SEIC / PTO INDEX

SEIC / PTO
APPLICATION INFORMATION

SEIC strategy

- Provides elevated engine speed to drive auxiliary commercial equipment such as hydraulic pumps, generators, air compressors; or maintain vehicle battery charge under extreme electrical demands.
- **Blunt-cut wires to access SEIC, and customer access for VSO, CTO, PARK, PARK-NEUTRAL signals**
  - E-Series: Located in the engine compartment, tagged and bundled with the large harness running below the windshield/cowl. Remove some of the plastic harness tape where the harness exits its plastic support gutter above the engine air induction tube to reveal the blunt-cut wires.
  - F-Series: Located in the cabin, behind the passenger side kick panel. Pass-thru wires are in the same location.
  - Transit: Located underhood wrapped in convulate, behind coolant reservoir and taped to harness next to Engine Junction Box.
  - The final stage manufacturer or up-fitter is required to supply the customer interface or controller.
  - Further details are in the “Circuit Descriptions” section of this BBLB chapter.
- **Optional up-fitter switches & access points**
  - May be used as a PTO activation switch.
  - Available Option Code 52S on E-Series Cutaway. Located below the windshield/cowl alongside blunt-cut wires as noted above.
  - Available Option Code 66S on Super Duty F-Series Pick-Up; standard on Chassis Cab. Located underhood on driver side of engine compartment near upfitter relay box.
  - Available Option Code 67C on all Transit vehicles. The Aux 1 and Aux 2 power outputs are located in the High Specification Vehicle interface Connector. Aux 3 and Aux 4 power outputs are located in the C33-H connector. Both of these connectors are found behind the glove box.
  - Further details are in the “Circuit Descriptions” section of this BBLB chapter.

VOCABULARY / DEFINITIONS

BCPIL / BCPSW: Battery Charge Protection – Illumination (Lamp) / Switch.

Change-of-State: Part of the Gas engine SEIC strategy only. If any condition is met that disables SEIC, the operator is required to turn off the PTO switch and back on again before SEIC will allow elevated idle to return.

Clutch-Pump: A type of PTO that is driven by the vehicle engine crankshaft through the FEAD pulley system.

Continuous Duty Usage: Greater than five (5) minutes out of a fifteen (15) minute period of continuous operation.

CTO: Clean Tach Out. An engine speed signal. Blunt-cut wire provided for access (see “Circuit Descriptions”).

ECT: Engine Coolant Temperature.

FEAD: Front End Accessory Drive (belt and pulley drive system).

Intermittent Duty Usage: Five (5) minutes out of a fifteen (15) minute period or less of continuous operation.

PCM: Powertrain Control Module

PTO Applications: Includes all forms of mechanical power, using the vehicle powertrain as the source, including transmission side-mounted PTO, split-shaft PTO, crankshaft PTO, and FEAD-mounted clutch-pumps, air compressors, and generators.

SEIC: Stationary Elevated Idle Control (PCM Strategy). Blunt-cut wires provided for customer access.

TPO: Throttle Position Out. Customer access not available.

TRO_N, TRO_P: Transmission Range Output, indicating either combination PARK or NEUTRAL, or PARK-ONLY.

VPWR: Battery voltage signal only, not intended to carry high current load.

VSO: Vehicle Speed Out. Blunt-cut wire provided for access (see “Circuit Descriptions”). 8000 pulses per mile, 2.2 Hz per mile-per-hour.

VEHICLES USED AS A STATIONARY POWER SOURCE – GENERAL RECOMMENDATIONS AND WARNINGS

Ford trucks are designed principally to provide vehicle motivation and short-term auxiliary power needs. Power activation of hydraulic or mechanically driven devices such as wrecker lift, snowplow blade lift and movement, power tailgate lift or dump body lift, are a few examples.

The variety of factors such as air circulation available, temperature environment, vehicle maintenance level, and other existing conditions, combined with the range of auxiliary horsepower and torque demands that may be placed upon a vehicle in power take-off usage, make it difficult to assess the ultimate performance of a vehicle subjected to extended duration usage as an auxiliary power source. The guidelines in this book are intended to assist the PTO equipment installer with avoiding inadvertent vehicle performance and safety concerns. These guidelines should not be considered all inclusive; it is the responsibility of the PTO equipment installer to choose and install a PTO system that the vehicle operators will be able to use in a safe manner, and with the necessary precautions to ensure safe operation and customer satisfaction.

Additional transmission fluid may be required with the addition of the transmission-mounted PTO.

1. The final stage manufacturer is responsible for alerting the user to proper maintenance. PTO usage may require using the Ford "severe-duty" vehicle maintenance schedules, including transmission fluid changes. Some applications may require an even more frequent maintenance schedule if the PTO system is used in "continuous duty".
2. Route PTO hydraulic lines and hoses away from the vehicle exhaust system.
3. Diesel engines are recommended over gas engines for stationary PTO operation of extended duration.
4. Do not block air flow circulation to the engine coolant radiator, engine, and transmission oil cooler.
5. The following are some maximum temperatures monitored by the PCM. The aftermarket PTO system designer or installer should consider adding a sensor to monitor these for the purpose of aborting the PTO operation to protect against vehicle powertrain damage. Some PTO suppliers may offer temperature monitors for this purpose.
   a) Maximum Engine Coolant Temperature (ECT): 220° F (Gasoline), 234° F (Diesel)
   b) Maximum Engine Oil Sump Temperature: 284° F
   c) Maximum Transmission Oil Temperature (TOT): 250° F
   d) Maximum Catalyst Temperature: varies (not intended for aftermarket monitoring).

   If any of the above temperatures are exceeded then "de-clutch" the auxiliary load of the PTO operation and return the vehicle engine speed to base engine idle. Allow the temperature to stabilize at a lower level before re-engaging PTO operation. Gas engine strategy uses these to abort SEIC (return engine to base idle speed and unlock automatic transmission torque converter).
6. The blunt-cut wires related to SEIC go directly back to pins on the PCM. Care should be taken with any aftermarket circuitry connecting with these or neighboring wires to prevent feeding those modules with any unwanted, threatening signals or voltages. Unwanted vehicle behavior and/or PCM damage may result.
7. Both gas and diesel powertrains are calibrated to accept up-fitter commands through the SEIC wiring only, which are battery-voltage commands only, no CAN messaging. Any alternate method to obtain stationary elevated idle control may result in unpredictable or inconsistent engine speed or stalling.

(Cont'd next page)

SEIC / PTO
APPLICATION INFORMATION (Cont'd)

PRODUCT DESCRIPTIONS

"Transmission Power Take-Off Provision" (Option Code 62R):

This Option, available for Super Duty F-Series only, provides the 6-speed auto transmission with an internal PTO drive gear and access port in the transmission case. A unique PCM is not included nor required.

Automatic Transmission Fluid Temperature Gauge:

A Transmission Fluid Temperature Gauge is included with the instrument cluster of Super Duty F-Series, signaled by the Transmission Oil Temperature (TOT) sensor. A complete description can be found in the vehicle's Owner Guide. Listed in brief below are some descriptions of gauge readings to help the operator monitor PTO operation:

- Cold Range: 50° F or less.
- White Area: Normal operating range of 51° F to 248° F.
- Yellow Area: Warning: Stop driving the vehicle or remove auxiliary loads at the earliest convenience. Typically, leave the engine running at base idle speed and allow to cool into the normal range before starting to drive or operate the PTO. The transmission fluid is not over-heated, but operating in the Yellow Range for extended periods of time may cause internal transmission damage.
- Red Area: The transmission fluid is over-heating. Stop the vehicle, do not drive, and allow to cool into the normal operating temperature range. If the gauge continues to show high temperatures then see your Ford dealer.

For readings in the Red and Yellow areas, make sure that snow or debris is not blocking airflow to the radiator and transmission fluid cooler, that cooler lines are not kinked nor restricted, and that vehicle load capacities or PTO duty cycles are not excessive.

SEIC (Stationary Elevated Idle Control):

This feature is included in the powertrain control strategy of all F250/350/450/550, E350/450 and Transit vehicles with all powertrains. For a stationary vehicle, it allows the operator to elevate engine idle speed to operate a transmission-mounted PTO, or engine FEAD-mounted clutch-pump, air compressor, or generator, or be used to help keep the vehicle battery charged.

SEIC uses CAN messaging internally. It is activated by the upfitter by applying discrete voltage signals to wires located in a bundle behind the F-Series passenger side kick panel, and similarly in the E-Series and Transit engine compartments. The upfitter will need to complete the circuits as described herein, and provide the customer interface (i.e., buttons, LCD read-out for engine speed, PTO switch, etc.).

Ramp-up rate is fixed at approximately 200 rpm/sec for diesel engines and 400 rpm/sec for gasoline engines.

NOTE: Ford Commercial vehicles offer four relayed rocker switches on the instrument panel for upfitter use.

PTO Control (For automatic transmission-mounted PTO only):

This is PCM strategy within the SEIC feature that automatically looks for and recognizes whether the vehicle has a TorqShift automatic transmission with a side-mount PTO ("Transmission PTO Provision", Option Code 62R). For the 6R140 transmission, the PTO gear is splined directly to the transmission torque converter turbine shaft and does not depend on torque converter lock up. When all of the vehicle safety enablers are met, the engine speed is commanded by the operator to at least 900 rpm to deliver engine torque to the PTO gear and elevate the transmission hydraulic line pressure to at least 150 psi nominal for the aftermarket PTO to use to hold its engagement clutch.

NOTE: Applying battery voltage to the Diesel "PTO" or Gasoline "PTO-Mode" wires is what the transmission looks for to initiate these commands. Failing to do so may show up as low or oscillating hydraulic line pressure and low or no aftermarket PTO torque or pump flow output. Any attempt to operate the aftermarket PTO at elevated idle without these commands may result in under-capacity PTO clutch wear, resulting in rapid contamination of transmission fluid and internal transmission damage. This applies to both stationary and mobile automatic transmission PTO operations.

(Cont'd next page)

SEIC / PTO
APPLICATION INFORMATION (Cont'd)

GENERAL SYSTEM BEHAVIOR

- To guarantee full advertised torque capability at the automatic transmission PTO gear through the aftermarket PTO clutch, the hydraulic line pressure serving the aftermarket PTO clutch must be elevated. Applying battery voltage to the PTO circuit is the signal to the transmission to enter SEIC strategy and command these two important functions. This applies to both stationary and mobile PTO operations.
- If an SEIC disabler occurs:
  - Both GASOLINE and DIESEL engines will require a "change-of-state", meaning the operator is required to turn off voltage to the “PTO-Request” circuit, and back on again to re-invoke SEIC and PTO operation.
- Battery Charge Protection (BCP): Available on E-Series, Super Duty F-Series and Transit. When switched to ON, the engine speed goes immediately to 600 rpm. In this state, the Powertrain Control Module (PCM) monitors battery voltage, ambient air temperature and engine oil temperature information; the PCM will adjust engine speed to maintain battery voltage. Maximum engine speed in BCP mode is 1200 rpm. Loss of an enabling condition after BCP is engaged will cancel BCP and require recycling of the BCP switch to re-engage the BCP function.
- If the Transmission Oil Temperature (TOT) sensor reaches 240°F, then the SEIC system will disengage and the hydraulic line pressure serving the aftermarket PTO clutch will drop, preventing torque from being delivered to the aftermarket PTO equipment.
- SEIC/PTO strategy function in the PCM is not affected by the loss of vehicle battery electrical power.
- SEIC Ramp Rate (fixed, not programmable):
  - Gasoline engines: 400 rpm/second
  - Diesel engines: When first applying battery voltage to the PTO circuit, the PCM directs the engine to go to the initial target that it sees at the RPM circuit at 200 rpm/second.
- Correlation between engine speed and resistor values:
  - The SEIC system offers buffered PCM voltage and ground circuits to complete the resistor circuits for engine speed.
  - If there is a high electrical demand on the chassis battery, such as from aftermarket inverters or generators, etc., the actual elevated idle engine speed may vary with that demand for any given resistance in the SEIC circuit.
- GASOLINE Engine Only:
  - Normal base engine calibration allows approximately +/- 50 rpm fluctuation. If any factory vehicle accessories are used during SEIC, e.g., A/C, defroster, etc., then that fluctuation may increase to approximately +/- 100 rpm or more.
  - The sudden loss of aftermarket PTO hydraulic pressure during SEIC/PTO operation, like a ruptured hose, may send SEIC engine speed to near 3000 rpm. It is recommended that a hydraulic pressure switch linked to SEIC/PTO be added to disable SEIC/PTO when a hose ruptures.
  - Because of a service brake circuit characteristic at engine-start, invoking SEIC may cause the diagnostic error code FFG_BOO to get flagged (recorded in the PCM). To avoid this, simply tap the service brake pedal sometime after engine-start and prior to invoking SEIC. Once the code is set, SEIC may not be available until it is erased.
  - Gasoline engines require a "change-of-state" at both the PTO-Mode and PTO-Engage circuits whenever a disabler turns off SEIC (remove battery voltage signal and re-apply).
  - For aftermarket remote engine start-stop: a change-of-state is required to get SEIC to function again.

SEIC ENABLE-DISABLE CONDITIONS

Vehicle Conditions to Enable SEIC (all are required)	Vehicle Conditions that Disable SEIC (any one required-See note 1)	Gasoline Engine	Diesel Engine
Parking brake applied.	Parking brake disengaged.	Yes	Yes
Foot off of service brake	Depressing service brake	Yes	Yes
Vehicle in PARK (automatic trans.)	Vehicle taken out of PARK	Yes	Yes
Foot off of accelerator pedal		Yes	Yes
Vehicle speed is 0 mph (stationary)		Yes	Yes
Brake lights functional	Brake light circuit disconnected	Yes	Yes
Engine at a stable base idle speed		Yes[2]	Yes[2]
Trans Oil Temp above 20°F	Transmission Oil Temperature (TOT) Limit exceeds 240°F.	Yes	Yes
Eng Coolant Temp above 20°F	Engine Coolant Temperature (ECT) above 234°F	No	Yes
Eng Coolant Temp above 40°F[3]	Engine Coolant Temperature (ECT) above 220°F	Yes	No
	Catalyst Temperature Limit	Yes	Yes

(1) A “Change-of-State” at the “PTO-Request” (and “PTO Engage” - Gasoline engines) circuit is required to re-invoke SEIC. When a disabler is seen by the PCM, the "PTO-Indicator" circuit changes from "Ground-Source" to an “Open-Circuit". After approximately 3 seconds SEIC drops out, returning the engine speed to base idle. For vehicle-stationary operation, the automatic transmission torque converter unlocks as engine speed proceeds below 1200 rpm. To re-initiate SEIC the operator must turn off the aftermarket PTO switch (removing command voltage to the “PTO-Mode” circuit) and then turn it back on again.
(2) If a SEIC disabling condition occurs, the engine must be allowed to reach a stable base idle before the system can be re-initiated.
(3) 6.2L engines- above 140°F.

(Cont'd next page)

SEIC / PTO
APPLICATION INFORMATION (Cont'd)

GUIDELINES FOR SPECIFIC APPLICATIONS

FEAD-Mounted Auxiliary Equipment:

1. An auxiliary crankshaft bearing support is required on 6.8L gasoline engine applications where the clutch-pump is drawing greater than 5-hp from the engine crankshaft pulley. This further applies to all tangentially-mounted auxiliary aftermarket equipment in general.

   A "spider" bracket kit can be obtained for this purpose. It allows up to 70 lb-ft of torque at the clutch-pump. Part Number: (6.8L) XC2E-7275-BB.
2. Always maintain the clearance relationship between the Ford OEM fan, radiator, and shroud to help maintain optimum engine cooling performance.
3. Always consider engine roll and body/frame torsion when packaging clearances.
4. Temperature monitoring of powertrain fluids as discussed earlier in this section is recommended.
5. Avoid the use of aftermarket “power chips” in the engine powertrain control system. These boost engine power by dumping fuel, which heats the engine, thereby turning on the cooling fan 100%, resulting in accelerated FEAD belt and tensioner wear.
6. Belt spans greater than 250 mm [9.8 in] require a pulley or tensioner support within the span.

Split-Shaft PTO (Super Duty F-Series Diesel Only – Ref: SVE Bulletin Q-256)

Split-Shaft PTO gearboxes provide a cost effective means for driving a pump, generator, air compressor, winch or other auxiliary equipment from the truck engine. An aftermarket gearbox installed in a mid-ship position of the truck between two sections of a split drive shaft. Split-Shaft mode is activated by applying supply voltage to both the PTORS1 & PTORS2 PCM circuits simultaneously.

The enablers are as follows:

- Assure engine is running and warmed-up.
- Apply park brake.
- With transmission in NEUTRAL, disengage drive wheels by shifting the PTO gearbox to AUXILIARY POWER.
- Engage the load and apply RPM REQUEST voltage.
- With foot off brake and accelerator, switch Split-Shaft PTO to ON.
- While pressing the service brake, shift transmission into DRIVE.
- The system will shift the transmission into 4th gear, lock the converter and then ramp up to the desired speed in a controlled manner. Release the service brake.
- If vehicle unexpectedly lurches or moves, immediately depress brake pedal and shift transmission into PARK or NEUTRAL to secure vehicle. Contact upfitter immediately for further guidance.

An auxiliary engine cooling system may be required to run at full loads above 2400 rpm. This will be determined by the upfitter based upon the application installed.

LiveDrive Mobile Mode (Super Duty F-Series Diesel and Gasoline Engine – Ref: SVE Bulletin Q-256)

LiveDrive Mobile Mode operates in all gears and all vehicle speeds. The engine idle speed is slightly elevated when the Mobile Mode is initiated. Engine rpm is controlled by the driver through the throttle pedal, but peak engine speed is not limited beyond normal operating ranges. There is no built-in provision to limit engine speed to a set rpm. To prevent over-speed damage to attached pumps and equipment, an additional aftermarket rpm limiter will be required. The maximum load allowable for mobile mode is 150 ft-lbs at the transmission PTO gear. If the PTO feature is used for extended periods of time without vehicle movement it is recommended to switch to Stationary Mode.

SEIC / PTO
E-350/450
VOLTAGE SOURCES (VPWR)

VOLTAGE SOURCES (VPWR)

E-350/450 – 6.2L & 6.8L Gasoline Engine		
Circuit Intent	**Wire Tag**	**Description**
Hot-at-all-times		Circuit no. SBB68 Wire Color: Green / Red • A fused 50 amp circuit. • Found: at 4-pin customer access connector above the brake master cylinder or above and to the right of parking brake release handle by the relay pack (part of the Modified Vehicle Wiring)
Ignition Hot-in-RUN		Circuit no. CAC14 Wire Color: Yellow / Orange • A fused 40 amp circuit • Found: at 4-pin customer access connector above the brake master cylinder or above and to the right of parking brake release handle by the relay pack (part of the Modified Vehicle Wiring)
• Upfitter switch Output: Ign-Hot/ACC • Found: under windshield cowl on driver's side engine zone • Requires Upfitter Switch Option 52S	Aux-1	[30-amp] Circuit No. CAC05 Wire Color: Yellow
	Aux-2	[30-amp] Circuit No. CAC06 Wire Color: Green / Brown
	Aux-3	[10-amp] Circuit No. CAC07 Wire Color: Violet / Green
	Aux-4	[15-amp] Circuit No. CAC08 Wire Color: Brown

NOTE: FOR PASS THRU CIRCUITS – REFER TO THE ELECTRICAL SECTION OF THIS BOOK

SEIC / PTO
E-350/450
CUSTOMER ACCESSIBLE SIGNALS & SEIC CIRCUIT DESCRIPTIONS
6.2L & 6.8L GASOLINE ENGINE

CUSTOMER ACCESSIBLE SIGNALS

NOTE: For additional information, see ***SVE Bulletin Q-235***

E-350/450 – 6.2L & 6.8L Gasoline Engine PCM		
Circuit Intent	**Wire Tag**	**Description**
OUTPUT Park-Only	TRO_P	PCM Pin 6.8L C1551E-19 Circuit No. CET22 Wire Color: Gray/Brown • An output from the PCM that indicates when the Transmission Range Sensor is indicating that the Transmission is in the Park Position. The Low Side driver in the PCM will pull this output to ground when active (Transmission is in the PARK Position). To properly reference this output, the customer supplied external controller/device needs to pull this output up to VPWR with a 10K Ohm resistor. Thus when the output is active, the voltage at this output will be 0 volts. When this output is not active, the output will be pulled up to VPWR by the 10K Ohm pull up resistor.
OUTPUT Neutral-Only	TRO_N	PCM Pin 6.8L C1551B-43 Circuit No. CET21 Wire Color: White • An output from the PCM that indicates when the Transmission Range Sensor is indicating that the Transmission is in the Neutral Position. The Low Side driver in the PCM will pull this output to ground when active (Transmission is in the Neutral Position). To properly reference this output, the customer supplied external controller/device needs to pull this output up to VPWR with a 10K Ohm resistor. Thus when the output is active, the voltage at this output will be 0 volts. When this output is not active, the output will be pulled up to VPWR by the 10K Ohm pull up resistor.
OUTPUT Vehicle Speed	VSOUT	PCM Pin 6.8L C1551B-78 Circuit No. VMC05 Wire Color: Violet / Orange • An output from the PCM that provides 8000 pulse per mile signal with a 50% duty cycle. The low side driver in the PCM will switch the output off and on (off will allow the output to be pulled up close to VPWR), (on will put the output to 0 volts). To properly reference this output, the customer supplied external controller/device needs to pull this output down to ground with a 10K Ohm resistor.
OUTPUT Engine Speed	CTO	PCM Pin 6.8L C1551B-77 Circuit No. CE913 Wire Color: Blue • An output from the PCM that indicates a Clean Tachometer Output to provide an indication of engine RPM. The low side driver in the PCM will switch the output off and on (off will allow the output to be pulled up close to VPWR), (on will put the output to 0 volts), at a frequency = ((Engine RPM's * Number of cylinders) / 120), with a duty cycle of 50%. To properly reference this output, the customer supplied external controller/device needs to pull this output down to ground with a 10K Ohm resistor.
PASS-THRU		Circuit No. CAC17 Wire Color: Violet / Gray Found: at 4-pin customer access connector
PASS-THRU		Circuit No. CAC18 Wire Color: Yellow / Gray Found: at 4-pin customer access connector

NOTE: FOR PASS THRU CIRCUITS – REFER TO THE ELECTRICAL SECTION OF THIS BOOK

(Cont'd next page)

SEIC / PTO
E-350/450
CUSTOMER ACCESSIBLE SIGNALS & SEIC CIRCUIT DESCRIPTIONS (Cont'd)
6.2L & 6.8L GASOLINE ENGINE

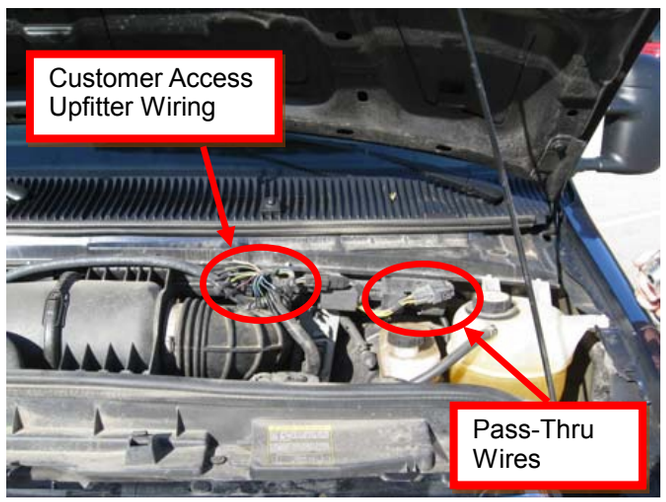
SEIC CIRCUIT DESCRIPTIONS

NOTE: For additional information, see ***SVE Bulletin Q-235***

E-350/450 – 6.2L & 6.8L Gasoline Engine PCM		
Circuit Intent	**Wire Tag**	**Description**
INPUT (VPWR)	PTO_REQUEST	PCM Pin C1551B-84 Circuit No. CE912 Wire Color: Yellow / Green • Applying vehicle battery voltage to this wire begins SEIC process. • Verifies safety enablers. • Turns off OBD and other emission-related monitoring. • Elevates engine speed to 900 rpm "standby" speed if it finds an "open-circuit" at PTO_RPM Select. • Invokes the PTO Indicator circuit when safety enablers are met. • Looks for the target engine speed requested at the PTO_RPM Select circuit using a resistor or potentiometer.
OUTPUT	PTO_OK	PCM Pin C1551B-98 Circuit No. CE326 Wire Color: Blue / White • A low-side driver, changing from "open-circuit" to "ground" indicating that the engine is ready for the PTO operation to begin, and that a PTO load may be applied. • Intended for powering a PTO indicator lamp, or turn on a relay coil (not to exceed 1 amp) LED lights require adding a resistor in series.
OUTPUT	PTO_VREF	PCM Pin C1551B-52 Circuit No. LE423 Wire Color: Green / Violet +5VDC reference voltage.
INPUT (resistor)	PTO_RPM	PCM Pin C1551B-85 Circuit No. VE925 Wire Color: Green • Add a resistor or a potentiometer to obtain fixed or variable engine target speed. • Combine in circuit with PTO_VREF (+5VDC). • Speed range available: 650 rpm to 2400 rpm
INPUT	PTO_SIGRTN	PCM Pin C1551B-51 Circuit No. RE405 Wire Color: Green / White • A ground reference, buffered, used to complete the potentiometer circuit for engine speed selection.
INPUT (VPWR)	PTO_ENGAGE	PCM Pin 6.8L C1551B-88 Circuit No. CE924 Wire Color: Blue / Green • Applying vehicle battery voltage to this wire signals the PCM that the PTO load is being applied.
OUTPUT	BCPIL	PCM Pin C1551B-17 Circuit No. CE140 Wire Color: Tan • A low-side driver, changing from "open-circuit" to "ground" indicating that BCP is in effect. • Intended for powering an indicator lamp (not to exceed 40mA).
INPUT	BCP_SW	PCM Pin C1551B-82 Circuit No. CE926 Wire Color: Violet / Brown • Applying vehicle battery voltage to this wire begins BCP. BCP regulates engine speed between 600 to1200 rpm to maintain charge system voltage

NOTE: FOR PASS THRU CIRCUITS – REFER TO THE ELECTRICAL SECTION OF THIS BOOK

SEIC / PTO
E-350/450
ACCESS & PASS-THRU WIRING LOCATIONS



E350/450
Engine Compartment

- Blunt-cut access for SEIC, “Customer Access” signal circuits for CTO, VSO PARK, optional Upfitter Switch output, and Pass-Thru wires are located below the driver's side windshield/cowl.

E350/450
Engine Compartment

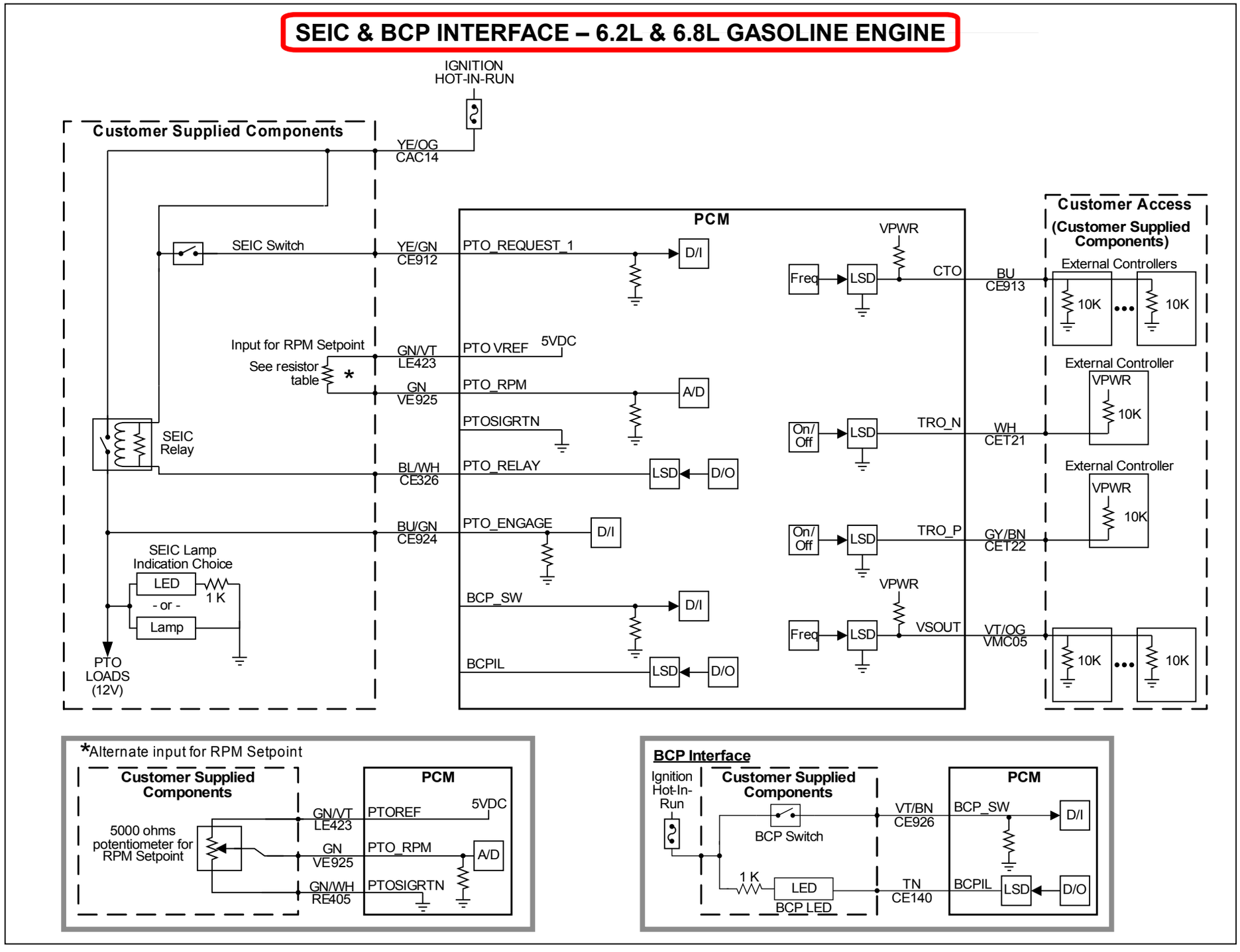
- To find Blunt-cut Customer access wires, remove some of the plastic harness tape where the large harness (below the engine cowl) exits its plastic support gutter above the engine air induction tube to reveal the blunt-cut wires.

E350/450
Engine compartment

- The two pass-thru wires are part of the same modified vehicle wiring kit as prior years. Located at the 4-pin connector in the harness below the cowl, outboard of the brake master cylinder, as shown. Mating pigtail connector, 4C24-14A411, Found in dunnage. Opposite ends located above driver-side kick-panel.

SEIC / PTO
E-350/450
WIRING SCHEMATIC (Cont'd)
6.2L & 6.8L GASOLINE

SEIC & BCP INTERFACE – 6.2L & 6.8L GASOLINE ENGINE



SEIC / PTO
E-SERIES
RPM / RESISTANCE / VOLTAGE CHARTS

6.2L & 6.8L Gasoline Engine SEIC		
Engine Target Speed (RPM)	**Resistor (Ohms)**	**Voltage (volts)***
(Base)	100000	0.218
650	54400	0.4
750	30880	0.665
800	25320	0.787
900	17520	1.06
1000	13280	1.31
1100	10220	1.578
1200	8130	1.837
1300	6500	2.102
1400	5220	2.375
1500	4250	2.63
1600	3430	2.89
1700	2740	3.162
1800	2168	3.426
1900	1684	3.685
2000	1247	3.954
2100	891	4.203
2200	544	4.482
2300	255	4.741
2400	0 (closed circuit)	5

* Voltages are exact to achieve RPM shown.
Resistors are standard 5% values (1 watt) and yield RPM values +/- 32rpm

SEIC / PTO
F-250/350/450/550
ALL INFORMATION – REF SVE BULLETINS

All SEIC / PTO information for the F-250/350/450/550 models is currently contained within SVE Bulletins available at the online BBAS website at https://fordbbas.com.

The following are pertinent linked SVE Bulletins:

- **Q-252: 2017 and Later F-Series Super Duty Upfitter Switches**
- **Q-256: 2017 and Later F-250-550 Stationary Elevated Idle Control**
- **Q-259: 2017 MY Super Duty Customer Access Circuit Schematics**

SEIC / PTO
F-650/750
ALL INFORMATION – REF BBLB F-650/750 CHAPTER

SEIC / PTO information for the F-650/750 models is currently contained within the F-650/750 chapter of the *Body Builder Layout Book*.

SEIC / PTO
TRANSIT
VOLTAGE SOURCES (VPWR)

Transit Battery Voltage Sources (VPWR)

Refer to the *Transit Body Equipment Mounting Manual (BEMM)*and *SVE Bulletin Q-239* for more information.

Transit		
Circuit Intent	**Wire Tag**	**Description**
Hot-at-all-times		**Circuit no. SB153** • A fused 40 amp circuit (F53) • Requires modified vehicle wiring option (53K) • Found at: – Vehicle interface connector **C11-H** (4-pin connector), **Pin #4,** at firewall on driver side of the engine compartment. – Vehicle interface connector **C12-A** (6-pin connector), **Pin #3,** behind left side of center stack. – Vehicle interface connector **C33-C** (6-pin connector), **Pin #3**, behind passenger side airbag, above glove box. **Circuit No. SB118 Connector: C33-C Pin:6** • A fused 40 amp circuit (F18). • Found: at vehicle interface connector **C33-C** (6-pin connector), **Pin #6**, behind passenger side airbag, above glove box. • Requires modified vehicle wiring option (53K). **Customer Connection Point** • A fused 60 amp VBATT feed. • Found: at right side rear of driver seat pedestal. **Circuit No. CB121 Connector: C33-E Pin:6** • A fused 10 amp circuit. • Found: at vehicle interface connector C33-E (6-pin connector) on right side of driver seat pedestal beneath driver seat. **Circuit no. CAC14** • A fused 40 amp circuit (F52). • Requires modified vehicle wiring option (53K). • Found at: – Vehicle interface connector C11-H (4-pin connector), Pin #1, at firewall on driver side of the engine compartment. – Vehicle interface connector C12-A (6-pin connector), Pin #4, behind left side of center stack. – Vehicle interface connector C33-C (6-pin connector), Pin #5, behind passenger side airbag, above glove box.
Ford Upfitter Switches: • Requires Upfitter Switch Option 67C	Aux 1 Aux 2 Aux 3 Aux 4	[20-amp] Ignition supplied / Hot at all times [20-amp] Ignition supplied / Hot at all times [20-amp] Ignition supplied / Hot at all times [20-amp] Engine run

NOTE: FOR PASS THRU CIRCUITS – REFER TO THE ELECTRICAL SECTION OF THIS BOOK

SEIC / PTO
TRANSIT
CUSTOMER ACCESSIBLE SIGNALS

Customer Accessible Signals

Refer to the *Transit Body Equipment Mounting Manual (BEMM)* and SVE Bulletin Q-239 for more information.

Transit		
OUTPUT Park-Only	TRO-P	3.5L - PCM Pin C1551B-40 Circuit No. CET22 Wire Color: Gray / Yellow 3.7L - PCM Pin C175B-19 Circuit No. CET22 Wire Color: Gray / Yellow
OUTPUT Neutral-Only	TRO-N	3.5L - PCM Pin C1551B-81 Circuit No. CET21 Wire Color: Green / Orange 3.7L - PCM Pin C175B-43 Circuit No. CET21 Wire Color: Green / Orange
OUTPUT Vehicle Speed	VSOUT	Circuit No. VMC05 Connector: C33-E Pin:4 See BEMM for signal specification.
OUTPUT Engine Speed	CTO	3.5L - PCM Pin C1551B-40 Circuit No. VMC02 Wire Color: Blue / White 3.7L - PCM Pin C175B-19 Circuit No. VMC02 Wire Color: Blue / White 3.2L Diesel - PCM Pin C1232B Circuit No. VMC02 Wire Color: Blue / Orange
PASS-THRU		Circuit No. CAC17 • Found at: - Vehicle interface connector **C11-H** (4-pin connector), **Pin #2,** at firewall on driver side of the engine compartment. - Vehicle interface connector **C12-A** (6-pin connector), **Pin #1,** behind left side of center stack. - Requires modified vehicle wiring option (53K).
PASS-THRU		Circuit No. CAC18 • Found at: - Vehicle interface connector **C11-H** (4-pin connector), **Pin #3,** at firewall on driver side of the engine compartment. - Vehicle interface connector **C12-A** (6-pin connector), **Pin #2,** behind left side of center stack. - Requires modified vehicle wiring option (53K).

NOTE: FOR PASS THRU CIRCUITS – REFER TO THE ELECTRICAL SECTION OF THIS BOOK

SEIC / PTO
TRANSIT
SEIC CIRCUIT DESCRIPTIONS (GASOLINE ENGINE)

SEIC Circuit Descriptions

Refer to the *Transit Body Equipment Mounting Manual (BEMM)* and *SVE Bulletin Q-239* for more information.

Transit – 3.5L and 3.7L Gasoline Engine PCM		
Circuit Intent	**Wire Tag**	**Description**
INPUT (VPWR)	PTO_REQUEST1	3.5L - PCM Pin C1551B-87 Circuit No. CE913 Wire Color: Blue 3.7L - PCM Pin C175B-84 Circuit No. CE913 Wire Color: Blue • Applying vehicle battery voltage to this wire begins SEIC process. • Signals PCM to enter SEIC strategy. • Verifies safety enablers. • Elevates engine speed to target found at PTO-RPM circuit. • Invokes the PTOIL circuit when safety enablers are met. • Looks for the target engine speed requested at the PTO_RPM circuit using a resistor or POT.
INPUT (VPWR)	PTO_REQUEST2	3.5L - PCM Pin C1551B-91 Circuit No. VE935 Wire Color: Green 3.7L - PCM Pin C175B-88 Circuit No. VE935 Wire Color: Green • RPM Increase Command Monitor
OUTPUT	PTOIL	3.5L - PCM Pin C1551B-80 Circuit No. CE326 Wire Color: Blue / White 3.7L - PCM Pin C175B-96 Circuit No. CE326 Wire Color: Blue / White • A low-side driver, changing from "open-circuit" to "ground" indicating that the engine is ready for the PTO operation to begin and that a PTO load may be applied. • Intended for powering a PTO indicator lamp, or turn on a relay coil (not to exceed 1 amp). • LED lights require adding a resistor in series.
INPUT (resistor)	PTO_RPM	3.5L - PCM Pin C1551B-33 Circuit No. CE925 Wire Color: Green / White 3.7L - PCM Pin C175B-85 Circuit No. CE925 Wire Color: Green / White • Add a resistor or a potentiometer to obtain fixed or variable engine target speed. • Combine in circuit with PTO_VREF (+5V). • Speed range available: 910 rpm to 2400 rpm.
OUTPUT	PTO_VREF	3.5L - PCM Pin C1551B-11 Circuit No. LE458 Wire Color: Blue / White 3.7L - PCM Pin C175B-52 Circuit No. LE458 Wire Color: Blue / White • A 5-volt reference, buffered against shorts to ground or power, used to complete the resistor circuit for engine speed selection.
INPUT	PTO_GND	3.5L - PCM Pin C1551B-18 Circuit No. RE407 Wire Color: Yellow / Violet 3.7L - PCM Pin C175B-51 Circuit No. RE407 Wire Color: Yellow / Violet • A ground reference, buffered, used to complete the resistor circuit for engine speed selection when a potentiometer is used.

NOTE: FOR PASS THRU CIRCUITS – REFER TO THE ELECTRICAL SECTION OF THIS BOOK

SEIC / PTO
TRANSIT
SEIC CIRCUIT DESCRIPTIONS (DIESEL ENGINE)

SEIC Circuit Descriptions

Refer to the *Transit Body Equipment Mounting Manual (BEMM)* and *SVE Bulletin Q-239* for more information.

Transit – 3.2L Diesel Engine PCM		
Circuit Intent	**Wire Tag**	**Description**
INPUT (VPWR)	PTO_NO	PCM Pin C1232B-33 Circuit No. CE913 Wire Color: Blue • Applying vehicle battery voltage to this wire begins SEIC process. • Signals PCM to enter SEIC strategy. • Verifies safety enablers. • Elevates engine speed to target found at PTO-RPM circuit. • Invokes the PTOIL circuit when safety enablers are met. • Looks for the target engine speed requested at the PTO_RPM circuit using a resistor or POT.
OUTPUT	PTOIL	PCM Pin C1232T-1 Circuit No. CE326 Wire Color: Blue / White • A low-side driver, changing from "open-circuit" to "ground" indicating that the engine is ready for the PTO operation to begin and that a PTO load may be applied. • Intended for powering a PTO indicator lamp, or turn on a relay coil (not to exceed 1 amp) LED lights require adding a resistor in series.
INPUT (resistor)	PTO_RPM	PCM Pin C1232B-43 Circuit No. CE925 Wire Color: Green / White • Add a resistor or a potentiometer to obtain fixed or variable engine target speed. • Combine in circuit with PTO_VREF (+5V). • Speed range available: 910 rpm to 2400 rpm.
OUTPUT	PTO_VREF	PCM Pin C1232B-51 Circuit No. LE434 Wire Color: White / Brown • A 5-volt reference, buffered against shorts to ground or power, used to complete the resistor circuit for engine speed selection.
INPUT	PTO_GND	PCM Pin C1232B-24 Circuit No. RE327 Wire Color: Green / Violet • A ground reference, buffered, used to complete the resistor circuit for engine speed selection when a potentiometer is used.
INPUT	BCP_SW	PCM Pin C1232T-43 Circuit No. CE926 Wire Color: Violet / Brown • Applying vehicle battery voltage to this wire begins BCP. • BCP regulates engine speed between 600 to1200 rpm to maintain required charge system voltage.
OUTPUT	BCP_LAMP	PCM Pin C1232T-42 Circuit No. CE140 Wire Color: Brown • A low-side driver, changing from "open-circuit" to "ground" indicating that BCP is in effect. • Intended for powering an indicator lamp.

NOTE: FOR PASS THRU CIRCUITS – REFER TO THE ELECTRICAL SECTION OF THIS BOOK

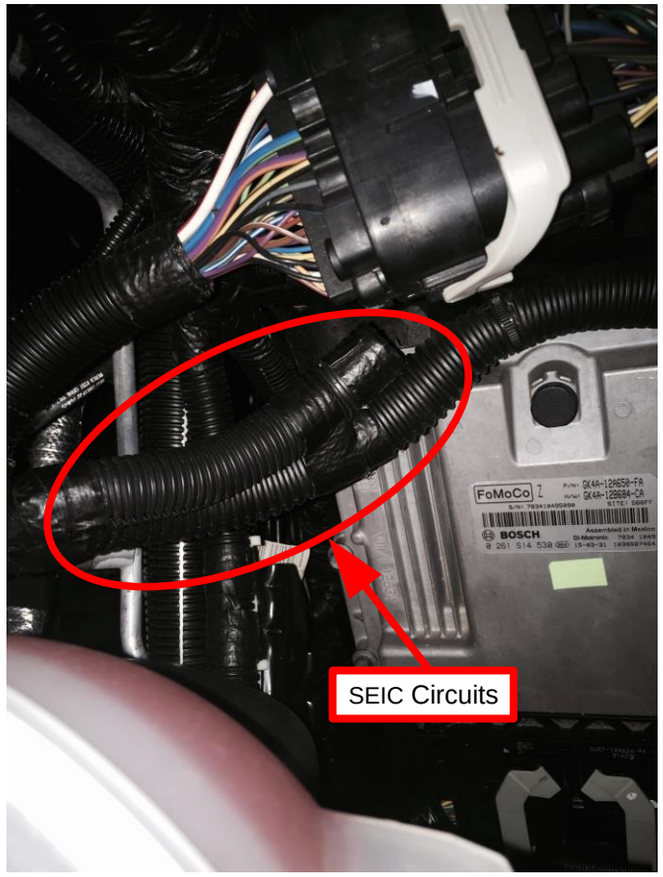
SEIC / PTO
TRANSIT
ACCESS & PASS-THRU WIRING

SEIC Access & Pass-Thru Wiring Locations

Refer to the *Transit Body Equipment Mounting Manual (BEMM)* and SVE Bulletin Q-239 for more information.

TRANSIT ENGINE COMPARTMENT

- 3.2LD / 3.5L / 3.7L SEIC Circuit Location – found underhood, wrapped in convulaute, taped to harness behind coolant reservoir

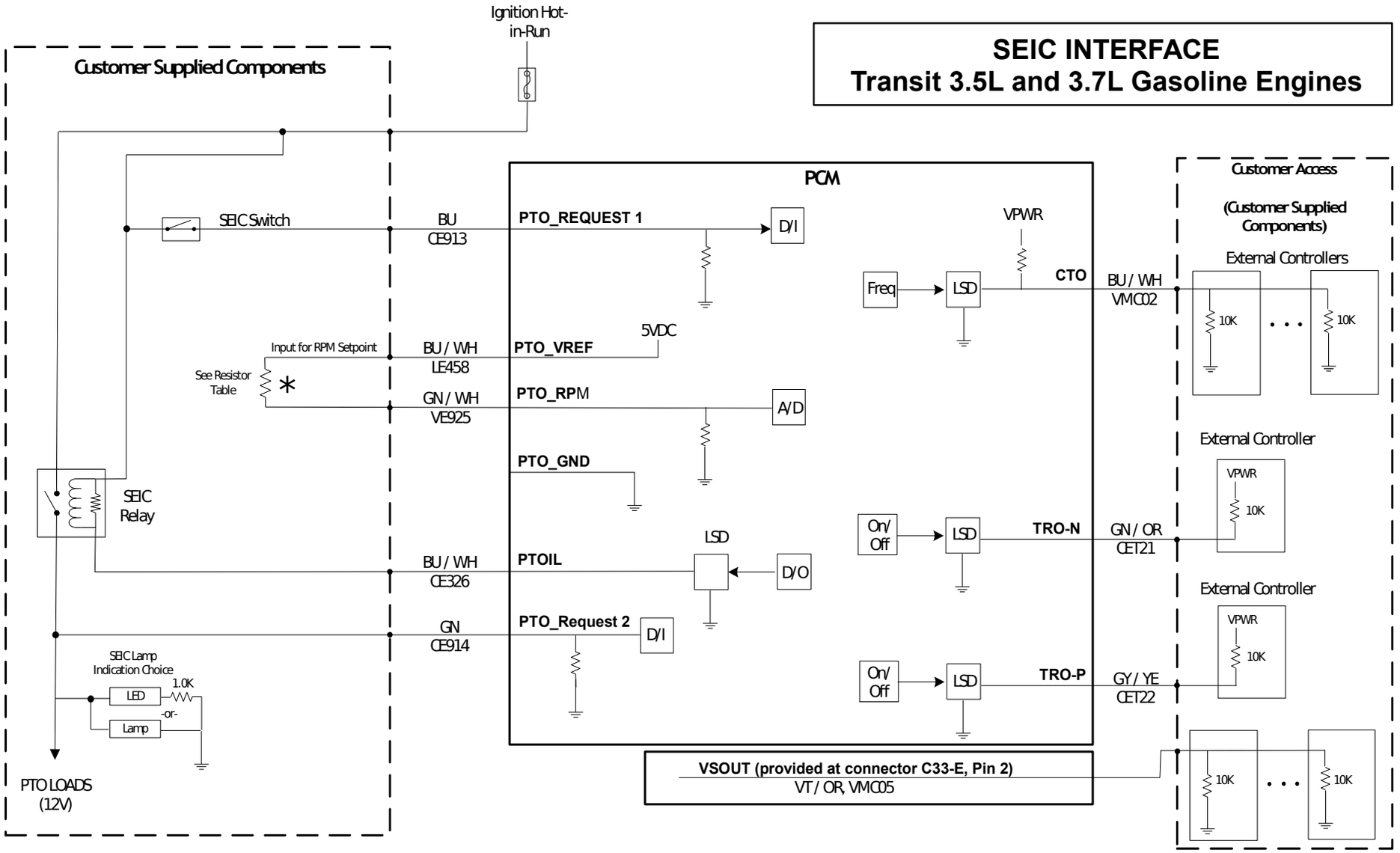


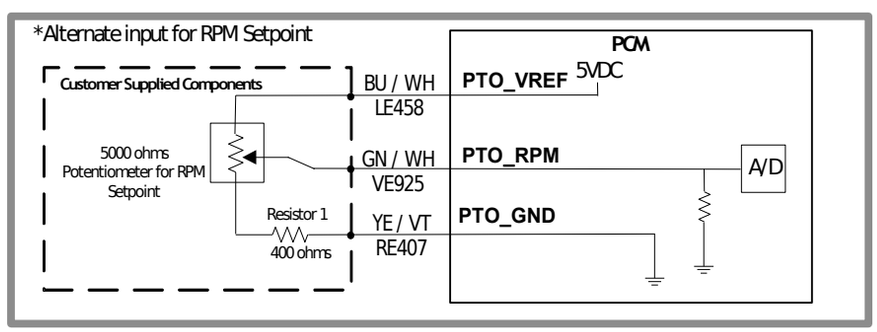
TRANSIT ENGINE COMPARTMENT

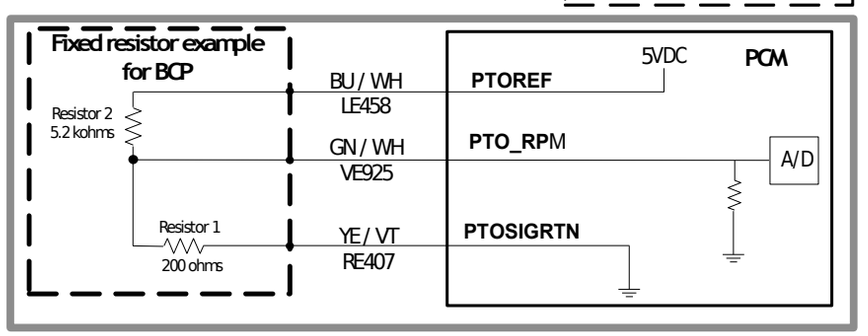
- 3.5L / 3.7L SEIC Circuit Location – found underhood, taped to harness next to Engine Junction Box

NOTE: FOR PASS THRU CIRCUITS – REFER TO THE ELECTRICAL SECTION OF THIS BOOK

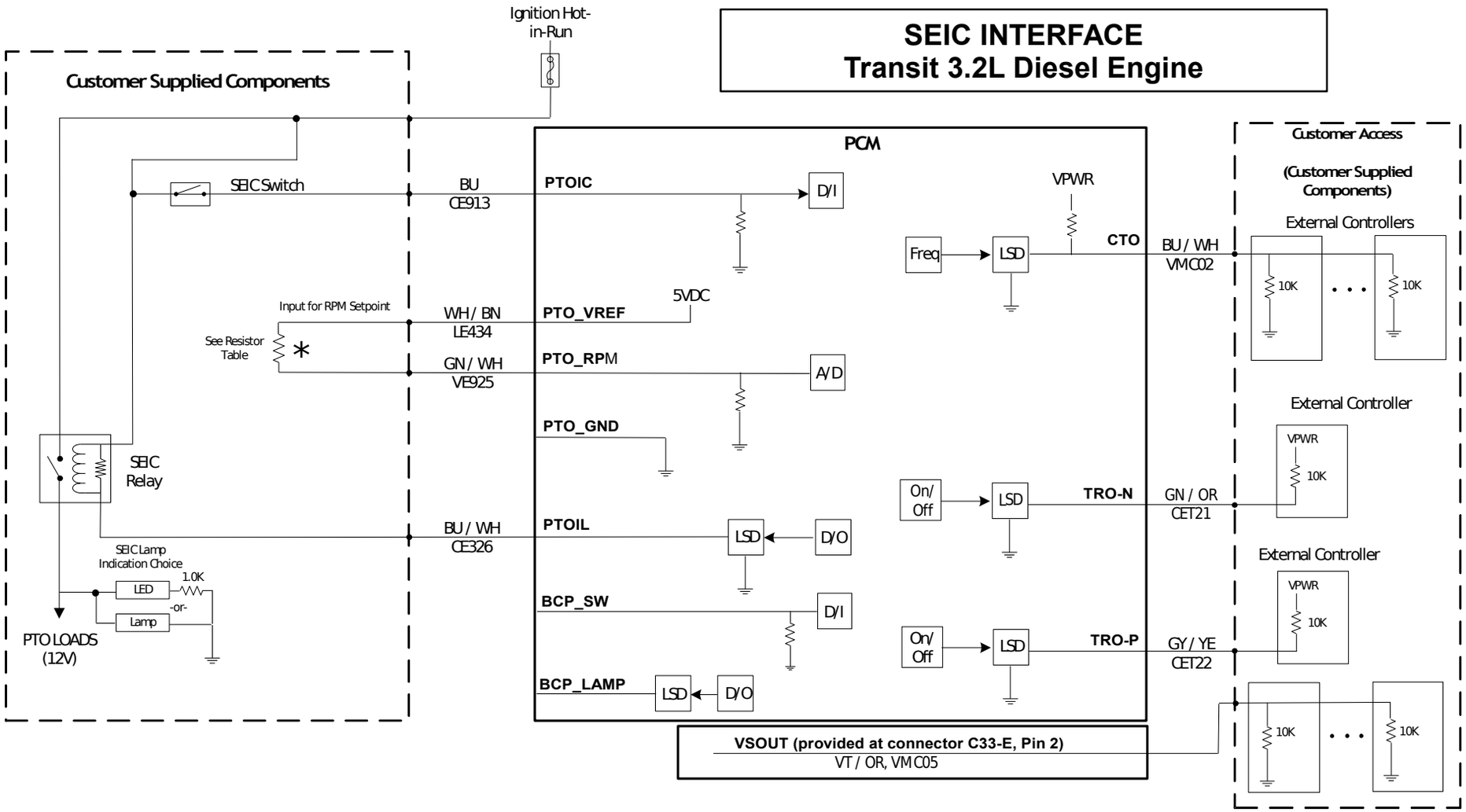
SEIC / PTO
TRANSIT
WIRING SCHEMATIC
3.5L & 3.7L GASOLINE ENGINES

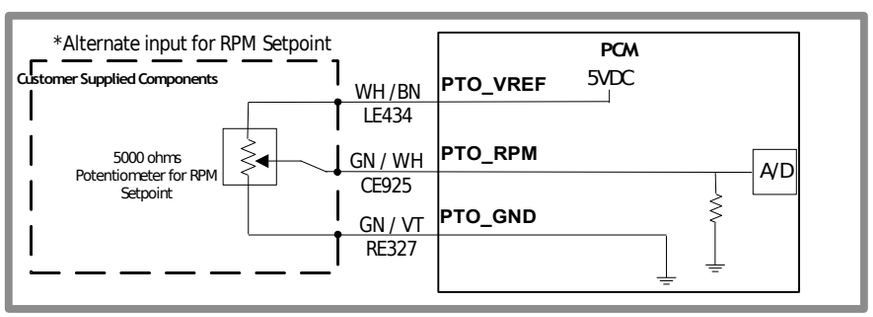


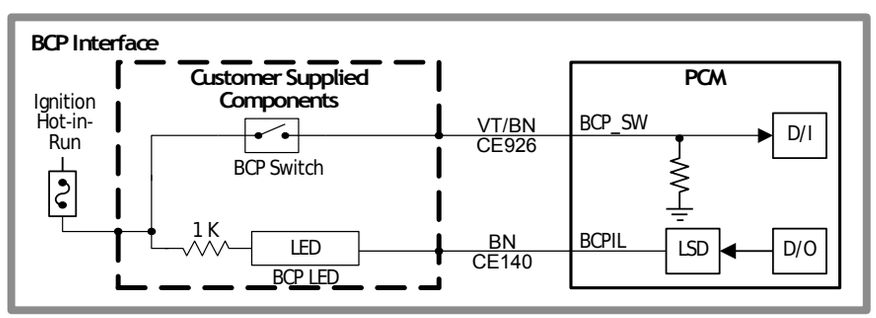




SEIC / PTO
TRANSIT
WIRING SCHEMATIC
3.2L DIESEL ENGINE







SEIC / PTO
TRANSIT
RPM / RESISTANCE / VOLTAGE CHARTS
3.5L / 3.7L GASOLINE ENGINE

GASOLINE ENGINE PRODUCT DESCRIPTION

SEIC

- Intended to be commanded ONLY by applying battery voltage to certain customer-access blunt-cut wire circuits, and adding a target-speed resistor, and is only available when the vehicle road speed signal is zero.
- Includes a link circuit which changes from open-circuit to ground when enablers are met, that may be used to turn on an indicator lamp, while providing battery power to an aftermarket PTO clutch or solenoid.
- Ramp rates are fixed and cannot be altered by the customer.
- Minimum engine speed: ~ 800 RPM
- Maximum engine speed: 2400 RPM

TYPICAL SEIC ENGAGEMENT SEQUENCE

Initiating SEIC by applying battery voltage to the SEIC-PTO wire immediately commands the PCM to first look for enabling conditions, such as vehicle gearshift selector in PARK, engine at base idle speed of about 650 rpm, etc. A complete list of enablers is provided in the "SEIC Enable/Disable Conditions" section of SVE Bulletin Q-239**.** Once enablers are satisfied, then the following takes place:

1. Command is sent to increase engine speed to 900 rpm standby.
2. The low-side driver circuit changes from open-circuit to ground.
3. Engine speed increases to the target RPM determined by resistor (see Table).

3.5L GTDI & 3.7L TRANSIT GASOLINE ENGINE SEIC RESISTOR CHART		
Engine Target Speed (RPM)	**Resistor (Ohms) (5%, 1/4 watt)**	**Voltage (volts)**
804	72000	0.3
850	48000	0.444
900	35200	0.591
950	27000	0.743
1000	21900	0.885
1100	15400	1.174
1200	11200	1.64
1300	8580	1.47
1400	6670	1.77
1500	5240	2.067
1600	4170	2.365
1700	3260	2.664
1800	2590	2.952
1900	1917	3.221
2000	1424	3.548
2100	986	3.836
2200	620	4.13
2300	284	4.711
2396	255	4.995
Battery Charge Protect (BCP) Mode		
700-1200*	5200	0.1857

*RPM varies as a function of battery charge state- see BCP description.

SPECIAL SITUATIONS

Alternative Calibration

All new Ford light trucks have an "Alternative Calibration" or ALT-CAL installed in the PCM that conditions the powertrain during its early lifetime. It may increase the PARK-idle or DRIVE-idle speed of the engine, by as small as 50 rpm or by several hundred rpm. It affects SEIC initiation by not letting it activate because one of the SEIC enablers is having a steady base idle speed, generally near 650 rpm. If ALT-CAL sets the idle at 700 rpm, then SEIC activation will be prevented. ALT-CAL is normally removed after 50 key-on starts or by driving over 5 continuous miles; it is also erased by disconnecting the battery for approximately one minute.

Battery Charge Protect Mode

Battery charge protect mode is available on 3.5L & 3.7L gasoline engine models. On these powertrains, Battery Charge Protect (BCP) mode is det4rmined through resistor selection (see resistor table).

NOTE: PTO_RPM REQ must have a voltage input between 0.16V and 0.20V in order for BCP to function.

When BCP is switched ON the engine speed goes immediately to 600 rpm. From this state, the PCM uses battery voltage as well as ambient air temperature and engine oil temperature information to raise engine speed higher to maintain a design intent battery charge. Maximum engine speed in BCP mode is 1200 rpm. Loss of an operating condition after BCP is engaged will require the BCP switch to be cycled before BCP will re-engage.

NOTE: FOR PASS THRU CIRCUITS – REFER TO THE ELECTRICAL SECTION OF THIS BOOK

SEIC / PTO
TRANSIT
RPM / RESISTANCE / VOLTAGE CHARTS
3.2L DIESEL ENGINE

GASOLINE ENGINE PRODUCT DESCRIPTION

SEIC

- Intended to be commanded ONLY by applying battery voltage to certain customer-access blunt-cut wire circuits, and adding a target-speed resistor, and is only available when the vehicle road speed signal is zero.
- Includes a link circuit which changes from open-circuit to ground when enablers are met, that may be used to turn on an indicator lamp, while providing battery power to an aftermarket PTO clutch or solenoid.
- Ramp rates are fixed and cannot be altered by the customer.
- Minimum engine speed: ~ 800 RPM
- Maximum engine speed: 2400 RPM

TYPICAL SEIC ENGAGEMENT SEQUENCE

Initiating SEIC by applying battery voltage to the SEIC-PTO wire immediately commands the PCM to first look for enabling conditions, such as vehicle gearshift selector in PARK, engine at base idle speed of about 650 rpm, etc. A complete list of enablers is provided in the "SEIC Enable/Disable Conditions" section of SVE Bulletin Q-239. Once enablers are satisfied, then the following takes place:

1. Command is sent to increase engine speed to 900 rpm standby.
2. The low-side driver circuit changes from open-circuit to ground.
3. Engine speed increases to the target RPM determined by resistor (see Table).

3.2L TRANSIT DIESEL ENGINE SEIC RESISTOR CHART

Engine Target Speed (RPM)	Resistor (Ohms) (5%, 1/4 watt)	Voltage (volts)
900	53800	0.4
950	40000	0.52
1000	31450	0.64
1100	21410	0.9
1200	15710	1.15
1300	12050	1.4
1400	9550	1.64
1500	7640	1.9
1600	6200	2.15
1700	5060	2.4
1800	4150	2.65
1900	3400	2.89
2000	2740	3.15
2100	2200	3.4
2200	1724	3.65
2300	1319	3.9
2400	959	4.14
2500	628	4.4

SPECIAL SITUATIONS

Alternative Calibration

All new Ford light trucks have an "Alternative Calibration" or ALT-CAL installed in the PCM that conditions the powertrain during its early lifetime. It may increase the PARK-idle or DRIVE-idle speed of the engine, by as small as 50 rpm or by several hundred rpm. It affects SEIC initiation by not letting it activate because one of the SEIC enablers is having a steady base idle speed, generally near 650 rpm. If ALT-CAL sets the idle at 700 rpm, then SEIC activation will be prevented. ALT-CAL is normally removed after 50 key-on starts or by driving over 5 continuous miles; it is also erased by disconnecting the battery for approximately one minute.

Battery Charge Protect Mode

Battery charge protect mode is available on 3.2L diesel engine models. On diesel powertrains, Battery Charge Protect (BCP) mode is activated through dedicated PCM inputs.

When BCP is switched ON the engine speed goes immediately to 600 rpm. From this state, the PCM uses battery voltage as well as ambient air temperature and engine oil temperature information to raise engine speed higher to maintain a design intent battery charge. Maximum engine speed in BCP mode is 1200 rpm. Loss of an operating condition after BCP is engaged will require the BCP switch to be cycled before BCP will re-engage.

NOTE: FOR PASS THRU CIRCUITS – REFER TO THE ELECTRICAL SECTION OF THIS BOOK