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# TBM

**AFRICA:  
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**AUTOHROTTLE**  
THE LATEST INNOVATION

**RUNWAY SAFETY**  
Watching out for the little things



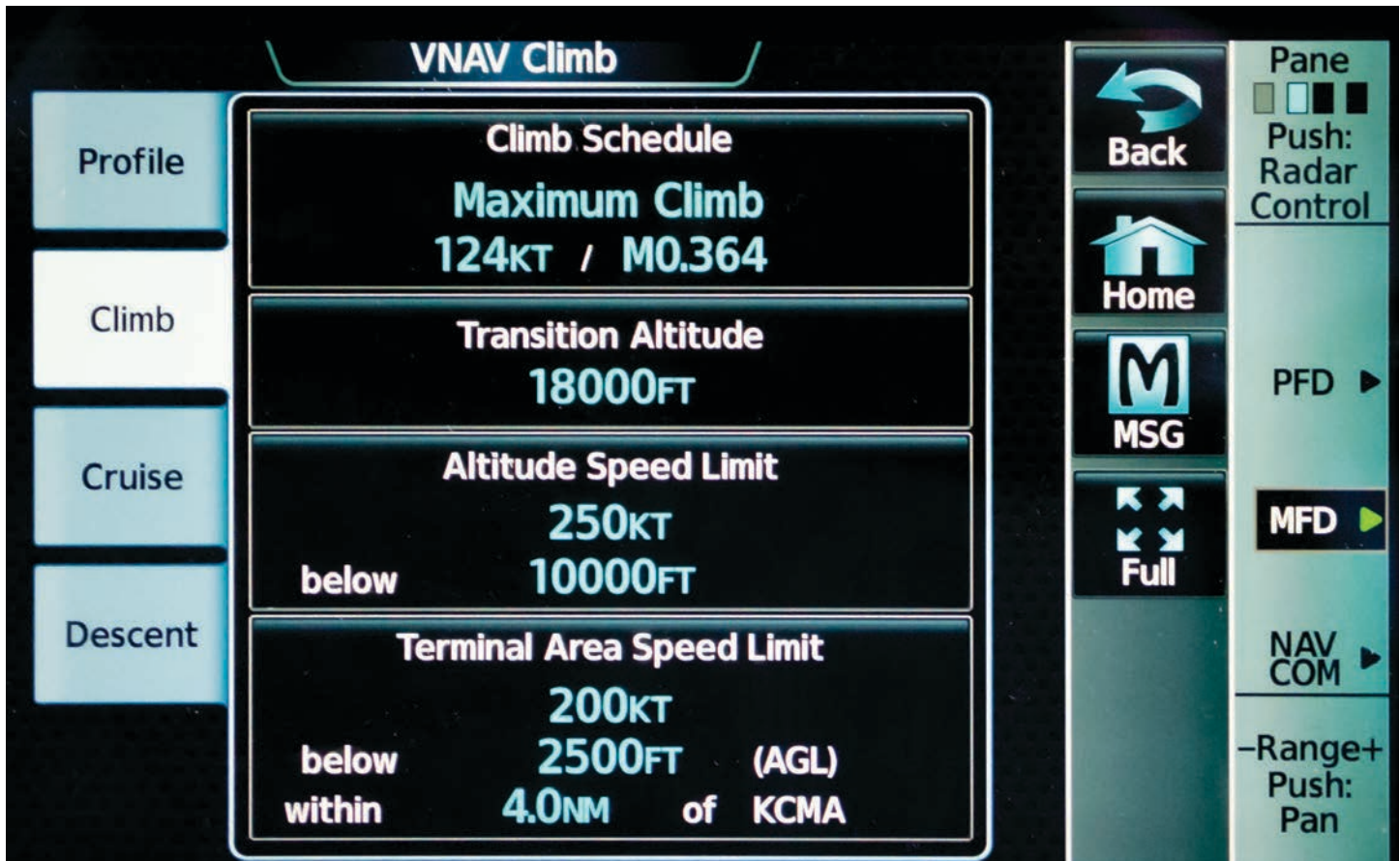
## DAHER'S LATEST INNOVATION: **AUTOTHROTTLE** A TECHNICAL REVIEW

by Danielle Booth

*Autothrottle is the latest enhancement to the TBM in Daher's long heritage of innovation and aviation firsts and is one of the most advanced systems available in general aviation today. The autothrottle application on the TBM is surprisingly stable for a first-generation component, a testimony to DAHER and Garmin's diligence to bring a mature product to the aircraft. Autothrottle has been dubbed an E-Copilot by DAHER, and it is that and much more, improving the TBM flying experience across a multitude of flight phases. The arming of the autothrottle for all phases of the flight can either be done before takeoff, or if the pilot wishes, at any time during the flight.*

**For take-off:** When armed for takeoff, the autothrottle engages when the power lever is manually advanced through 70% torque. The autothrottle takes over and at that point, advances the throttle to exactly 100% torque while at the same time protecting the engine from any of the other parameters that could cause a costly maintenance event. This now relieves the pilot of controlling the throttle and having to be concerned about ram rise, over torque, over temp, or Ng over speed. The pilot now only needs to focus on the runway, rotate at the appropriate speed, and manage the pitch and yaw of the aircraft.

**Pre-set customizable profiles:** The autothrottle system has preset climb, cruise, and descent profiles for universal use on every flight and features the ability to customize the profiles for individual missions.



**In the climb:** The speed parameters are customizable. One can elect to climb at a Maximum Climb, Enroute Climb or Pilot-Defined Climb. Once the speed profile is set, the autothrottle takes over managing the airspeed and setting torque to meet the selected profile. The system precisely manages the speed taking into consideration the torque, ITT and the Ng speed, and respecting the max power tables set by Pratt and Whitney.

**In the cruise:** One can select between Recommended Cruise, Maximum Cruise, Long Range Cruise, or Pilot-Defined Cruise. The autothrottle does all the calculations for where the torque should be set for any of the available cruise settings given the current outside air temperature and altitude.

**In the descent:** The autothrottle manages torque so that one does not have to continually back the

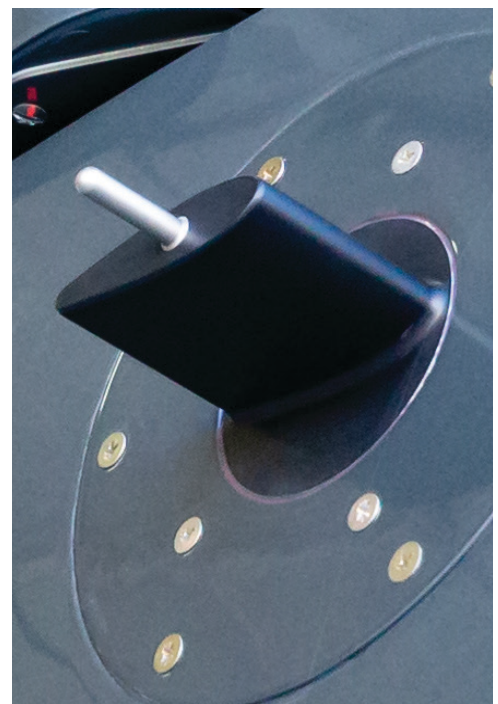
throttle off to maintain a constant airspeed. One simply dials in the descent schedule or pilot-defined speed and the autothrottle manages the incremental decreases in torque as the air gets denser through the descent.

**V-Nav in three dimensions:**

Autothrottle takes V-Nav to the next level, allowing a pilot to enter a fix with a crossing altitude, and now at a crossing speed. Pilots can dial in the parameters, and the plane will fly a precise descent with no effort by the pilot required to manage the energy and engine in the descent. With the V-Nav/autothrottle functionality, one can also select a transition level and speed constraints.

**Inertial Separator use:** At any time if the plane encounters conditions that warrant the use of the inertial separator (either deployed by the pilot or by the Auto Ice System), the torque, IT and Ng are all managed

by the autothrottle. For example, if ice is detected by the Auto Ice Detection System and the Inertial Separator is automatically deployed the autothrottle will note the rise in Ng or ITT and set the power to remain within the limitations. This feature eliminates one of the most prevalent areas of flight overtemps and compressor over speeds.



# Autothrottle: A Technical Review

**On approach:** When an arrival is loaded into the system, oftentimes there are crossing speeds that are associated with fixes on arrivals. The autothrottle will observe these restrictions as you approach the fix and automatically retard the throttle and provide precise crossing speeds, leaving the pilot only to manage the aircraft systems rather than continually setting torque to manage speed. Effectively, the autothrottle adds another level into the VNAV system, allowing one to cross a fix at an altitude and a specified airspeed.

**In the pattern:** One can elect what speed to fly the pattern and the autothrottle will hold that speed precisely. If you elect, it can hold 150 knots on downwind, and as you turn base you can set 120 knots, and as you roll out on final you can set 85

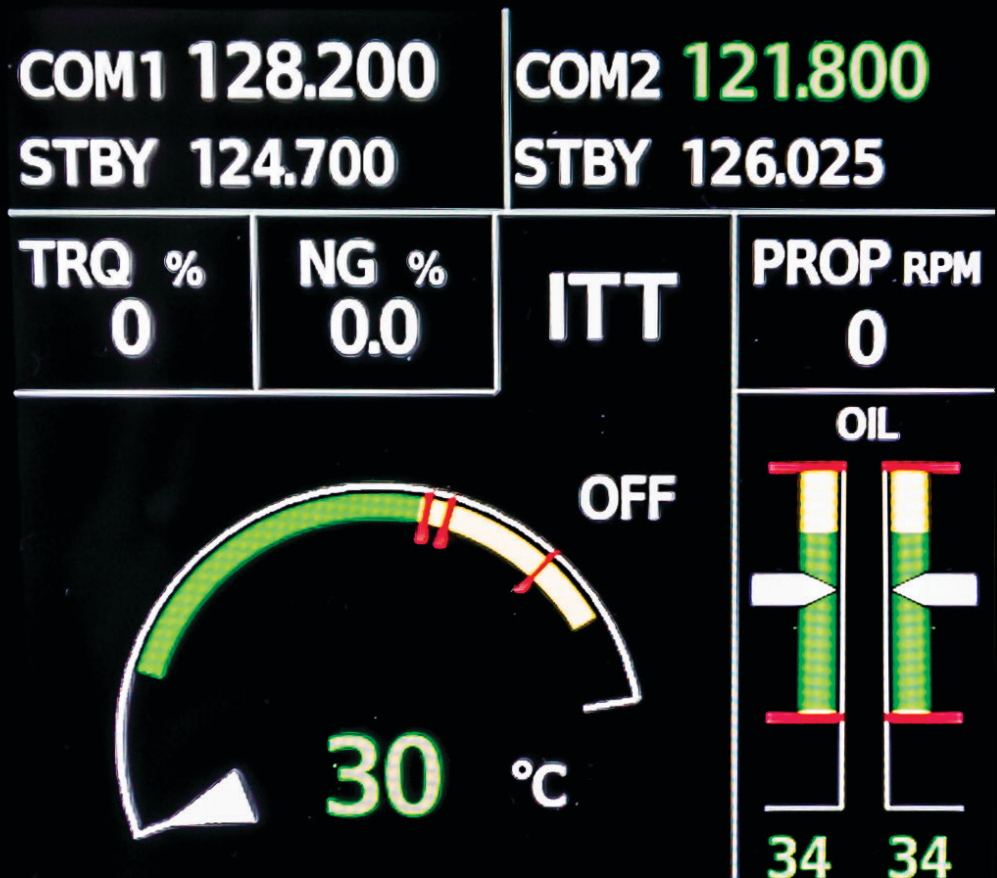
knots. This feature lets you simply fly the plane and not have to worry about tweaking the throttle as the energy decays. The plane will fly at the precise speed that you have set. This provides the pilot substantially more bandwidth for monitoring the traffic environment and mitigating other distractions during this critical phase of flight. This feature could be particularly useful while flying in busy terminal environments to Class Bravo airports, like in the vicinity of LAX or SFO.

**On a go-around:** The phase of flight that creates the highest work load, the go-around, is now merely a job of management. When a pilot engages the Go-Around switch on the throttle, the power rolls up to 100% torque, the flight director bars pitch up to 10 degrees and the

plane will fly the published missed approach. This makes the maneuver very simple, stress free, and most importantly, safe.

**For safety:** The autothrottle is integrated into the Envelope Protection System, so anytime the plane gets slow, the Autothrottle will compensate with max power for recovery, then retard to 50% torque to allow the pilot to take over. For example, if one is flying without the autothrottle engaged, with AP on, EPS activated, and gets slow, the stick pusher will push the nose over, the autothrottle will advance to 100 percent torque and once recovered, will return the plane to the original altitude and retard the power to 50% torque. If one tries to stall the aircraft at FL310 (a maneuver that is on the edge of the envelope for this plane), it is impossible to stall irrespective if one is on autopilot or hand flying because the EPS will engage and the autothrottle will take over. This feature effectively erases the possibility of a stall, therefore, significantly reducing the likelihood of a loss of control incident, the leading cause of loss of life in the fleet.

**Auto ice detection:** Another first for turboprops is the Automatic Ice Detection System. The detection is done through a probe mounted on the vertical stabilizer that vibrates at a defined frequency. If any ice accretion occurs on the probe, the frequency of vibration changes turning on windshield heat, inertial separator and the de-ice boots. The autothrottle will automatically react to these changes and set the appropriate power. Once the aircraft leaves icing conditions and the normal frequency range restored, the Auto Ice Detection switches off,



another way in which DAHER has worked to relieve workload and provide protection to the aircraft.

**For your scan:** The 940 has a Parameter Limit Indicating Gauge that prominently displays the primary indication that is most closely approaching its critical limit. For example, if you are taking off on a hot day and you are approaching ITT limits, the ITT gauge becomes the primary gauge. If you were approaching a torque limit, the torque gauge would become the primary gauge and the other indicators would still be visible but not prominent. During start, the Ng appears first and then is replaced by the ITT gauge as that becomes the most important parameter. This enables the pilot to focus on the most critical parameter and provides a less cluttered scan of the primary engine instrument during any phase of flight.

**For the pocketbook:** The autothrottle works off a trending algorithm and makes sure that you stay within the suggested operating limits laid out by Pratt and Whitney, effectively making it nearly impossible to overtemp one's engine with AT engaged.

To keep you in good graces with the Feds: The system is smart and knows when one is flying below Class Bravo and slows down to 200 knots and respects speed limits in designated airspace, altitudes, and within the terminal environment. Conveniently, the altitude speed limits and terminal speed limits can be manually adjusted by the pilot.

**Less jockeying:** The throttle lever in the TBM is sensitive and pilots tend to focus on it when making power changes and during take-off and landing. The autothrottle manages the application of power during all phases of flight and does so with a precision and efficiency that is unmatched by human ability.

**You're still in control:** There is a manual speed control setting for the autothrottle, so you can always switch between the FMS and MAN function to set to a specific airspeed. If

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you want to shake the dust off your right hand occasionally, simply turn auto throttle off, and “hand fly” the throttle at any time! There are many ways to disconnect the autothrottle; clicking a button on the throttle itself, clicking a button on the autopilot mode controller, or simply just put your hand on the throttle and disconnect automatically like you can with cruise control on your car.


### **Did I mention the system is smart?**

The system works precisely off a trending algorithm that considers current airspeed, angle of attack, throttle position, engine power output, fuel load, density altitude, outside air temperature, and aircraft configuration. The autothrottle algorithm does math quicker than any human and considers more factors than even the most diligent aviator. It reacts to things that are unable to be calculated by a human pilot and makes corrections based off trends, effectively making inputs and taking important action quicker and more precisely than any pilot could be able to. It also accounts for the aircraft’s configuration when looking at airspeed limitations.

**Flight Experience:** Once the autothrottle is set, the power or speed that you have dialed in is precisely managed in a manner that can only be described as “Precision Control.” As typical with Daher, this is a modern product that is impressive in all aspects. Coupling the precise control of the autothrottle with the GFC-700 autopilot gives a flight experience that is unmatched in terms of how smooth and coordinated the TBM 940 carries itself through the sky.

The improved flying characteristics and added safety are only the start. It

is foreseeable that there will be other benefits that shake out as a result of autothrottle technology. Autothrottle technology paired with Garmin software is sure to provoke even further modernization and features. As Daher has announced, safety features like autoland may be in the near to immediate future. The robust and accurate autothrottle system may expedite the availability of more advanced technologies for the TBM platform. It will also be interesting to see if the insurance underwriters recognize the added safety feature with some sort of modification in underwriting rates. With the volatility that we are observing in the insurance market today, one would hope they would recognize those that have invested in equipment that directly correlates with a reduction in accidents. Another foreseeable positive result of the autothrottle platform will be customer longevity and retention. Many TBM pilots are nearing the mature stages in their flying careers. The safety advancement and reduced workload will be attractive to pilots looking to simplify their flying and reduce risk.

To learn more about the tactical use and functionality of the autothrottle on the TBM 940, go to your myTBMdocs app and under the “Video” tab titled “GTC Mgmt for Autothrottle,” Daher and Mark Diaz have released a very informative video showing operational use of the touchscreen GTC paired with the autothrottle interface. Flying the 940 is surreal; one can’t help but think to oneself that “We really are living in the future.” The autothrottle has far surpassed even the most imaginative of expectations and done so with unmatched precision. 

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