SECTION A-2:
SHIFT CALIBRATION FAMILIARIZATION

ALLISON 6TH GENERATION CONTROLS

APPLICABLE MODELS: **1000/2000 Product Family**
2900 Product Family
3000 Product Family
4000 Product Family

Contents:

SECTION A-2: SHIFT CALIBRATION FAMILIARIZATION FOR ALLISON 6TH GENERATION CONTROLS

1.0 PURPOSE

The purpose of this section is to describe Allison 6th Generation Controls (6th Gen) shift calibrations. For a description of Allison 6th Generation Controls system features and components, refer to *Section A-1: Controls System Familiarization for Allison 6th Generation Controls*.

2.0 REFERENCED DOCUMENTS

Unless otherwise noted, all documents referenced in this document may be found in the Allison HUB website at https://hub.allisontransmission.com/login. To locate the referenced documents look for Tech Data under the Engineering heading on the Allison HUB home page. In this document, these references are identified by italic font. Contact your Allison Transmission representative if you do not have access to the Allison HUB. A list of all items referenced in this document can be found at the end of this document.

3.0 TRANSMISSION SHIFT CALIBRATIONS

The transmission shift calibration includes multiple sets of shift scheduling options which are used to control transmission operation based on operator request and various vehicle operating conditions. The shift calibration is one component of the overall TCM calibration.

These shift schedules determine when range shifts will occur by two means, table-based shift scheduling or DynActive™ Shifting. The point at which each shift occurs within table-based shift schedules is determined by a combination of transmission output speed, engine throttle position, and vehicle acceleration. Table-based shift schedules are not available for the 2900 Product Family. DynActive™ Shifting utilizes those inputs in addition to environmental and other vehicle parameters to meet drivers' power demands more efficiently and intelligently than table-based shift scheduling. A table-based shift schedule is typically defined by a shift strategy and a shift speed. Each shift schedule consists of multiple sets of upshift and downshift points for various throttle positions. DynActive™ Shifting is defined by an economy index for both flat ground operation and on-grade operation.

The upshift and downshift points affect the timing of shifts commanded by the TCM. The shift points have no effect on the number of gear ranges that may be commanded. The number of available gear ranges varies depending upon the transmission model and the selected range position of the shift selector. Typical shift sequences for each transmission model, including available gear ranges and availability of lockup operation in each range, are discussed separately in Section B: System Operation for the 1000/2000, 2900 or 3000/4000 Product Families.

The most commonly used shift schedules and DynActive™ Shifting are described in this document.

4.0 PRIMARY AND SECONDARY SHIFT SCHEDULES

The TCM accommodates two shift schedules, labeled as primary and secondary schedule. Primary and secondary shifts schedules may have unique shift speeds, strategies and number of ranges, as defined in the calibration. The secondary schedule can be requested by the operator, automatically via Dynamic Shift Sensing, or can be result of an input from another vehicle system.

The primary and secondary shift schedules must be specified when the transmission calibration is defined. Frequently, either a Performance or an Economy shift schedule is selected for the primary shift schedule, based on the most common use of the vehicle. The other shift schedule is selected for the secondary shift schedule. Dynamic Shift Sensing automatically toggles between these two shift schedules automatically based on conditions.

4.1 SHIFT STRATEGIES FOR THE 1000/2000 PRODUCT FAMILY

The following shift strategies are available for use with the 1000/2000 transmissions:

- **Variable** – Suitable to be used with all engine governor types, especially variable speed, or all-speed, governed engines. The Performance shift schedule has wide open throttle (WOT) upshifts near full load governed speed (FLGS). The Economy shift schedule is typically set with the shift speed at 200 rpm below FLGS.
- **Limiting** – Designed to be used specifically with limiting speed governed engines. The Performance shift schedule has wide open throttle (WOT) upshifts near full load governed speed (FLGS). The part throttle shifts for the Limiting shift strategy are higher than those of the Variable shift strategy. The Limiting shift strategy may not perform well with variable speed governed engines, exhibiting a "hung shift" feel. The Economy shift schedule is typically set with the shift speed at 200 rpm below FLGS.
- **Asian** – Designed to meet specific fuel economy requirements typical of OEMs in Asia. This Economy shift strategy is typically used in Asia but can be used elsewhere upon acceptance by the OEM or end-user. Part throttle upshifts are lower than the part throttle shift points for the standard Variable shift strategy for a given shift speed.
- **European** – Designed to meet specific fuel economy requirements typical of OEMs in Europe. This Economy shift strategy is typically used in Europe but can be used elsewhere upon acceptance by the OEM or end-user. WOT upshifts are lower than the WOT shift points for the standard Variable shift strategy for a given shift speed.
- **SA** Economy – WOT upshifts are similar to Variable. The SA part-throttle upshifts and downshifts occur at significantly lower speeds than the Variable part throttle shifts.
- **SB** Economy – WOT shifts and downshifts similar to SA. The SB part-throttle upshifts occur at slightly higher speeds than the SA part-throttle upshifts.
- **SC** Economy – WOT upshifts at speeds which pull engine speed down to a fixed rpm after the shift. The SC part-throttle and closed-throttle upshifts and downshifts are similar to the SA part-throttle and closed-throttle shifts.
- **SD** Economy – WOT shifts at speeds which pull engine speed down to a fixed rpm after the shift. The SD part-throttle and closed-throttle upshifts and downshifts are similar to the SB part-throttle and closed-throttle shifts.

Shift schedules with strategies SA, SB, SC and SD should be reviewed in *iSCAAN* to confirm that the selected schedule is appropriate for the vehicle configuration and vocation. The vehicle builder is responsible for evaluating the driveability of an SA, SB, SC or SC shift schedule in the intended vehicle and duty cycle.

4.2 SHIFT STRATEGIES FOR THE 3000 AND 4000 PRODUCT FAMILIES

For the 3000 and 4000 Product Families the most commonly used shift strategies are identified as S1 through S8. Global emphasis on vehicle fuel economy has led to the development of additional economy shift strategies. The shift strategies available for the 3000/4000 transmissions are described below:

- **S1 & S5** Performance – Wide open throttle (WOT) upshifts near full load governed speed (FLGS)
- **S2 & S6** Performance – WOT upshifts at approximately 90% of FLGS
- **S3 & S7** Economy – Upshifts at speeds which pull engine speed down to a fixed rpm after the shift [(0.6 x FLGS) + 100 rpm]
- **S4 & S8** Economy – Upshifts at speeds which pull engine speed down to a fixed rpm (and less than S3) after the shift [(0.6 x FLGS) - 50 rpm]
- **S9** Economy – Upshifts and downshifts occur at speeds that are even lower than the S4 shift strategy. Developed specifically for transit buses.

- **SA** Economy – WOT upshifts are similar to S1 & S5. The SA part-throttle upshifts and downshifts occur at significantly lower speeds than the S5 part-throttle shifts.
- **SB** Economy – WOT upshifts and downshifts similar to SA. The SB part-throttle upshifts occur at slightly higher speeds than the SA part-throttle upshifts.
- **SC** Economy – WOT upshifts are similar to S3 & S7. The SC part-throttle and closed-throttle upshifts and downshifts are similar to the SA part-throttle and closed-throttle shifts.
- **SD** Economy – WOT upshifts and downshifts similar to S3 & S7. The SD part-throttle and closed-throttle upshifts and downshifts are similar to the SB part-throttle and closed-throttle shifts.

Shift strategies S1 through S4 are typically used with engines using variable speed, or all-speed, governors. The differences between the strategies occur primarily in the full throttle region of the curve, approximately 92% throttle and above.

Shift strategies S5 through S8 are designed to provide the same WOT upshifts as the corresponding S1 through S4 strategies. However, for S5 through S8 part throttle shift speeds have been modified to accommodate the characteristics of engines with limiting-speed governors.

Shift schedules with strategies S9, SA, SB, SC and SD should be reviewed in *iSCAAN* to confirm that the selected shift schedule is appropriate for the vehicle configuration and vocation. The vehicle builder is responsible for evaluating the driveability of a shift schedule with S9, SA, SB, SC or SC in the intended vehicle and duty cycle.

4.3 SHIFT SPEED SELECTION

The traditional shift speed used for the definition of a shift schedule is the engine full load governed speed. If the customer desires lower shift points at all throttle positions for fuel economy, a lower shift speed can be specified when the calibration is defined. Separate shift speeds may be selected for the primary shift schedule and for the secondary shift schedule. The engine full load governed speed must always be specified accurately when the transmission calibration is defined, regardless of the shift speeds selected. DynActive™ Shifting capabilities, preselect downshifts, hold upshifts, power upshifts and power downshifts, all are based on the actual full load governed speed of the engine.

NOTE: Shift speeds that are less than engine full load governed speed by a difference greater than 200 rpm require a FuelSense™ package.

4.4 DYNACTIVE™ SHIFTING

DynActive™ Shifting is an innovative approach to shift scheduling that uses an algorithm to choose the most efficient shift point based on environmental and vehicle parameters. This continuously variable shift scheduling will meet drivers' power demands more efficiently and intelligently than table-based shift scheduling.

The algorithm is deterministic, meaning the results (shift points, fuel economy, etc.) will be the same given the same set of inputs. The transmission calibration can be programmed to have DynActive™ Shifting as either, or both, the primary and secondary shift schedules. However, DynActive™ Shifting is overridden for specialty conditions such as minimum engine speed setting, engine hold override speed, kickdown, engine brake, retarder, driver preselects, and ABS events. Therefore, a table-based schedule may still need to be defined in the calibration. DynActive™ can be biased for both flat ground operation and on-grade operation in the calibration using a scale of 0% to 100%. 100% provides maximum economy and 0% provides maximum performance. Refer to the *Allison Calibration Configuration Tool (ACCT)*, or *iSCAAN*, found on the Allison HUB for additional calibration details.

When engine make & model is known and selected in the calibration, the transmission control system will learn the engine's torque curve. This occurs when the vehicle is accelerated through all forward ranges at 100% throttle. This can take several acceleration events before the full torque curve is defined, loading the vehicle to slow the acceleration through the ranges can reduce the number of these events.

When a basic (SEM & LRTP OFF) engine is used, one of the following two options must be used to provide the TCM with engine torque information if DynActive™ Shifting is enabled:

1. Manually define engine torque curve in the calibration via parameter 17900. The torque curve is entered as ascending order engine speed in RPM (parameter 17901-17920) and maximum torque in N•m (parameter 17941-17960) pairs. At least 6 non-zero pairs must be entered with the ability to enter up to 20 pairs. The curve must end with 0 N•m in the 7th or later pair. Speed points should start at engine idle (preferred) or at the minimum engine speed applicable to the transmission model (acceptable) and end where fueling has ceased past the high speed limit (No Load Governed Speed). Speed points are not required to be evenly spaced. Pairs should be positioned to best represent the shape of the torque curve. See an example of a manually de-fined engine torque curve in Figure A2-1.

ID	Name	Value/Range
17900	DynActive: Engine Torque Curve (Defined)	1
17901	DynActive: Defined Engine Curve - Speed Point 1 (RPM)	800
17902	DynActive: Defined Engine Curve - Speed Point 2 (RPM)	1200
17903	DynActive: Defined Engine Curve - Speed Point 3 (RPM)	1800
17904	DynActive: Defined Engine Curve - Speed Point 4 (RPM)	2200
17905	DynActive: Defined Engine Curve - Speed Point 5 (RPM)	2600
17906	DynActive: Defined Engine Curve - Speed Point 6 (RPM)	2750
17907	DynActive: Defined Engine Curve - Speed Point 7 (RPM)	3000
17941	DynActive: Defined Engine Curve - Torque Point 1 (NM)	386
17942	DynActive: Defined Engine Curve - Torque Point 2 (NM)	485
17943	DynActive: Defined Engine Curve - Torque Point 3 (NM)	660
17944	DynActive: Defined Engine Curve - Torque Point 4 (NM)	645
17945	DynActive: Defined Engine Curve - Torque Point 5 (NM)	630
17946	DynActive: Defined Engine Curve - Torque Point 6 (NM)	620
17947	DynActive: Defined Engine Curve - Torque Point 7 (NM)	0

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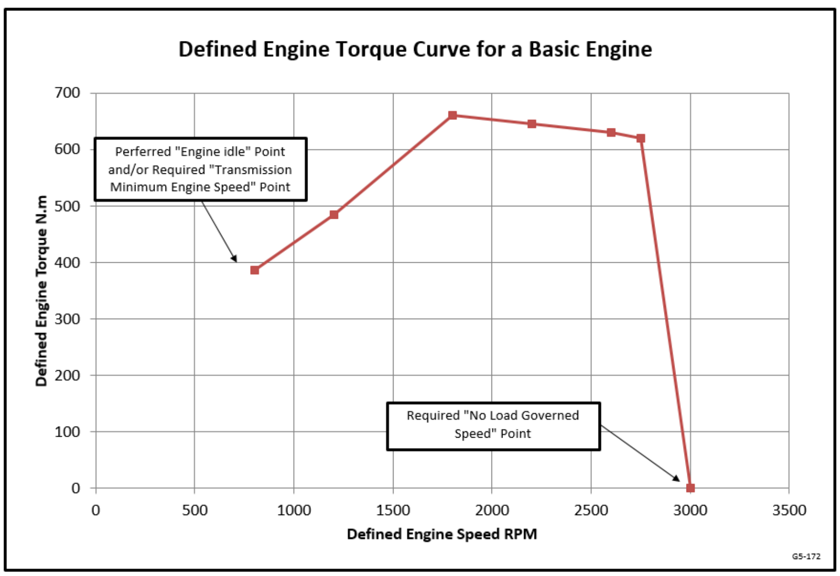

Figure A2-1: Example of Manually Defined Engine Torque curve for DynActive™ Shifting

NOTE: Manually defined engine torque curves in the transmission calibration with incorrectly, or insufficiently, defined engine torque/speed points could lead to adverse shift decisions and decreased vehicle driveability.

2. Allow TCM to learn the engine torque curve by selecting dedicated enhanced engine answers (13-15) in the calibration in lieu of the basic engine answers (0-6) for Engine Make & Model VEPS parameter 11020. Please contact Allison Customer Integration Engineering for further details as this option requires confirmation if accurate engine torque information is available.

   Whenever DynActive™ Shifting is enabled in the calibration, Allison Transmission recommends not leaving the Torque Converter parameter (14000) set to a default value, and select the actual torque converter model in the calibration as represented in the transmission hardware. The true torque converter model in the calibration allows for further refined accuracy of torque information interpreted by the TCM.

   Economy Bias Description for Flat Ground:

0%	Will always give most performance
25%	Will give solid performance feel
50%	Blend between performance and fuel economy
75%	Fuel economy with some performance
100%	Will always short-shift for best fuel economy

   Economy Bias Description for Grade:

0%	Climb grade a max physically permitted engine speed
10%	Engine will be limited to engine's max power speed; permissible lugback speed starts to decrease through grade econ bias of 100
60%	Grade climb will control engine up to engine peak power speed; max controlled cycling permitted
100%	Engine will lug back to and control at the lowest possible speeds; will upshift even if resulting in decel

Minimum Engine Speed Operation can be set by the OEM above Allison's default setting based on testing limitations. For 1000/2000 and 2900 Product Families, minimum engine speed is 1000 rpm by default. For 3000/4000 Product Families, minimum engine speed is 900 rpm by default.

Additional options are available to customize DynActive™ shifting behavior, including modifications based on cruise control state, vehicle cornering behavior, engine load, speed, and torque control, and lockup apply states. See the Programming Guides for more information.

5.0 HOLD SCHEDULE FOR UPSHIFTS

As a standard feature of each shift calibration, the transmission controls incorporate a **hold upshift** schedule, which the operator may select if the transmission is not operating in its highest range. When this schedule is active, the shift points for upshifts are raised in order to hold the transmission in its current gear and inhibit upshifting beyond the current range. Holds are activated by selecting the current range or a lower range on the shift selector.

> **CAUTION: A typical use of the hold feature is to maximize engine braking when operating downhill. However, in order to prevent over-speeding the engine, the hold function is not infinite. It will permit shifts from the hold range to the next higher range (hold override upshift) at some speed above the shift calibration speed.**

6.0 PRESELECT SCHEDULE FOR DOWNSHIFTS

6.1 DURING NON-ENGINE BRAKE OPERATION

The operator may initiate a preselect downshift schedule by selecting any forward gear on the shift selector that is lower than the gear currently in use. When a range has been preselected, shifts to and from gears above the preselected gear range occur at higher than normal engine speeds. Shifts below the preselected range occur at the normal closed-throttle downshift speeds. Preselect downshifting is beneficial in maintaining higher engine speed, resulting in increased engine braking during downhill operation or vehicle deceleration cycles. Preselect shifts are permitted only if an engine over-speed condition will not occur after completion of the downshift.

When the transmission calibration is defined, one of the following Preselect Strategies may be selected:

- Standard Preselects – the preselect downshift schedule with the highest downshift speeds. This is the default Preselect Strategy.
- Low Preselects – an optional preselect downshift schedule that occurs at lower engine speeds than the Standard Preselects. The Low Preselects may be chosen as the Preselect Strategy instead of the Standard Preselects.

6.2 DURING ENGINE BRAKE OPERATION

When an engine brake is active, the TCM can command preselect downshifts and non-preselect elevated downshift speeds to enhance engine brake performance. The commanded schedule may be the selected Preselect Strategy, Standard or Low, and/or the Engine Brake Alternate Downshift schedule.

The Engine Brake Alternate Downshift schedule is included in every transmission shift calibration. The Engine Brake Alternate Downshift schedule downshifts occur at lower engine speeds than the Low Preselect downshifts, but at higher engine speeds than the normal closed-throttle downshifts.

As a part of the Engine Brake Interface the preselect downshifts and non-preselect elevated downshift speeds that can occur during engine brake operation are specified by gear range using the following Customer Modifiable Constants (CMC's):

- Engine Brake Preselect Range
- Engine Brake Alternate Minimum Elevated Downshift Range

Based on these selections, when the engine brake is active, the TCM will command downshifts as follows:

- Preselect downshifts will occur per the chosen Preselect Strategy, Standard or Low, until the Engine Brake Preselect Range has been attained.
- After the Engine Brake Preselect Range is attained, the downshifts will occur at elevated speeds until the Engine Brake Alternate Minimum Elevated Downshift Range has been attained. The elevated speed downshifts will occur only if the Engine Brake Alternate Minimum Elevated Downshift Range is a lower gear range than the Engine Brake Preselect Range.
- After the Engine Brake Alternate Minimum Elevated Downshift Range (or the Engine Brake Preselect Range if lower) is attained, the downshifts will occur per the closed-throttle downshift points in the transmission shift calibration.

Refer to Engine Brake Interface, *Input H / Output A* or *Input I / Output A*, for more information on the CMC's.

6.3 PRESELECT OPTIMIZATION

Preselect Optimization is an optional feature that can be used to provide additional vehicle control using automatically activated preselect downshifts. Preselect downshifts occur at higher engine speeds than normal closed throttle downshifts. The resulting operation at higher engine speeds can enhance engine brake performance, provide greater control during downhill operation and vehicle deceleration, or assist cruise control in maintaining vehicle set speed.

Preselect Optimization monitors service brake status, cruise control status, vehicle speed, vehicle acceleration and deceleration, and the road grade. Based on these parameters, the TCM invokes preselect downshifts when braking is needed and is requested by the operator, thus reducing brake wear and improving vehicle controllability. This monitoring also prevents preselect downshifts from being invoked when the operator is not requesting braking, thus saving fuel.

All Preselect Optimization features will continue to preselect as configured until attaining the range defined by *PRESELECTS: Minimum Preselect Range*.

Preselect Optimization is available for three separate modes of vehicle operation which can be independently enabled, disabled, and configured:

- **Cruise Control** – preselect downshifts are initiated when the actual vehicle speed is above the cruise control set speed during cruise control operation. Normal shifts resume when the vehicle has slowed to the cruise control set speed.
- **Engine Brake** – preselect downshifts are initiated when the service brake is applied during engine brake operation.
- **Grade Braking** – preselect downshifts are initiated when deceleration or braking on a grade is requested and the engine brake and cruise control are inactive or not available on the vehicle. Grade Braking can be implemented only if Input BS, Grade Braking / Regeneration Input, is available in the selected Input / Output package

Assuming all modes are configured on and enabled:

- If cruise control is active, use Cruise Control Preselect Optimization
  - If engine braking activates while in cruise control, continue using Cruise Control Preselect Optimization
- If cruise control is inactive, but engine braking activates, use the Engine Brake Preselect Optimization
- If both cruise control and engine braking are inactive, use the Grade Braking Preselect Optimization

Individual configuration of Preselect Optimization features provides greater flexibility in preferred vehicle control mechanisms:

- Cruise Control – ordered by preselect availability
  - Aggressive
    - Preselects when vehicle speed is 8 Kph higher than the cruise set speed
  - Moderate
    - Preselects when vehicle speed is 10 Kph higher than the cruise set speed
  - Minor
    - Preselects when vehicle speed is 14 Kph higher than the cruise set speed
  - Custom
    - Preselects when vehicle speed is higher than the cruise set speed by a set amount

- Engine Brake – ordered by preselect availability
  - Immediate
    - Preselects minimum range as soon as engine brake activates
  - Aggressive
    - Preselects minimum range as soon as service brake activates while engine brake is active
    - Continues to preselect the minimum even if service brake is released
  - Aggressive – Hold
    - Preselects minimum range as soon as service brake activates while engine brake is active
    - Holds the current preselect when the service brake is released
  - Moderate
    - Preselects based on road grade / vehicle mass / engine brake torque / service brake
    - Selects the best range for a grade by calculating the effort required to hold an acceleration
    - The longer the driver holds the service brake, the more the target acceleration decreases which can result in more preselects
  - Minor
    - Preselects based on road grade / vehicle mass / engine brake torque / service brake
    - Selects the best range for a grade by calculating the effort required to hold an acceleration
    - The longer the driver holds the service brake, the more the target acceleration decreases which can result in more preselects
- Grade Braking – ordered by preselect availability
  - Aggressive
    - Preselects minimum range as soon as service brake activates when the input is active
    - Continues to preselect the minimum even if service brake is released
  - Aggressive – Hold
    - Preselects minimum range as soon as service brake activates when the input is active
    - Holds the current preselect when the service brake is released
  - Moderate
    - Preselects based on road grade / vehicle mass / service brake when the input is active
    - Selects the best range for a grade by calculating the effort required to hold an acceleration
    - The longer the driver holds the service brake, the more the target acceleration decreases which can result in more preselects
  - Minor
    - Preselects based on road grade / vehicle mass / service brake when the input is active
    - Selects the best range for a grade by calculating the effort required to hold an acceleration
    - The longer the driver holds the service brake, the more the target acceleration decreases which can result in more preselects

- Grade Braking is only enabled using Input BS, Grade Braking / Regeneration Input - a dash switch is required if this function is implemented in a vehicle. With the dash switch ON (feature enabled), preselect downshifts are initiated when deceleration or braking on a grade is requested and the engine brake and cruise control are inactive or not available on the vehicle. Also, closed throttle upshifts that result in undesired vehicle acceleration will be inhibited. With the dash switch OFF, preselect downshifts will not occur unless manually selected by the operator, however, closed throttle upshifts that result in undesired vehicle acceleration will continue to be inhibited. Refer to *Input BS - Grade Braking / Regeneration Input*.

- Grade Braking Inhibit Closed Throttle Upshifts Only - this option does not require Input BS and no dash switch is used. With this option, preselect downshifts will not occur unless manually selected by the operator, however, closed throttle upshifts that result in undesired vehicle acceleration will be inhibited.

7.0 SHIFT SCHEDULES INCLUDED IN STANDARD SHIFT CALIBRATIONS

7.1 CRUISE MODE SHIFT SCHEDULE

This shift schedule is activated when a J1939 datalink message is received to indicate cruise control is active. Shift points for this operation are modified in order to reduce the frequency of upshifts and downshifts during cruise operation. This shift schedule is a standard feature of each shift calibration.

7.2 COLD-TEMPERATURE SHIFT SCHEDULE

Available transmission ranges may be temporarily limited in cold operating conditions until the transmission sump temperature increases.

For the 1000/2000 Product Family:

- With a transmission sump temperature below -35 ºC (-31 ºF), transmission operation will be limited to Reverse, Neutral, and 2nd forward range, converter mode only. When Drive is selected, the transmission will start and be limited to 2C operation.
- With a transmission sump temperature between -35 ºC (-31 ºF) and -25 ºC (-13 ºF), transmission operation will be limited to Reverse, Neutral, 2nd and 3rd forward ranges, converter mode only. When Drive is selected, the transmission will start in 2C and upshift to 3C at the appropriate speed.
- With a sump temperature between -25 ºC (-13 ºF) and 0 ºC (32 ºF), all transmission ranges will be available, but will be limited to converter mode operation. Above 0 ºC (32 ºF) normal full functionality will resume. All transmission ranges are available including lockup operation.

For the 2900 Product Family:

- With a transmission sump temperature below -12 ºC (10 ºF), transmission operation will be limited to Reverse, Neutral, and 5th forward range, converter mode only. When Drive is selected, the transmission will start and be limited to 5C operation. Once above -8 ºC (18 ºF) cold mode will be exited.
- Above 0 ºC (32 ºF) normal full functionality will resume. All transmission ranges are available including lockup operation.

For the 3000 & 4000 Product Families:

- With a sump temperature below -5 ºC (23 ºF), transmission operation will be limited to Reverse, Neutral, and 2nd gear hold. When Drive is selected the transmission will start in 2C and transition to 2L at the appropriate speed. Once the sump temperature exceeds -1 ºC (30 ºF), normal full functionality will resume.

7.3 OVER-TEMPERATURE SHIFT SCHEDULE

For the 1000/2000 Product Family, the TCM will automatically limit transmission operation to 4th range or below when the transmission oil exceeds temperature limits. This restriction occurs regardless of the range selected by the operator. If the transmission is above 4th range when the over-temperature condition occurs, the preselect shift schedule is used for all downshifts until 4th range is reached.

The Over-Temperature Shift Schedule is not invoked for 2900, 3000 or 4000 Product Family transmissions during transmission over-temperature conditions. In transmission calibrations for emergency vehicles, the Over-Temperature Shift Schedule is disabled.

7.4 ACCELERATION-BASED PATTERN (ABP)

All table-based shift schedules include the Acceleration-Based Pattern (ABP) feature. ABP raises the full throttle upshift and downshift points under the following conditions:

- The throttle position is at or near 100%
- The vehicle is not accelerating

An example of these conditions is a loaded vehicle climbing a grade. ABP will downshift the transmission at higher output shaft speeds than the standard full throttle downshifts. Downshifting the transmission increases the output torque and allows the vehicle to maintain road speed.

7.5 RETARDER MODE SHIFT SCHEDULE

The retarder mode shift schedule is automatically activated when the retarder is switched on. This raises the closed throttle downshifts for additional cooling during retarder operation. Retarder closed throttle downshifts occur at speeds approximately halfway between the normal closed throttle downshift and the preselect downshift for each range. This shift schedule is included in the shift calibration for all retarder-equipped transmissions except those used in bus duty cycles (B and T-Models).

7.6 OTHER SHIFT SCHEDULES

Other shift schedule changes may also be commanded automatically by the TCM as a result of changing operating conditions in the vehicle. A common example is to invoke the preselect shift schedule if an engine overheat condition is detected, forcing the transmission to downshift at higher-than-normal speeds, thereby increasing engine speed and coolant flow through the radiator.

8.0 OPTIONAL SHIFT SCHEDULES

8.1 DYNAMIC SHIFT SENSING

This shift strategy feature combines the advantages of both performance and economy shift strategies by automatically selecting between the two strategies based on conditions. When enabled, the controls will automatically select the Economy shift schedule when an unloaded state of the vehicle is detected, based on capability of the vehicle to accelerate quickly. The controls will automatically switch to the Performance shift schedule when the vehicle is loaded and its ability to accelerate is reduced. Vehicle acceleration, mass, and the inclinometer in the TCM can all be used as inputs to refine this selection. The resulting operation can continuously modify transmission shifting to keep the engine near its more efficient speed range. This can produce improved overall vehicle fuel economy while still enabling high productivity when the vehicle is loaded or not accelerating.

Dynamic Shift Sensing is implemented two different ways depending on whether the vehicle has Engine Management integration between the engine and transmission controls or if Acceleration-Based Dynamic Shift Sensing is forced via *DYNAMIC SHIFT SENSING: Mode Scheduling Capability:*

- **Torque-Based Dynamic Shift Sensing**: In vehicles where the engine and transmission have Engine Management integration, the Dynamic Shift Sensing algorithm will use the J1939 engine torque messages to estimate the vehicle load. Torque-Based Dynamic Shift Sensing is also available for engines that do not have full Engine Management Integration, but do communicate engine torque to the transmission controller.

- **Acceleration-Based Dynamic Shift Sensing**: In vehicles without Engine Management integration between the engine and transmission, the Dynamic Shift Sensing algorithm uses throttle position and output acceleration to estimate the vehicle load.

Applications may choose to force Acceleration-Based Dynamic Shift Sensing via DYNAMIC SHIFT SENSING: Mode Scheduling Capability if the respective application makes fast and frequent large mass changes, such as Dock Spotter applications, which provide little opportunity for the algorithm to detect the mass difference.

Dynamic Shift Sensing is available for all transmission models, except the OFS (Oil Field Series). It is not feasible when an OFS transmission is operating in pump mode.
General requirements/recommendations for Dynamic Shift Sensing are as follows:

- The Dynamic Shift Sensing feature, and designation of the economy shift schedule (most fuel efficient operation), must be selected when specifying the shift calibration.
- Allison recommends that the Primary and Secondary shift schedules have the same starting range and the same top gear range.
- Allison recommends that the rpm difference between the Primary and Secondary shift schedules should be less than or equal to 200 rpm for table-based shift schedules.
- The Economy shift schedule may be in either Primary Mode or Secondary Mode.

If the Economy shift schedule is in Primary Mode, the operator may switch to the Performance shift schedule at any time, typically by pressing the MODE button. When the Performance shift schedule has been invoked, the TCM will resume Dynamic Shift Sensing operation after a defined override time duration has elapsed.

Dynamic Shift Sensing, when using table-based shift schedules, includes an additional shift mode which is a more aggressive economy table-based shift schedule. The Super Economy Shift Schedule (SESS) works in the background of the selected Economy and Performance shift schedules. SESS allows the vehicle to cruise at the lowest possible engine speed without lugging the engine. Dynamic Shift Sensing will shift based on the SESS when the vehicle meets the following conditions:

- Constant throttle position
- Very low tractive effort
- Steady cruise operation

Any sudden change in throttle position or tractive effort will cause the TCM to exit SESS and return to the basic Economy and Performance shift schedules. SESS is standard in most Dynamic Shift Sensing enabled calibrations. DynActive™ Shifting already compensates accordingly in its continuously variable shift scheduling.

The TCM will initialize in the same mode, Economy or Performance, that it was in when last shutdown. The vehicle load is re-estimated during the first high throttle acceleration and the appropriate mode is then commanded. For Torque-Based Dynamic Shift Sensing, the mode is also reset to Performance when one of the following is detected:

- An engine de-rate condition
- The loss of torque data from the engine
- The transfer case is placed in low (if so equipped)
- The TCM is recalibrated

In addition to providing the capability to automatically switch between performance and economy shift strategies, the availability of economy mode in Dynamic Shift Sensing is selectable as a customer modifiable constant in the TCM calibration. See Figure A2-2 for details.

Dynamic Shift Sensing Setting	Calibration Selection	Description of Dynamic Shift Sensing Operation
0	Custom	This setting allows a specific numerical value to be selected via the Custom Breakpoint Setting parameter which has a range from a minimum of 1 kg to a maximum of 2,000,000 kg. As the value is increased, the vehicle will stay in economy mode in a greater extent of operational conditions. This setting is not available for Acceleration-Based Dynamic Shift Sensing.
3	Low	This setting will keep the vehicle in economy mode when lightly loaded or on low upgrades. The vehicle will always be in performance mode if carrying a moderate load or when negotiating moderate grades.
4	Medium	This setting will keep the vehicle in economy mode more than the low setting. When the vehicle is empty, even on moderate grades, economy mode will normally be in use. Likewise, economy mode will also be in use on nearly level grades with moderate loads. Performance mode will be commanded when heavily loaded or with moderate loads on steeper grades.
5	High	This setting will keep the vehicle in economy mode in most circumstances. Performance will typically be commanded only when negotiating severe grades when heavily loaded. This setting will permit higher powered vehicles to be in economy mode for most operation except during the most demanding operating conditions.

Figure A2-2: Availability of Economy Mode with Dynamic Shift Sensing

8.2 KICKDOWN SHIFT SCHEDULE

Kickdown is an optional shift schedule which is activated when Input AH: Kickdown is enabled, or via J1939 EEC2 SPN 559 – ACCELERATOR PEDAL KICKDOWN SWITCH. In order to enable Kickdown via a hard wire, an Input/Output (I/O) Package that includes Input AH must be specified when the TCM calibration is defined. Kickdown is available with either Table Based or DynActive™ shift schedules. When Kickdown is active, the upshift points occur slightly below the Kickdown Speed specified in the calibration. Kickdown downshift speeds are set such that the post shift engine speed will be a bit below the Kickdown upshift speed for the post-shift range. The Kickdown Speed must less than or equal to the engine governed speed. An Allison Customer Integration Engineer should be contacted if the Kickdown Speed is set to be less than engine governed speed.

8.3 LOW SPEED GRADE ASSIST

When the engine is being lugged down during full throttle operation, Low Speed Grade Assist allows a quicker transition into first lockup from second converter in 6-speed transmissions, and a quicker transition into second lockup from third converter in 7-speed models. Low Speed Grade Assist is available in most 3000 and 4000 Product Family applications that have Engine Management integration between the transmission controls and the engine controls. Refer to the *Allison Calibration Configuration Tool (ACCT)* for your specific model. ACCT can be found in the Allison HUB of the Allison Transmission website, or contact your Allison Transmission representative if you do not have access to ACCT. The Low Speed Grade Assist feature must be specified when the transmission calibration is defined.

8.4 FIRST LOCKUP FOR BUSES

Allison offers lockup in first gear for transit buses and school buses that operate in heavy traffic at low vehicle speeds with a high number of stops per mile. Typical shift schedules apply the lockup clutch in second gear. If the vehicle acceleration rate allows, the converter lockup clutch will remain engaged during the shift from first gear into second gear.

First Lockup for Buses is available for the following:

- Bus Models (B and T-Models) in the 3000 and 4000 Product Families
- 1000/2000 Product Family PTS Models used in school bus vocations
- 1000/2000 International models used in school bus vocations

First Lockup is required in 3000 xFE™ and 1000/2000 xFE™ CR models.

The following requirements apply to applications using 1000/2000 Product Family models:

- No 4-cylinder engines unless xFE™ CR models
- Must have SEM integration with the engine controls

This feature must be specified when the transmission calibration is defined.

8.5 TAILORED SHIFT SPEEDS

The Tailored Shift Speeds feature allows the following shift speeds to be modified when the transmission calibration is defined:

- Primary and Secondary Shift Speeds
- Hold Override Shift Speeds
- Kickdown Shift Speeds
- Acceleration-Based Pattern (ABP) Shift Speeds

This advanced feature is available only with highly integrated vehicles that have been reviewed by Customer Integration Engineering, including extensive in-vehicle validation.

8.6 FIXED SHIFT SCHEDULES

The term fixed shift is used to describe an upshift or downshift which is fixed at a common speed for all throttle positions. Fixed shifts have no reduction in shift speed during part throttle operation. Elevated shift points in the part-throttle zone are required for some specialized equipment in order to maintain high engine speed at low ground speed conditions with minimal transmission shifts.

Fixed shifts adversely affect shift quality and fuel economy. Therefore, fixed shift schedules are not used in typical on-highway and on/off-highway vehicles.

A true fixed shift schedule exists for oil field pumping applications, in which all upshifts and downshifts are at the same fixed speeds in all throttle zones. Fixed, Fixed 2, and True Fixed shift schedules are available only in secondary mode.

APPENDIX: 1st & 2nd LOCKUP AVAILABILITY
(for 4 cylinder engines, and for engines with greater than 4 cylinders)

	1000/2000 MODELS				3000/4000 MODELS			
	Close Ratio Models		Wide Ratio Models		Close Ratio Models		Wide Ratio Models	
Engine -->	4cyl	>4cyl	4cyl	>4cyl	4cyl	>4cyl	4cyl	>4cyl
1st Lockup	N	N(2)	N	N(2)	N(1)	N(1)(3)	N	N
2nd Lockup	Y	Y	Y	Y	Y	Y	Y	Y

	1000/2000 xFE™ MODELS				3000 xFE™ MODELS	
	Close Ratio Models		Wide Ratio Models		xFE Ratio	
Engine -->	4cyl	>4cyl	4cyl	>4cyl	4cyl	>4cyl
1st Lockup	Y	Y	N	N(2)	Y	Y
2nd Lockup	Y	Y	Y	Y	Y	Y

Notes:

(1) 1st Lockup for Buses available through a special release

(2) For PTS models, 1st lockup available through a special release

(3) For 3000 HS model, 1st lockup available through a special release

(4) For ORS & RDS_HET Models, 1st lockup available through a special release (Off highway & Heavy Haul)

LIST OF REFERENCED DOCUMENTS

Allison 6th Generation Controls Manual

- *Section A-1: Controls System Familiarization*

- *Section B: System Operation*
  - *for the 1000/2000 Product Family*
  - *for the 2900 Product Family*
  - *for the 3000/4000 Product Families*

- *Engine Brake Interface (Standard), Input H / Output A*

- *Engine Brake Interface (Special), Input I / Output A*

- *Input AH: Kickdown*

- *Input BS - Grade Braking / Regeneration Input*

- *Input/Output Package Guides*

- *iSCAAN*, Allison's vehicle performance calculation program

REVISION HISTORY

<u>May 25, 2022</u>

- Added the 2900 Product Family.

<u>April 28, 2020</u>

- Created, Allison 6th Generation Controls - Controls Installation Manual - Section A-2 Shift Calibration Familiarization