque requests and applying a cut for more instantaneous torque reduction. This is particularly useful on gear shifts where sharper than factory shift response is required. Figure 12.0 shows the location of this setting.



TCM Torque Limit Engine Cut Setup

TCM Torque Limiting Engine Cut Mode	OFF	
TCM Torque Limiting Engine Cut Type	Ignition Cut	
TCM Torque Limit Engine Cut Threshold	10.0	%
TCM Torque Limit Engine Cut - Max Clamp	25.0	%
TCM Torque Limit Engine Cut Gain	1.00	%/%Cut

0: OFF
1: TCM Torqu
2: TCM Torqu

TCM Torque

This mode is engines torque for improved gearshift con throttle plate control and retard, but in situations of a large torque reduction, the addition of engine cutting can be used to help this process.

The TCM Sends torque limit requests using either Throttle or Retard. Either torque value can be selected as the reference for the engine cutting calculation.

Press F1 for Help

Figure 12.0

12.1 TCM Torque Limiting Engine Cut Mode

0: OFF
1: TCM Torque Limit Ref: Throttle
2: TCM Torque Limit Ref: Retard

This mode is used to assist the TCM and ECU in reducing the engines torque for improved gearshift control. The primary source of Torque Reduction is throttle plate control and retard, but in situations of a large torque reduction, the addition of engine cutting can be used to help this process.

The TCM Sends torque limit requests using either Throttle or Retard. Either torque value can be selected as the reference for the engine cutting calculation.

12.2 TCM Torque Limiting Engine Cut Type

0: Ignition Cut
1: Fuel Cut
2: Ignition + Fuel Cut

12.3 TCM Torque Limit Engine Cut Threshold

This mode is used to assist the TCM and ECU in reducing the engines torque for improved gearshift control. The ECU converts the Torque Limit (Nm) sent by the TCM into a calibrated Engine Cut Percentage.

This setting controls the Torque Threshold above which Engine Cutting can be used to reduce torque.

Example.:
Cut threshold 10%
TCM requesting torque limit of 300Nm.
Engine torque 600Nm

10% of 300Nm = 330Nm

The ECU will calculate the required cut% from 600Nm down to 330Nm.

12.5 TCM Torque Limit Engine Cut - Max Clamp

This mode is used to assist the TCM and ECU in reducing the engines torque for improved gearshift control. The primary source of Torque Reduction is the closing of the throttle plate, but in situations of a large torque reduction, Ignition cutting can be used to help this process.

The ECU converts the Torque Limit (Nm) into a calibrated Engine Cut Percentage.

This setting controls the Maximum amount of Cut the ECU can apply for a given
Torque Limit request.

Example.: 50%

This means the Maximum Cut applied to the Engine will be clamped to 50%.

12.6 TCM Torque Limit Engine Cut Gain

During a TCM torque reduction request the ECU can cut the engine to reduce torque. This setting indicates to the ECU the percentage of torque reduced for every 1% of Engine Cut.

Example.
- Engine Torque at 600Nm.
- 200Nm Torque Reduction is requested.
- This is a 33% Reduction in Torque

1.0 %/ %Cut. ECU will cut engine at 33%
0.8 %/ %Cut. ECU will cut engine at 41%
1.2 %/ %Cut. ECU will cut engine at 27%

**Arming Conditions :

1) Only active on upshift

2) Latches OFF and stays OFF when cut hits 0%

3) ONLY works on TCM Torque Reduction Retard. (not throttle)

13.0 Launch Control

Launch Control is enabled in the base calibration supplied. The TCM controls how this is armed. The ECU will arm based on the enabling of R Mode of the Transmission. The launch control feature allows the user to target a torque level. The base calibration leverages Engine Speed Limit 2 as per Figure 13.0 to control the engine speed during launch. There is a lot of flexibility to allow the user control but the ideal setting will usually not require engine speed limiting once the vehicle is moving.

Rpm Limit 2 Table ()

Vehicle Speed (kph)

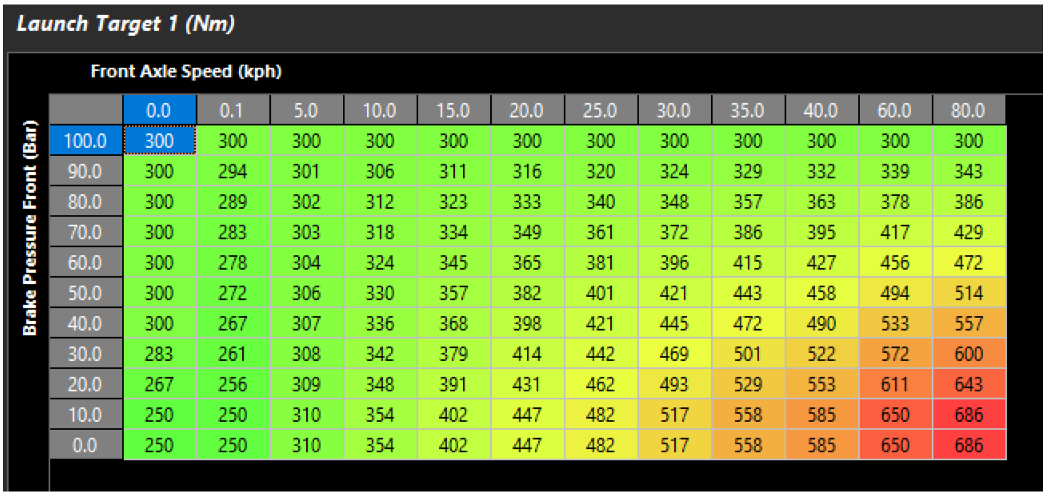
Brake Pressure Front (Bar)

	0.0	5.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0
100.0	3200	4000	4420	5000	5630	6250	6875	7500	7500	7500	7500	7500
90.0	3200	4000	4420	5000	5630	6250	6875	7500	7500	7500	7500	7500
80.0	3200	4000	4420	5000	5630	6250	6875	7500	7500	7500	7500	7500
70.0	3200	4000	4420	5000	5630	6250	6875	7500	7500	7500	7500	7500
60.0	3200	4000	4420	5000	5630	6250	6875	7500	7500	7500	7500	7500
50.0	3200	4000	4420	5000	5630	6250	6875	7500	7500	7500	7500	7500
40.0	3400	4000	4420	5000	5630	6250	6875	7500	7500	7500	7500	7500
30.0	3400	4000	4420	5000	5630	6250	6875	7500	7500	7500	7500	7500
20.0	3400	4000	4420	5000	5630	6250	6875	7500	7500	7500	7500	7500
10.0	3400	4025	4420	5000	5630	6250	6875	7500	7500	7500	7500	7500
0.0	3400	4050	4420	5000	5630	6250	6875	7500	7500	7500	7500	7500

Figure 13.0 RPM Limit 2 Table

Note: Future revisions of R35 GT-R Plugin will have the Engine Speed Limit integrated with the Launch Control feature.

The correct torque target will achieve good acceleration and traction whilst not requiring any engine speed limiting. Figure 13.1 shows a typical torque target table.



Launch Target 1 (Nm)

Front Axle Speed (kph)

Brake Pressure Front (Bar)

	0.0	0.1	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	60.0	80.0
100.0	300	300	300	300	300	300	300	300	300	300	300	300
90.0	300	294	301	306	311	316	320	324	329	332	339	343
80.0	300	289	302	312	323	333	340	348	357	363	378	386
70.0	300	283	303	318	334	349	361	372	386	395	417	429
60.0	300	278	304	324	345	365	381	396	415	427	456	472
50.0	300	272	306	330	357	382	401	421	443	458	494	514
40.0	300	267	307	336	368	398	421	445	472	490	533	557
30.0	283	261	308	342	379	414	442	469	501	522	572	600
20.0	267	256	309	348	391	431	462	493	529	553	611	643
10.0	250	250	310	354	402	447	482	517	558	585	650	686
0.0	250	250	310	354	402	447	482	517	558	585	650	686

Figure 13.1 Launch Target 1 (Nm)

14.0 Emtron CAN Features

CAN control features not available at the time of writing.

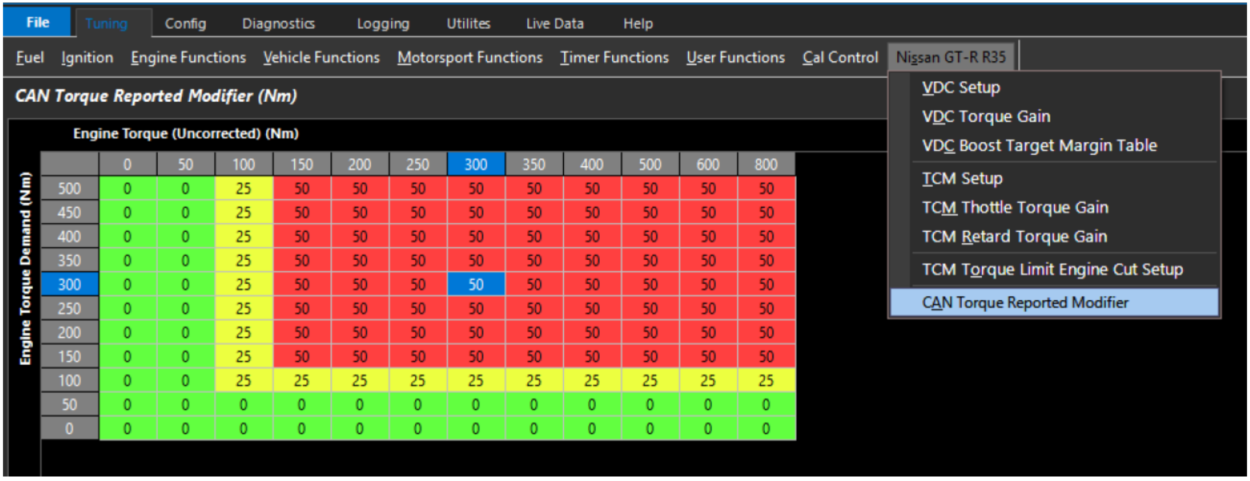
15.0 Communications Torque

Torque Information over the CAN bus can be modified. This can change the behavior of the Gearshift along with clutch pressure in gear. If there is excessive slip typically the Torque reported should be increased. If the gearshift feel is too sharp and aggressive the Torque reported should be reduced. The table applies an offset.

This effects:
1) Engine Torque Demand
2) Engine Torque

Table range is +/- 500Nm

Figure 15.0 shows a typical setting. The increase in Torque reported over the CAN bus will have the effect of sharpening the transmission shifting and clutch lockup. It is important to note that directly programming the TCM through a third party flashing tool is advised over using the ECU to offset the torque reported.



CAN Torque Reported Modifier (Nm)

Engine Torque (Uncorrected) (Nm)

Engine Torque Demand (Nm)

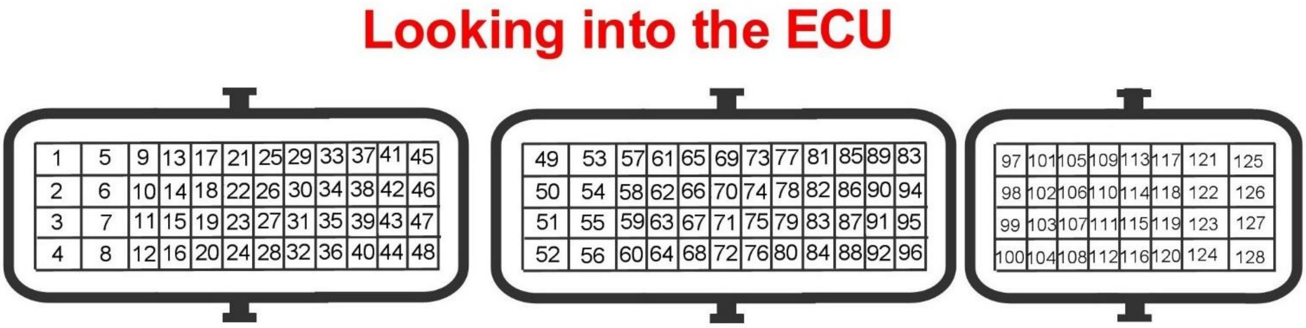
	0	50	100	150	200	250	300	350	400	500	600	800
500	0	0	25	50	50	50	50	50	50	50	50	50
450	0	0	25	50	50	50	50	50	50	50	50	50
400	0	0	25	50	50	50	50	50	50	50	50	50
350	0	0	25	50	50	50	50	50	50	50	50	50
300	0	0	25	50	50	50	50	50	50	50	50	50
250	0	0	25	50	50	50	50	50	50	50	50	50
200	0	0	25	50	50	50	50	50	50	50	50	50
150	0	0	25	50	50	50	50	50	50	50	50	50
100	0	0	25	25	25	25	25	25	25	25	25	25
50	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 15.0 CAN Torque Reported Modifier (Nm)

16.0 Ordering Information

Product	Part Number
Emtron R35 Plugin	1609-1835

Appendix A - ECU Pinout



OEM Pin Number	**Function**	
A1	Throttle Control Motor Supply (paired with pin 49)	AUX9-12 Supply
A2	Throttle Servo Bank 2 Motor +	AUX11
A3	AF Sensor 2 Heater (denso narrowband)	AUX15
A4	AF Sensor 1 Heater (denso narrowband)	AUX15
A5	Throttle Servo Bank 2 Motor -	AUX12
A6	Power Ground	
A7	Evaporative Purge Canister Vent Control Valve	AUX6
A8	Evaporative Purge Canister Volume Control Solenoid	AUX3
A9	Ignition Cylinder 2	Ignition Channel 2
A10	Ignition Cylinder 1	Ignition Channel 1
A11	Secondary Injector 1	**Injector Channel 7**
A12	Secondary Injector 2	**Injector Channel 8**
A13	Ignition Cylinder 3	Ignition Channel 3
A14		
A15	TPS Bank 2 Ground	Sensor Ground 1
A16	Secondary Injector 3	**Injector Channel 9**
A17	Fuel Injector Cylinder 3	INJ 3
A18		
A19	MAF Sensor Bank 2 Ground	Sensor Ground 1
A20	TPS Bank 1 Ground	Sensor Ground 1
A21	Fuel Injector Cylinder 2	INJ 2
A22	MAF Sensor Bank 1 Ground	Sensor Ground 1
A23	SAMAF and TAM Ground	Sensor Ground 1
A24	Secondary Air Injection MAF Sensor (SAMAF)	DI 11
A25	Fuel Injector Cylinder 1	INJ 1
A26	Engine Oil Temp/Engine Temp Ground	Sensor Ground 1
A27	Engine Oil Temperature	ANV9
A28	Throttle Servo Bank 2 Position Main	ANV4

A29	Fuel Pump Control Signal	AUX7
A30	Fuel Pump Control Diag Input	DI 8
A31	Mass Flow Sensor Bank 1	ANV13
A32	Throttle Servo Bank 2 Position Tracking	AV5
A33	Ignition Cylinder 4	Ignition Channel 4
A34	Ignition Cylinder 5	Ignition Channel 5
A35	Secondary Injector 4	**Injector Channel 10**
A36	Throttle Servo Bank 1 Position Tracking	ANV3
A37	Fuel Injector Cylinder 4	INJ 4
A38	Ignition Cylinder 6	Ignition Channel 6
A39	Secondary Injector 5	**Injector Channel 11**
A40	Throttle Servo Bank 1 Position Main	ANV 1
A41	Fuel Injector Cylinder 5	INJ 5
A42	Fuel Level Sensor	ANV 10
A43	Secondary Injector 6	**Injector Channel 12**
A44	Airbox Temperature	ANV8
A45	Fuel Injector Cylinder 6	INJ 6
A46	Coolant Temperature	ANV7
A47	Inlet Mass Flow Bank 2	ANV14
A48	Inlet Manifold Pressure Bank 2	ANV1
B49	Throttle Control Motor Supply (paired with pin 1)	
B50	Throttle Servo Bank 1 Motor +	AUX 9
B51	Inlet Camshaft Bank 2 Solenoid	AUX 2
B52	Inlet Camshaft Bank 1 Solenoid	AUX 1
B53	Throttle Servo Bank 1 Motor -	AUX 10
B54	Power Ground	
B55	O2HR1 - Wideband bank1 Heater	*Not Connected*
B56	O2HR2 - Wideband bank2 Heater	*Not Connected*
B57		
B58		
B59		
B60		
B61	Boost Control Solenoid	AUX 4
B62	Ground - Camshaft Position Bank 1	Sync Sensor -
B63	Camshaft Bank 1 Position Sensor (inlet)	Sync Sensor +
B64	Crankshaft Position Sensor	Crank Index +
B65		
B66	Ground - Camshaft Position Bank 2	Sync Sensor -
B67	Camshaft Bank 2 Position Sensor (Inlet)	DI 1
B68	Ground - Crankshaft Position Sensor	Crank Index -
B69		

B70	Ground - WB Band Sensor 1 and 2 (joined in loom)	
B71	Knock Sensor Ground for Bank1 and 2 (joined in loom)	ECU Ground
B72	Knock Sensor Bank 1	Knock 1 +
B73	O2SR1 - Wideband bank1 sensor	*Not Connected*
B74	Ground (Power Steer Pres, MAP, Refrigerant Pressure)	Sensor Ground 1
B75	Ground (Evap sensor, Boost sensor Bank 1 and 2)	Sensor Ground 1
B76	Knock Sensor Bank 2	Knock 2 +
B77	O2SR2 - Wideband bank2 sensor	*Not Connected*
B78	Evap Control System Pressure Sensor	DI 10
B79	Boost Pressure Bank 2	DI12
B80	Boost Pressure Bank 1	DI13
B81	Denso Sensor AF+ (Bank 1 Narrowband)	*Not Connected*
B82	Denso Sensor AF- (Bank 1 Narrowband)	Sensor Ground 1
B83	Power Steering Pressure	DI 9
B84	5V Supply - TPS Bank 2	5V Engine Supply
B85	Denso Sensor AF+ (Bank 2)	*Not Connected*
B86	Denso Sensor AF- (Bank 2)	Sensor Ground 1
B87	5V Supply - Crankshaft	5V Trigger Supply
B88	5V Supply - Camshaft Position Bank 1	5V Trigger Supply
B89	Air Conditioner Refrigerant Pressure	DI 14
B90		
B91	5V Supply - Camshaft Position Bank 2	5V Trigger Supply
B92	5V Supply - Evap sensor, Boost sensor Bank 1 and 2	5V Aux Supply
B93	Sub Fuel Pump + (feedback)	DI 7
B94	Sub Fuel Pump - (feedback)	*Not Connected*
B95	5V Supply - Power Steer Pres, MAP, Refrig Pressure	5V Engine Supply
B96	5V Supply - TPS Bank 1	5V Engine Supply
C97	500k vehicle CAN bus to ABS	CAN 2 LO (500kbps)
C98		
C99	5V Supply - Pedal Position Sensor 2	5V Engine Supply
C100	5V Supply - Pedal Position Sensor 1	5V Engine Supply
C101	500k vehicle CAN bus to ABS	CAN 2 HI
C102	Steering Wheel Button	DI 5
C103	Ground - Pedal Position Sensor 1	Sensor Ground 1
C104	Pedal Position Main	ANV11
C105	ECM relay	EFI Relay
C106	Ignition Switch	Ignition Switch

C107	Ground - Pedal Position Sensor 2	Sensor Ground 1
C108	Pedal Position Tracking	ANV12
C109	Air Cut Solenoids Relay Control (Banks 1 and 2 joined)	AUX14
C110	Brake Switch (Stop Lamp Switch)	DI 4
C111	Neutral Switch (from TCM)	DI 3
C112		
C113	Tacho out (To Power Steer control until)	AUX 8
C114	K-Line	
C115		
C116		
C117	Cruise Control Brake Switch	DI 2
C118	Keep Alive Memory power	
C119		
C120	Air Pump Relay	AUX 13
C121	VBR - Power from ECM Relay -Feeds Sec Air Inj Pump, MAF sensors etc	
C122	VBR - Power from ECM Relay	
C123		
C124	Power Ground	
C125		
C126	Sub Fuel Pump Relay	AUX 5
C127	DBW on/off relay (power for relay coil from ECM Relay)	IGN 7
C128	Power Ground	

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