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FUEL ECONOMY AND THE MODERN TRANSMISSION

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General Fuel Economy Tips

❑ **Get Involved with OEM in Vehicle Design During Pre-Production Meetings**

  ❑ **Pick your drivetrain (axle ratio, tire size, etc.) to best match the vehicles characteristics, expected duty cycles, terrain, etc.**

  ❑ **Have OEM make various performance scans**

❑ **Reduce Parasitic Losses**

  ❑ **Monitor tire pressure / wheel alignment / brake functionality**

  ❑ **Consider utilizing electric accessories (i.e radiator fans / A/C system)**

  ❑ **Control your A/C settings (is lowest temp. always necessary?)**

  ❑ **Use synthetic oils / lower viscosity oils**

  ❑ **Monitor idle time, consider a shutdown timer**

  ❑ **Monitor maintenance practices / intervals and adjust to maximize fuel economy**

  ❑ **Choose a transmission shift schedule that properly performs yet maximizes fuel economy for the vehicles duty cycle**

❑ **When discussing fleet fuel economy, be aware of differences in fleet configurations to ensure "apples to apples" comparison (i.e. axle ratio, tires, fan type, route, etc.)**
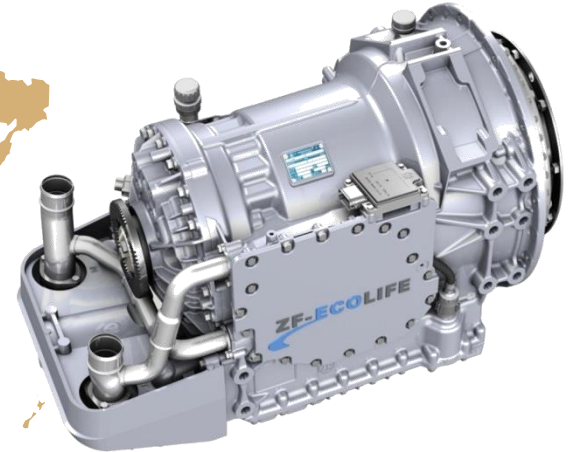
Fuel Economy Features of Modern Transmissions

- ❏ **AIS (Automatic Idle Shift) / RELS (Reduced Engine Load at Stop) / ANS (Automatic Neutral at Standstill)**
    - ❏ **Pseudo-neural state during stop**
    - ❏ **Eliminates converter losses – 20 to 30% reduction in engine load = less fuel used**
    - ❏ **Reduced heat load on transmission.**
    - ❏ **Reduced wear on engine components.**
- ❏ **AIS (Automatic Idle Shift) While Driving**
    - ❏ **Activate AIS before full vehicle stop**
- ❏ **Vehicle Mass and Topography Calculations (Topodyn / LBSS / Sensotop)**
    - ❏ **Use of various measurements and calculations to determine best shift points based on load / grade**
    - ❏ **Automatically select different shift strategies based on vehicle load / grade**
- ❏ **Shift to Neutral With Parking Brake Apply (Auto Neutral)**

Fuel Economy Features of Modern Transmissions

- ❑ **Active Acceleration Limitation (VAC Management)**
  - ❑ **Consider allowing less than APTA acceleration requirements**
- ❑ **Oil Pump Pressure Management**
  - ❑ **Bypass main pressure to reduce parasitic loss**
- ❑ **Lock Up Torque Converter in 1st Gear**
- ❑ **Use Torsional Damper Converters**
- ❑ **Use Low Viscosity Transmission Oils**

Questions?

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Thank you for your attention!

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Detailed Appendix

What Is AIS / RELS / ANS?

Automatic Idle Shift (AIS) / Reduced Engine Load at Stop (RELS) / Automatic Neutral at Standstill (ANS):
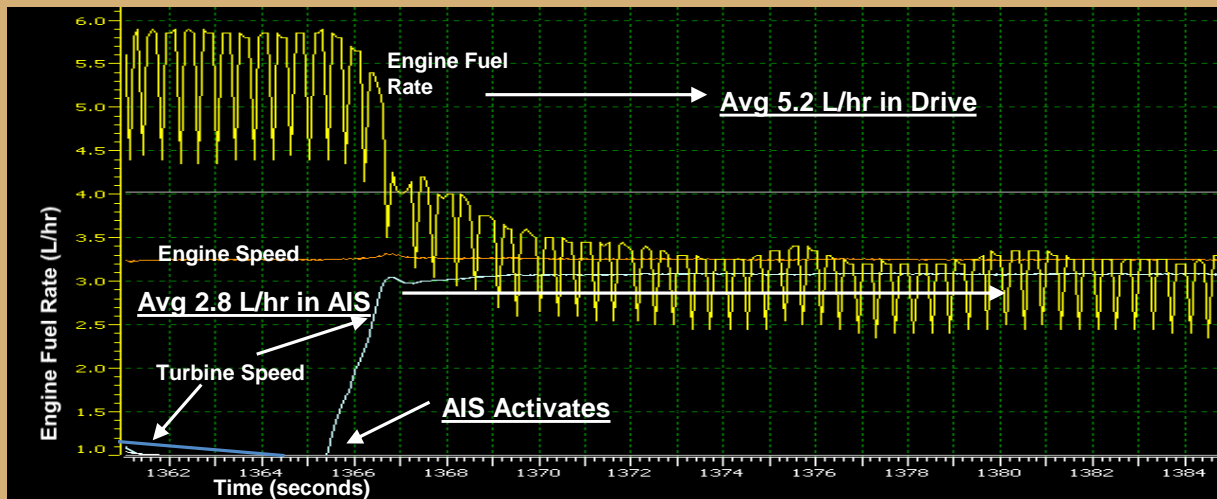
AIS / RELS / ANS is a function that puts the transmission into a pseudo-neutral state once at a stop:

- ❑ **The process begins when the driver presses the brake to come to a complete stop**

- ❑ **Once the vehicle is at rest and all conditions are met, AIS / RELS / ANS is engaged**

- ❑ **Once engaged, the transmission is in a pseudo-neutral state**

- ❑ **When in AIS / RELS / ANS, some OEM's set the vehicle brake interlocks or lock the transmission brake clutches to prevent any possible rollback**

- ❑ **To release AIS / RELS / ANS, OEM's generally perform this in one of two ways:**

  - ❑ **Throttle tip in**

  - ❑ **Footbrake release**

AIS / RELS / ANS

- ❑ **The AIS / RELS / ANS function puts the transmission into a pseudo-neutral state when the vehicle comes to a stop**

- ❑ **Transparent to driver**

- ❑ **~50% fuel saving compared to idling vehicle in drive**

- ❑ **Save approximately 1 gallon of fuel per 100 minutes**

Measurement from a Cummins ISL280 EPA10 model engine

What Is Automatic Idle Shift While Driving?

**Automatic Idle Shift (AIS) While Driving:**

AIS while driving is a function that puts the transmission into a pseudo-neutral state once the vehicle is close to stopping:

- ❑ **The process begins when the driver presses the brake and is ready to come to a complete stop**

- ❑ **Once the vehicle is close to a stop and all conditions are met, then AIS while driving is engaged**

- ❑ **This engagement happens just after the retarder is no longer effective but the vehicle is still rolling**

- ❑ **Once engaged, the transmission is in a pseudo-neutral state**

- ❑ **Once in AIS, some OEM's set the vehicle brake interlocks or lock the transmission brake clutches to prevent any possible rollback**

- ❑ **To release AIS while driving, OEM's generally perform this in one of two ways:**

  - ❑ **Throttle tip in**

  - ❑ **Footbrake release**

AIS While Driving

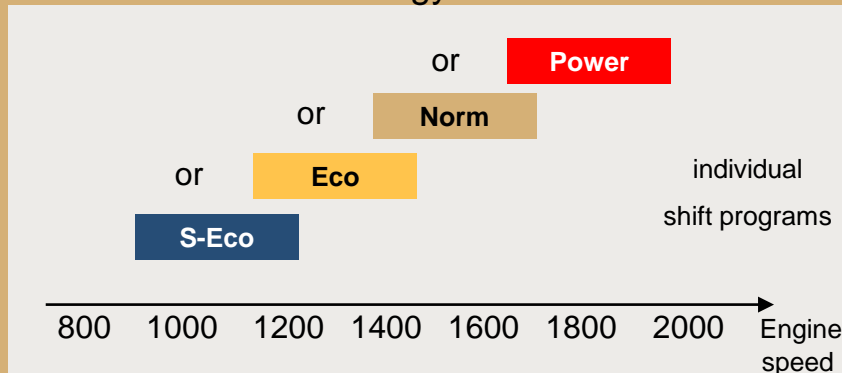- **Automatic Idle Shift (AIS) while driving function puts the transmission into a pseudo-neutral state when the vehicle comes close to a stop.**

- **Transparent to driver.**

- **With this feature, ZF EcoLife transmission is able to gain ~5.5 seconds of additional AIS per stop. That is an approximate fuel savings of 1 gallon/850 stops.**
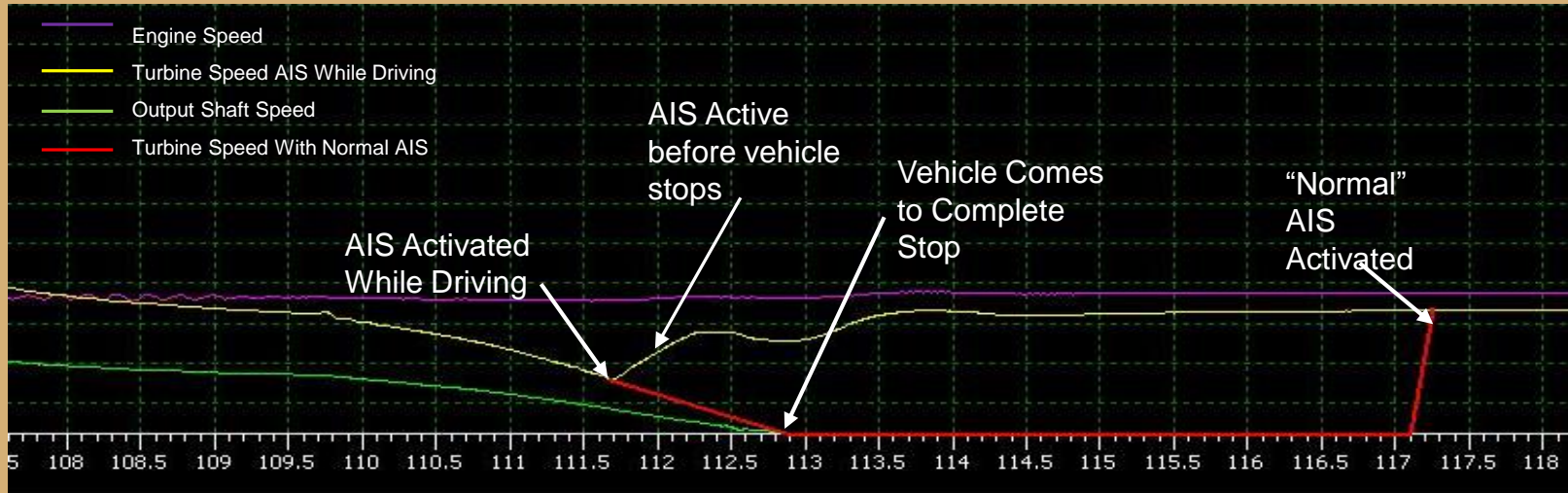
# Vehicle Mass / Topography Calculations (Topodyn / LBSS / Sensotop)

❏ Automatic shift program selection depends upon the topography

State-of-the-art technology

or **Power**

or **Norm**

or **Eco**

S-Eco

individual

shift programs

800 1000 1200 1400 1600 1800 2000   Engine speed

ZF TopoDyn

| S-Eco | Eco | Power |

shift vector

Level   **Increase**

800 1000 1200 1400 1600 1800 2000   Engine speed

-vs-

❏ Different shift programs stored at the control unit; however, only one program is active at a time.

❏ Optional: Hidden eco / power switch for workshop personnel for switching back and forth between two programs.

❏ Electronics select the shift point within the respective program in a gradient- and load-related manner.

❏ Used for current competition fuel savings technology, as they switch between the various programs.
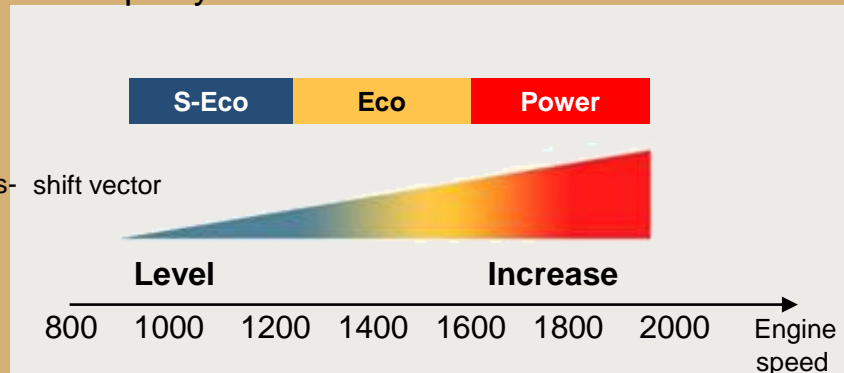
❏ The control unit calculates inclination percentage & utilizes torque pre-calculation on a continuous basis to dynamically select the optimum shift program for the current topography.

Advantages:

+ Reduction of fuel consumption on flat grounds (starting with the Eco - program).

+ Increase of drivability on gradients (uphill/downhill).

+ Higher level of stability of the individual drive programs in order to prevent gear hunting.

ZF Ecolife With Topodyn Technology

ZF TopoDyn adjusts the shift points in a continuously
variable manner without the need for discrete program changes

Topodyn shift vector technology

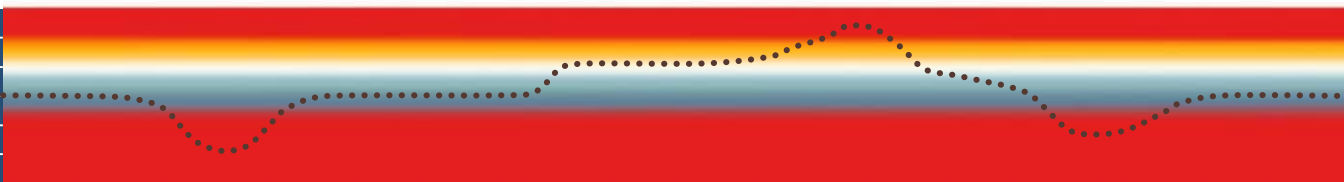S-Eco   Eco   Power

Level   Increase

Mass / Topography Calculation

Route Profile

Inclination
(%)

+ 10
+ 5
0
- 5
- 10

TopoDyn Life

What Is Acceleration Limitation (VAC Technology)?

- One of the most effective features inside Topodyn / LBSS technology is the fact that it utilizes a vehicle acceleration limitation at launch.

- Most vehicle drivers depress the accelerator pedal to 100% at takeoff, even though it may not always be necessary.

- Using acceleration limitation technology, the transmission controller watches the acceleration <u>rate</u> (∂ m/s^2) rise.

- Once the acceleration <u>rate</u> rise hits the pre-defined limit in the transmission software, the controller begins to send a torque limit to the engine to slow the vehicle's acceleration down.

- When the vehicle slows down to below the pre-defined acceleration rate limit, then the torque limit from the transmission to the engine is released.

- The end result is eliminating driver influence to vehicle behavior, which provides a consistent, smooth ride from vehicle to vehicle / driver to driver.

- Most important, IT SAVES FUEL!

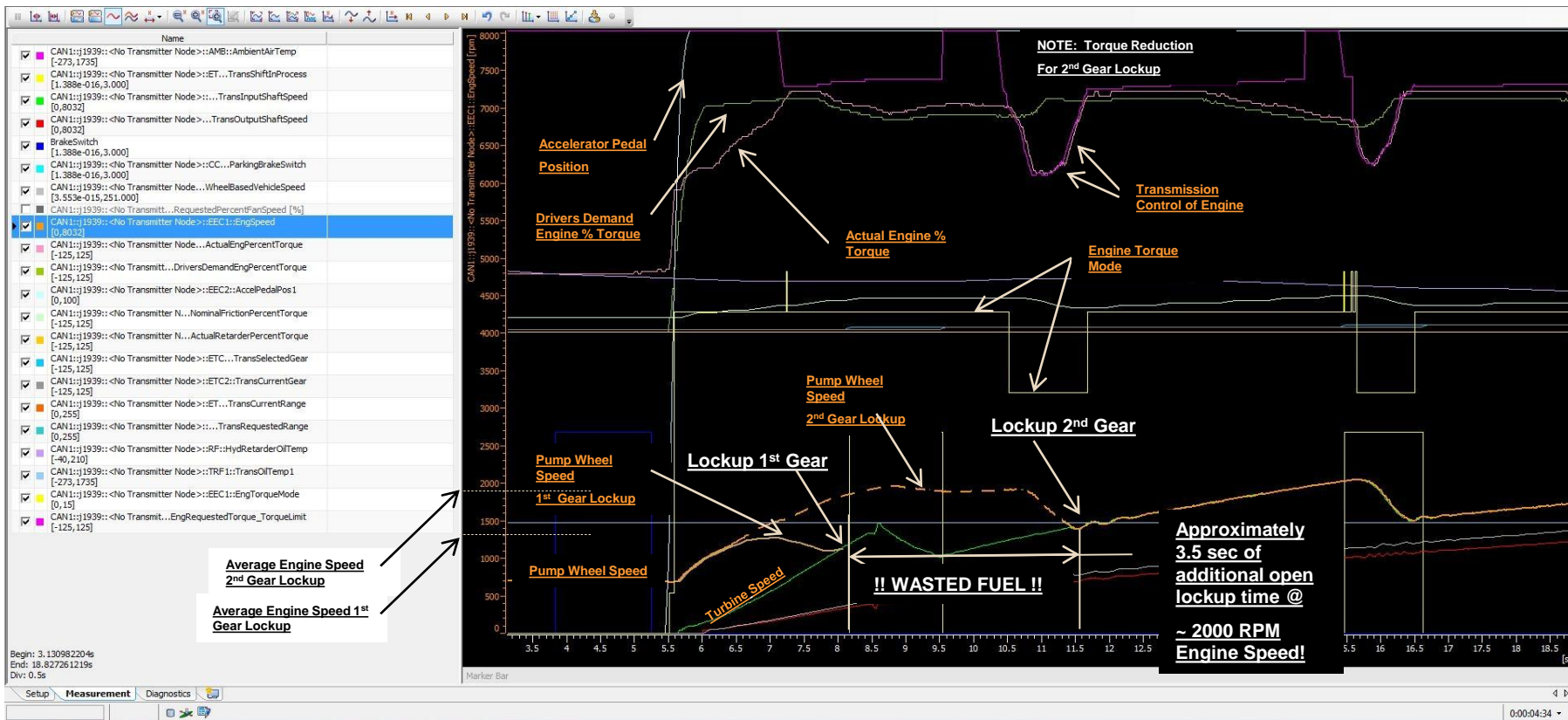# What Is Acceleration Limitation (VAC Technology)?
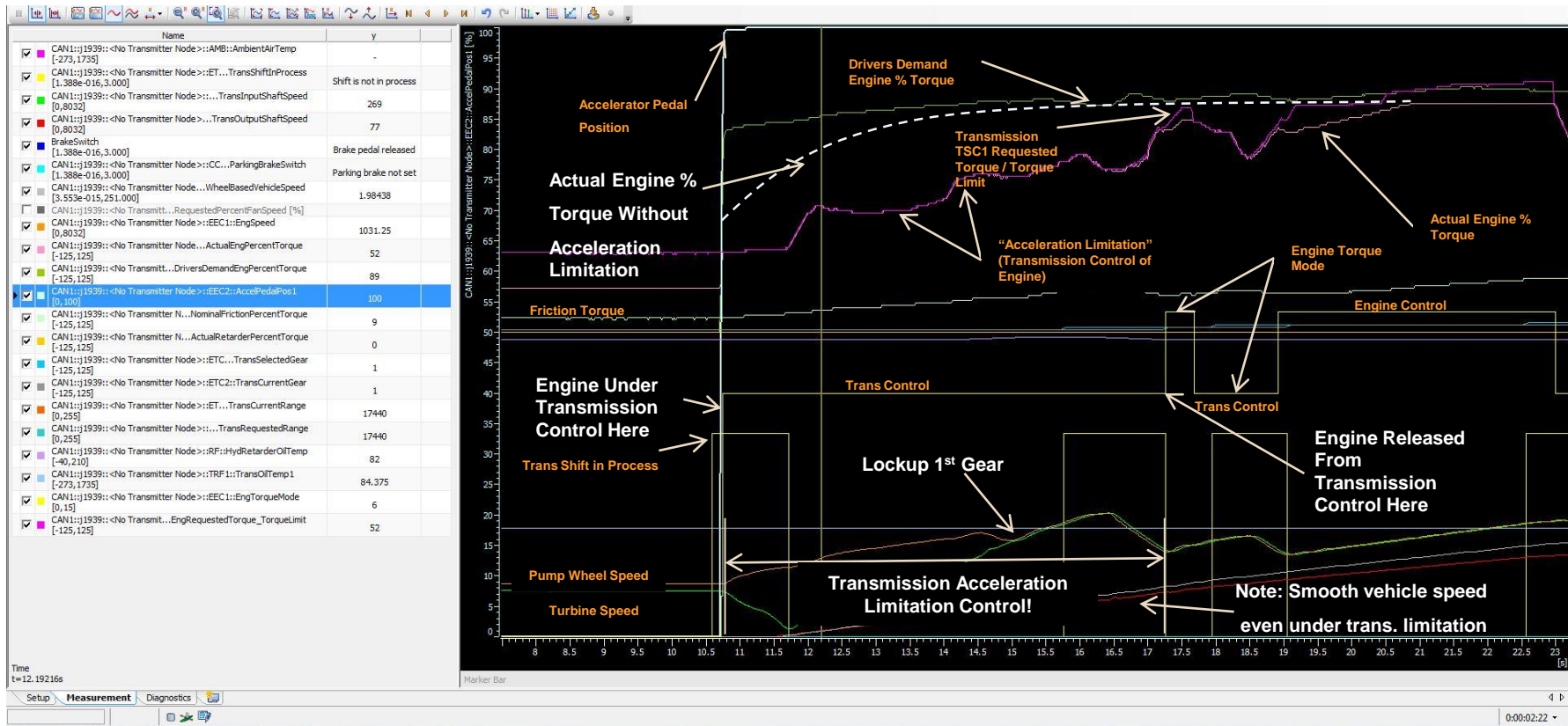
Torque Converter Lockup In 1st Gear

- ❑ **Traditionally, torque converter lockup is performed in 2nd gear for transit bus applications**

- ❑ **In the past, 2nd gear was chosen as it provided the most comfortable shift given the hardware and controls available**

- ❑ **This was considered "state of the art" in its time as it provided the most driver / passenger comfort. However, the price for this comfort is increased fuel consumption**

- ❑ **As the demand from the end user for improved fuel consumption rises, it becomes critical to implement 1st gear lockup for gaining further efficiency.**

New Technology:

- ❑ **With the addition of torsional dampers in torque converters, variable control valves and rapid TCU processors, 1st gear lockup has become a possible reality for the North American Market.**

- ❑ **Hence, additional fuel economy could be realized as a result.**

Torque Converter Lockup in 1st Gear

Thank you for your attention!

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