

## Subject

### VMAC Digital Throttle Control

## OVERVIEW

In June 2019 VMAC released its first Digital Throttle Control (DTC), to be included with select UNDERHOOD™ 40, UNDERHOOD™ 70, UNDERHOOD™ 150, and Direct Transmission Mount systems. Details of operation and adjustments follow.

## OPERATION

The new digital throttle controller has been designed to closely match the operation of VMAC's previous analog throttle controllers. When system air pressure is low, the engine revs up. When air pressure is close to or at the pre-set system regulated pressure, the engine revs down. How high the engine will rev and when the engine will start to rev up are both controlled using the "Max RPM" and "Ramp Up Pressure" adjustments. The RPM versus pressure behaviour is shown in the figure below.

With the factory throttle controller settings, the system has been set up to operate at its maximum achievable CFM. In some situations, it may be desirable to change this. Below are some of the settings that can be adjusted on the throttle controller to change how the system operates (Figure 1).



Figure 1 illustrates an example and does not reflect the set-points of all systems with DTC.

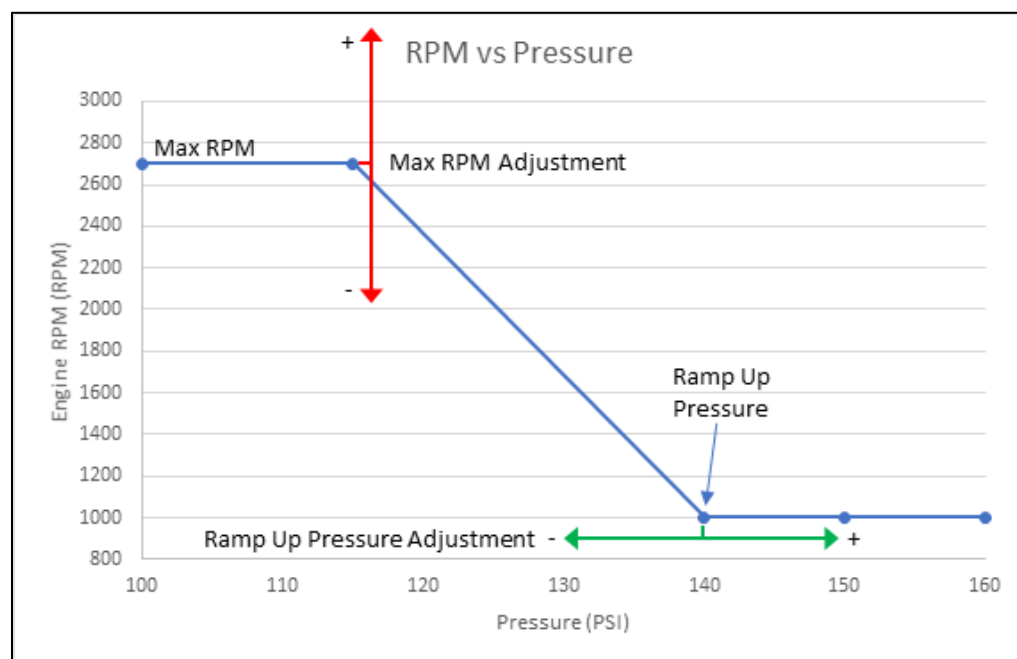


Figure 1

## OPERATION DURING STARTUP

The only time the behaviour of the DTC differs from the figure above is during the initial start-up, or when errors have been detected. Error behaviour will be discussed later. During an initial start-up when air pressure is 0 psi, the engine will rev up slowly to the DTC's maximum rpm to bring the air pressure up to the pre-set, regulated system pressure (usually 150 PSI). If system pressure is achieved before the throttle reaches maximum DTC rpm, it will return to the VMAC base idle. This is known as "Slow Ramp". After the initial start-up and full charge of air, subsequent demands for air will result in quicker throttle response as needed.

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## MAXIMUM & IDLE RPM ADJUSTMENT

The "MAX RPM" is the maximum rpm the engine will run at when the system pressure is significantly low ("RAMP UP PRESSURE" minus 25 psi). For example, the factory setting for a specific system might be 2350 rpm. In some situations, the operator may want to increase or decrease this value. If at 2350 rpm engine noise is too loud and the tooling does not require that much cfm, the "MAX RPM" could be lowered to drop the engine noise level.

Increase/decrease the maximum rpm by pressing the "MAX RPM" up ▲ and down ▼ buttons on the throttle controller keypad (Figure 2). The throttle may temporarily jump up to the currently set maximum rpm to show you the current setting. After 4 seconds of inactivity, the throttle will return to normal and store the new "Max RPM" value. Each button press will adjust the "MAX RPM" by 50 RPM. The range of "MAX RPM" adjustment varies from system to system, but the example above might be from 1000 RPM to 2650 RPM. This setting will be retained in memory and used the next time the system is powered up.

Enable the idle adjust mode by pressing and holding RAMP UP PRESSURE ▲ and ▼ buttons at the same time for about 10 seconds. All LEDs will turn on momentarily to indicate idle adjust mode was successful. The rpm setpoint will drop to idle and the calibration will turn on. The "MAX RPM" ▲ and ▼ buttons now control the idle RPM level and will revert to their normal function once the system has been turned off.

## RAMP UP PRESSURE ADJUSTMENT

The RAMP UP PRESSURE is the pressure the system must drop to before the engine will begin to rev up. If system air pressure continues to drop, the engine RPM will continue to rise until it reaches "Max RPM". The RAMP UP PRESSURE typically is set 10 PSI below the system pressure. Default system pressure is 150 PSI, which means the default RAMP UP PRESSURE is set to 140 PSI. This is indicated by an LED on the throttle controller. If the system pressure is adjusted on the VMAC compressor, adjust the RAMP UP PRESSURE accordingly. For example, if the system pressure on the VMAC compressor is set to 170 PSI, set the RAMP UP PRESSURE to 160 PSI.

There are 4 RAMP UP PRESSURE settings: 100 PSI, 120 PSI, 140 PSI (default), 160 PSI. Increase/decrease the RAMP UP PRESSURE by one step by pressing the RAMP UP PRESSURE ▲ or ▼ once. The LED will move to the new settings indicating that the change has been made (Figure 2). This setting will be retained in memory and used the next time the system is powered up.

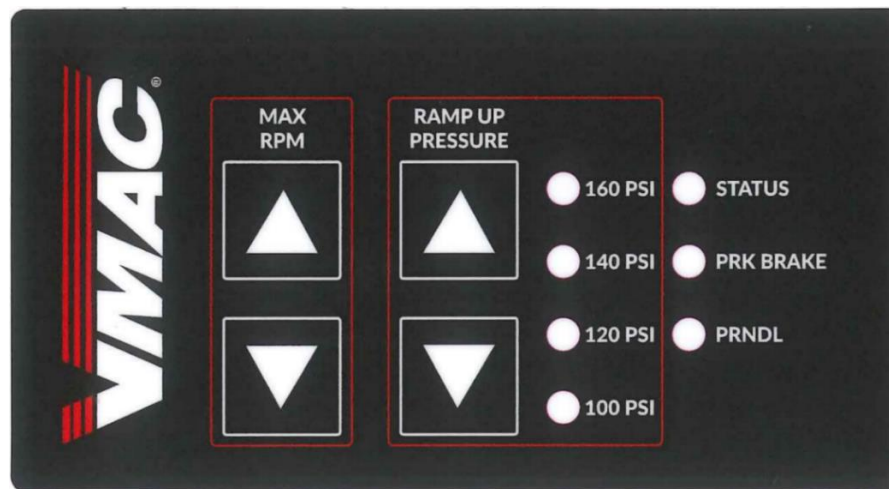


Figure 2

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## FACTORY RESET

The "Factory Reset" will reset the system settings to the factory default values and is accessed via the small hole on the side of the throttle controller box.

Do not trigger the "Factory Reset" while the air is being used; ensure all air tools are off and no air is being drawn.

To trigger a "Factory Reset", press the "Factory Reset" button using a paper clip (or similar) to press and hold for 4 to 5 seconds. Once the "Factory Reset" has been triggered, a small click will be heard (sound of the relay opening and closing). All of the LEDs will turn on for several seconds while the settings are set back to their factory default values. After the LEDs return to their normal state, the system is ready for use again.

## INDICATOR LEDs

- **STATUS (green/red):** Is green when the throttle controller is active and the system is operating normally. Is blinking red when throttle controller is not active and system is not operating normally. The red LED will blink an error code to indicate the problem. When neither the green nor the red LED is active, this indicates that the PRK BRAKE is not ON and/or the PRNDL is not in PARK or NEUTRAL.
- **PRK BRAKE (green):** For UNDERHOOD™ 40 systems, is green when the park brake is ON. For UNDERHOOD™ 70 and UNDERHOOD™ 150 systems, is always green regardless of park brake position.
- **PRNDL (green):** Is green when the vehicle is in PARK or NEUTRAL.
- **160 PSI, 140 PSI, 120 PSI, 100 PSI (green):** Indicates the current "Ramp Up Pressure" setting. Only one setting can be selected.

## SAFETY FEATURES

The digital throttle controller has built in safety features that will prevent the throttle controller from operating if an unsafe condition is detected. When this happens the digital throttle controller becomes inactive; the STATUS LED will turn OFF, and the engine will remain at idle. Once all unsafe conditions have been rectified and the digital throttle has been turned OFF and ON again, it will operate as normal.

Condition	Throttle Controller State	LED State
<b>Normal</b>	Active	STATUS LED green PRK BRAKE LED green PRNDL LED green
<b>Not in PARK or NEUTRAL (PRNDL)</b>	Not Active	STATUS LED off PRNDL LED off
<b>Park Brake not on</b>	*Not Active	STATUS LED off PRK BRAKE LED off
<b>No RPM data (either no tach or no OBD2 comms)</b>	Not Active	STATUS LED blinking red (2 pulses)
<b>Bad pressure sensor</b>	Not Active	STATUS LED blinking red (3 pulses)
<b>RPM too high</b>	Not Active	STATUS LED blinking red (4 pulses)
<b>Voltage too high/low</b>	Active	STATUS LED blinking red (5 pulses)

\*The park brake sensor is only used on UNDERHOOD™ 40 systems. On UNDERHOOD™ 70/150 systems, the park brake is not monitored by the digital throttle and the PRK BRAKE LED will always be on.

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## ERROR CODES

If an error is encountered, the STATUS LED will blink a set number of pulses corresponding to the respective error code. If multiple error codes exist, the throttle controller will cycle through all error codes repeatedly. To clear an error code, turn the system OFF, fix the problem, and then turn the system ON again.

# of STATUS LED Pulses	Description
<b>2</b>	<b>RPM error.</b> No RPM detected via the OBD2 port (or tach wire if applicable). Possible causes: <ul style="list-style-type: none"> <li>• Bad crimp/wire/connector connection on the OBD2 harness from the DTC to the OBD2 wires</li> <li>• OBD2 harness wires connected to the wrong wires</li> <li>• Bad crimp/wire/connector connection on the Main harness from the DTC to the tach wire (if tach is applicable)</li> <li>• Main harness tach wire connected to the wrong wire (if tach is applicable)</li> <li>• Damaged DTC PCB</li> </ul>
<b>3</b>	<b>Pressure sensor error.</b> Pressure sensor signal is either too high or too low. Issue could be a crushed cable, damaged pressure sensor, bad connection, or damaged throttle controller. Possible causes: <ul style="list-style-type: none"> <li>• Pressure Sensor harness cable crushed or cut</li> <li>• Pressure sensor damaged</li> <li>• Bad crimp/wire/connector connection on the Pressure Sensor harness from the DTC to the pressure sensor</li> <li>• Damaged DTC PCB</li> </ul>
<b>4</b>	<b>RPM too high.</b> This error occurs when the "RPM Too High" threshold has been exceeded (usually around 3500 RPM). Possible causes: <ul style="list-style-type: none"> <li>• Compressor clutch not engaging</li> <li>• Starting the system when the engine RPM is high</li> <li>• Wrong code or wrong DTC for the vehicle</li> <li>• Damaged DTC PCB</li> </ul>
<b>5</b>	<b>Voltage too high/low.</b> The system will continue to operate with this error. This error occurs when the battery voltage is either too high or too low. The normal operating range for the throttle controller is 9.8V to 16V. Possible causes: <ul style="list-style-type: none"> <li>• Vehicle battery is almost dead, damaged, worn</li> <li>• Alternator is damaged and voltage output is too low or too high</li> <li>• Damaged DTC PCB</li> </ul>

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