

NEMESIS - TCS

Nemesis-TCS ‘Traction Control System’

Firmware TCS 2 cylinder 1.21 onwards
Firmware TCS 4 cylinder 1.08 onwards
TC-Pod 1.05
WinTC Software 1.11 -User – Onwards – 2 cylinder
WinTC Software 2.04 -User – Onwards – 4 cylinder

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For several years now a professional and well-developed traction control system for motorbikes has only been available to those with larger budgets or a top-level superbike team behind them.

All of this has now changed!!

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IMPORTANT – To be read by ALL installers and owners

Diagnostic light (Ducati models)

The Nemesis TCS directly controls the ignition coils on your bike. If you have a standard, re-flashed or DP ECU on your bike the internal diagnostics will think there is a problem with the coils and activate the diagnostic light on your dashboard. There is no way to avoid this.

Terms of use

The presence of the Nemesis-TCS does not take away the responsibility of the rider to operate the bike correctly within their own abilities, the track conditions and the laws of physics.

The system is designed to achieve greater on-track performance by the use of power modulation during wheel slip events, but in no way should it be considered possible for the system to recover from every conceivable loss of grip. The onus for safety always rests with the rider to stay within his or her own abilities, and to ensure that the ‘on-bike’ equipment is programmed, setup correctly, and an appropriate TC level selected for the skill of the rider, the bike and the track conditions.

This equipment is intended for racing or track day performance use only and where exhaust emission controls are not applicable.

By installing and using the Nemesis-TCS you automatically indemnify Competition Systems Ltd, our suppliers and our authorised dealers from all first party or third party loss or damages. Normal components warranty is not affected.

Nemesis-TCS system manual release 1.09 – 03/11/2011

Author – Mick Boasman

1.01 System operation

The Nemesis-TCS is a programmable device, which is able to reduce engine power by direct interaction with the ignition coil signals of any bike from 1 > 4 cylinders**. This direct action on the coil signal means it can be fitted to any ECU system.

**1>2 cylinders – Nemesis TCS

**1>4 cylinders – Nemesis TCS – 4c

The core controls and intelligence have been developed by us using real world experience from our Superbike customers and should not be confused with any other 'plug in' system currently on the market.

The amount of 'power correction' is determined by nine slip level maps which use wheel slip data calculated as a direct ratio between the front and rear wheel speed signals. Power reduction is created in 16 steps using retard, cut and pulsed cut to achieve the optimum results.

Slip maps are further corrected by built in sensors to determine when the bike is cornering and the level of acceleration out of the corner. This provides the maximum acceleration without sacrificing slip control.

Intelligent internal controls are able to recognise any 'wheelie' event and make corrections to the slip calculations to create a 'virtual front speed'. This 'virtual speed' is then used as the rear wheel speed comparator to enable real traction control when the front wheel is in the air.

Engine RPM 'rate of change' is not used within this system as it is unable to recognise or control 'wind up' slip event where the rear tyre gradually increases speed but without any significant 'RPM rate of change'

The Nemesis-TCS system is built into individual 'plug n play' kits comprising all of the hardware, software and TC maps for quick and easy installation onto all bikes. This manual covers only the generic items of the Nemesis-TCS, additional 'bike specific' manuals will also be supplied with your kit.

The Nemesis-TCS is supplied pre-programmed with base settings to suit a bike along with tyre size calibrations and slip maps to suit your tyres. But we also provide the software and a dedicated USB interface enabling users to change many of the parameters.

The TC system is active under these conditions:

- Wheel speed greater than 25kmh (34kmh for 4C systems)
- RPM is greater than 3000 (typical)
- Throttle (typical) is greater than 3% (typical)
- TC maps 1 to 9 have been selected by the rider
- All system diagnostics are OK

1.02 TCS hardware module description – (2 Cylinder version for shown)

The TCS module is a machined aluminium enclosure with fully resin-potted electronics, a carbon cover and rubber AV mounts.

The TCS module must be fitted to the bike in the orientation detailed in the installation manual for your bike.

- The mounting hardware we provide must not be modified in any way. The rubber mounts must be used in all installations. The mounting brackets you have received with your kit must be used without modification and in their original intended location.
- The TCS module should be isolated from all extreme heat sources such as exhausts.

IMPORTANT – Failure to follow these rules will seriously compromise the function and warranty of this equipment, and may invalidate warranty.



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1.03 TC-Pod display

The display module uses the same hardware as our TC-Pod as used for standard DTC control. It is however programmed differently for TCS applications so do not try and interchange modules, these instructions only relate to the software version as used by the TCS.

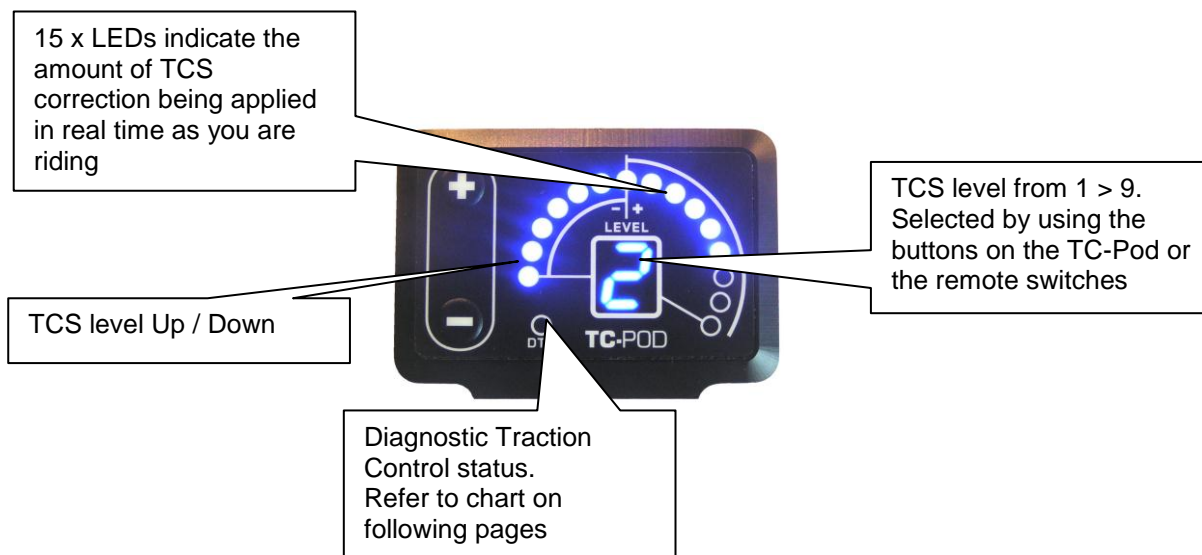
When the engine is not running only a '-' is seen in the display. In this state 'open the throttle' to check throttle operation.

The TC-Pod display allows you to do all of the following while the engine is running.

- TCS system ON/OFF.
- TCS level UP/Down through 1>9 via integrated or external push buttons.
- Multi LED display to indicate the amount of TCS correction being applied in real time. Steps 1>15.
- Numeric display of the current TCS level.
- Adjustable back lit displays for day or night riding.
- Warning LED in case of TCS errors, and built in self-diagnostic capability.
- Throttle test (when engine is not running)
- Communicates with the TCS over CAN.



The TC-Pod can be fitted either directly to the handlebars or centrally in front of the dash. Depending which kit you buy will determine the TC-Pod mounting locations.



Brightness adjustment.

- Hold down the **TC-DOWN (-)** button while you switch on the ignition.
- The TC-Pod will not go through the normal start up sequence, it will show a number from 0>9 in the centre and corresponding number of blue LEDs.
- Use the UP or DOWN buttons to adjust the brightness of the display, 0 being the lowest, 9 the brightest.
- When you get to your desired level, press and hold the UP(+) button for 2 seconds. The TC-Pod will now run through the normal 'power on' sequence.
- The TC-Pod will then revert to it's normal operation.

These brightness settings will be saved even after power off/on.



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TC-Pod continued

Quick shifter disable

By default the TCS module has the quick shifter input enabled but the user has the option to turn this off via the TC-Pod using the following procedure.

- Turn on the ignition and the TC-Pod will go through the normal start up sequence with the blue LEDs rising.
- While this is in progress, press and hold the + (UP) button.
- The TC-Pod will show a 1 in the centre and a green LED. This means the quick shifter is enabled.
- a short press of the – (DOWN) button will change the display to a 0 and the LED will turn RED, this means the quick shifter input is disabled.
- To go back to quick shift ON, use the + (UP) button.
- To save settings, press and hold the + (UP) button and the Pod will re-start.
- If you see a yellow LED it means that the quick shift has been disabled by the TCS internal programming so it is not possible to activate it via the TC-Pod.

These settings will be saved even after power off/on.

Changing slip map level

The system will remember the last slip map level you used even after power off/on. To change map level or switch off/on the TC system the engine must be running. When the engine is stopped the display will show a ‘-’ in the screen.

- Use the + (UP) button to increase the number and provide closer (more aggressive) slip control.
- Use the - (DOWN) button to reduce the number and provide lower (less) slip control.
- To turn OFF the traction control system, hold down the – (DOWN) button until a 0 shows in the centre display and the LED turns red.
- To turn ON the traction control system press and hold the + (UP) button until a number appears. This will be the map level you were using prior to switching off the TC.

1.04 TC-Pod Built in diagnostics

The TC-Pod monitors data continually as well as CAN messages from other devices on the bike to look for potential problems.

If a problem is found which lasts longer than 0.5 seconds the TC-Pod is able to show a series of error codes as a combination of:

- Centre numeric value
- Colour of DTC (Diagnostic Traction Control) LED
- The number of blue LEDs showing

During certain diagnostic events the TCS system is disabled, but immediately the fault is resolved the TC-Pod will automatically revert back to the previously used TC-Level settings.

If the diagnostic event has a very short duration it can be impossible for the user to notice the diagnostic value, for this reason, any diagnostic event code will stay visible for 2 seconds.

If wish to cancel a diagnostic message you can ‘press and hold’ the TC-Up (+) button for 2 seconds, this will not fix the problem, but it will clear the screen until the next time the system is switched off/on. Providing the error is not critical to function, TCS will continue to work.

Numeric value	LED colour	Blue LEDs	Source	Type	meaning
1	Yellow	1	TC module	Warning	Internal fault – Contact manufacturer / HW cal missing
1	Yellow	2	TC module	Warning	Internal fault – Contact manufacturer
1	Yellow	3	TC module	Warning	Internal fault – Contact manufacturer
1	Yellow	4	TC module	Warning	Map mismatch – TC-Pod level out of alignment with TCS module. <ul style="list-style-type: none"> • Re-set the diagnostic – see below. • Use buttons to cycle up/down the levels to check function • Power off/on
1	Yellow	5	TC module	Warning	Battery voltage too low
1	Yellow	6	TC module	Warning	Internal sensor test fail – Contact manufacturer
1	Yellow	7	TC module	Warning	Speed error
1	Yellow	15	TC module	Warning	Internal fault – Contact manufacturer
1	Red	1	TC module	Error	CAN Bus error
1	Red	2	TC module	Error	Throttle signal out of range
1	Red	3	TC module	Error	Internal sensor error
1	Red	4	TC module	Error	Front / Rear speed comparison too large

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1	Red	5	TC module	Error	Coil input or output error
1	Red	6	TC module	Error	Error in programming table – Check and re-load
1	Red	7	TC module	Error	Internal fault – Contact manufacturer
2	Red	off	TC-Pod	Error	Map request not accepted by TC module
3	Red	off	TC-Pod	Error	TC-Pod QS/Pit/TC not accepted by TC module
4	Red	off	TC-Pod	Error	CAN data not received from TC Module
5	Red	off	TC-Pod	Error	No CAN messages received from TCS module to display, check wiring or replace modules to locate fault.
6	Red	off	TC-Pod	Error	Push button TC +/- input failure – always ON
7	Red	off	TC-Pod	Error	Push button Pit Limiter input failure – always ON
Dot	Red	off	TC-Pod	--	Dot is shown to indicate diagnostic event has ended

Diagnostic re-set can be achieved by holding the UP button for longer than 3 seconds. This forces the current diagnostic message to end and a return to normal operation.

Note – For extended ‘stunt type’ wheelies where the front speed drops less than 35kmh lower than the rear for longer than 3 seconds the user will see a diagnostic message on the TC-Pod display and the Traction Control will be disabled. This will automatically recover once the front wheel is back on the ground.

We go to great lengths to ensure system integrity and to provide a rugged hardware installation, but it is important for any user to know that certain sensors/wiring/devices are critical to system functionality and that a sudden and unexpected failure by external damage or other causes can also lead to a sudden and unexpected de-activation of the TC system.

Throttle diagnostic. The throttle input is used by the TCS to know when the bike is under power, and also when the throttle is closed. We have now introduced a visual display using the blue LEDs to monitor the throttle input.

- Engine must be off to perform this test
- Display will show a ‘-’ on the screen
- Open the throttle and watch the blue LEDs illuminate.
- This proves the throttle input is working correctly
- When the engine starts the normal display of map level will be shown.

2.01 Cut, Retard, Pulse mode

Depending on the amount of wheel slip seen by the TCS and the position in the corner, the TCS produces one of 16 responses ranging from different levels of ignition retard, then on to retard and cuts, followed by retard and pulsed ignition cuts giving longer recovery periods coupled to short power bursts and finally to 85% ignition cut.

The five stages of slip control –

- The bike is at mid corner and neither accelerating nor braking. The lean angle is at maximum and the throttle is closed. TCS system is not active.
- The throttle is opened by the rider which is sensed by the TCS and traction control begins when the sensor voltage exceeds a map specific limit (equal to approx 3deg of throttle opening).
- Sensors within the TCS see that the bike is at mid corner and a very close slip control setting is applied. This setting will be aggressive enough to remove slip but still allow forward momentum. It is not unusual for a momentary high slip value to occur at this point as the transmission backlash is taken up and the resulting shock brakes traction. For this reason we may apply a short ignition cut at this point in certain maps.
- As the bike starts to accelerate and lift up out of the corner, sensors within TCS monitor this and apply different slip corrections.
- With the bike upright and accelerating hard the TCS is still working but will not intervene unless the slip levels indicate a problem.

So how much slip should there be?

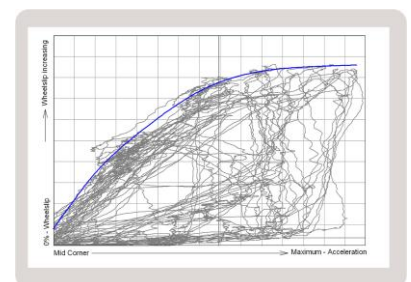
Firstly, without any slip (rear wheel faster than front) there is no propulsion so the system needs to know what is normal and what is excessive. Each tyre model has its own set of characteristics and equally important is the rolling circumference profile at different lean angles.

To give you an example of this, a tyre can generate up to 4% of measured slip just as a function of banking over and the circumference profile changing. This is why it is so important for the TCS system to make corrections based on corner position.

Within the TCS are pre-defined slip maps to suit your tyres and bike.

Each of the nine slip maps within the TCS will have a different table to cope with different riding styles and track conditions.

Within the 4C (4 cylinder) systems the user may also choose to apply Stronger or Weaker traction control in certain areas to suit their riding.



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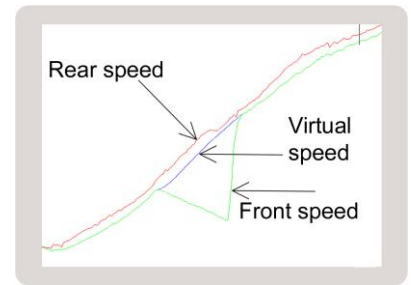
2.02 Overview / Wheelie

The TCS has a complex internal strategy which is able to identify when even the smallest wheelie occurs and also when the wheelie has ended and the front speed data becomes valid again. During a wheelie the front speed data is presumed to be incorrect and a new 'virtual front speed' is calculated and used for the calculation of wheel slip.

There is no user intervention required, as all of this is fully automatic.

The wheelie recognition system is not activated until:

- Throttle > 30%
- Bike speed > 30km/h



Note that extended 'stunt type' wheelies will result in a diagnostic message on the TC-Pod display and the TC system being temporarily disabled.

2.03 Map switches

There are 2 ways of changing the TCS map level, either use the + and – buttons directly on the TC-Pod or use the remote handlebar mounted switches. The TC level 1>9 will be displayed in the centre of the TC-Pod.

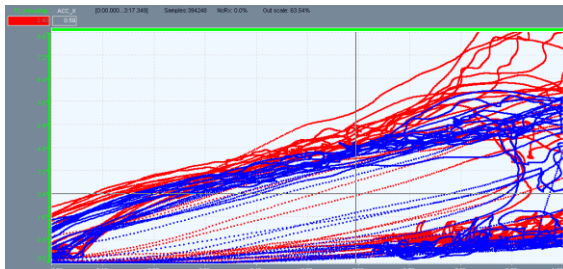
To turn off the Traction Control, use the (-) Down push button and hold for a further 2 seconds. You will see a '0' in the centre of the screen and the red light will illuminate. To turn back on, hold the (+) UP button for 2 seconds.

Which Traction control map should I use?

This of course depends on your riding skills and your typical lean angle, so the best place to start is at the maximum (level 9) and then work down until you feel it is working the way you want it. In an ideal world this will leave you other levels above and below where you are.

Slip explained

The graph below plots acceleration on the horizontal axis, and slip along the vertical axis with zero acceleration and zero slip at the bottom left corner. The blue trace is with new tyres and the red with worn tyres during the same race.



You can clearly see that the worn tyres require more slip to achieve the same acceleration as the new tyres. If the TCS system were not changed during a race to target a higher slip map then the bike would be slower out of the corners, and a lot slower at full acceleration.

It always seems alien to reduce TCS when the tyres are worn and certainly they do slip more. The user has a choice and it depends on their riding abilities. Increase the TCS to reduce the extra spin and accept the reduction in acceleration, or reduce the TCS to allow the tyres more spin and maintain the acceleration, but this requires greater rider skill.

Remember also, you are not removing the traction control; you are simply permitting it to spin more. The control is still there.

Win TC / Software

For users of Win TC the following adjustments are possible

1. Pit speed limit
2. Front and rear tyre size calibration for adjusting TC correction
3. Front and rear trigger teeth count
4. Quick shifter settings
5. Loading alternative slip maps
6. Real time monitor for system inputs
7. Option for Weaker / Normal / Stronger – TCS during corners (4C systems only)
8. View of extended diagnostics (4c systems only)

Details of this software are covered within a separate manual.