

balance™ hybrid electric vehicle



SPECIFICATIONS & ORDERING GUIDE

2011/2012 FORD E-450 CUTAWAY & STRIPPED CHASSIS



AZD's Balance™ Hybrid Electric Drive will make a difference to your bottom line and your carbon footprint.

“We're delighted with our relationship with Azure and the performance of our current fleet of Azure products. They are helping us reduce operating costs by improving our fuel economy and up time. We look forward to expanding our hybrid fleet in communities across Canada.”

PUROLATOR

ABOUT AZURE DYNAMICS

Azure Dynamics Corporation (TSX: AZD) (OTC: AZDDF.PK) is a world leader in the development and production of hybrid electric and electric components and powertrain systems for commercial vehicles. Azure is strategically targeting the commercial delivery vehicle and shuttle bus markets and is currently working internationally with a variety of partners and customers. The Company is committed to providing customers and partners with innovative, cost-efficient, and environmentally-friendly energy management solutions.





BALANCE™ HYBRID ELECTRIC

This vehicle is built on a Ford E-450 commercial stripped or cutaway chassis with a modified drivetrain and modified electronic controls system. AZD's Balance™ Hybrid Electric Drive System significantly reduces fuel consumption due to the following features:

- Engine stop/start capability
- Regenerative braking
- Electric-only mode at low speeds
- Electric launch-assist

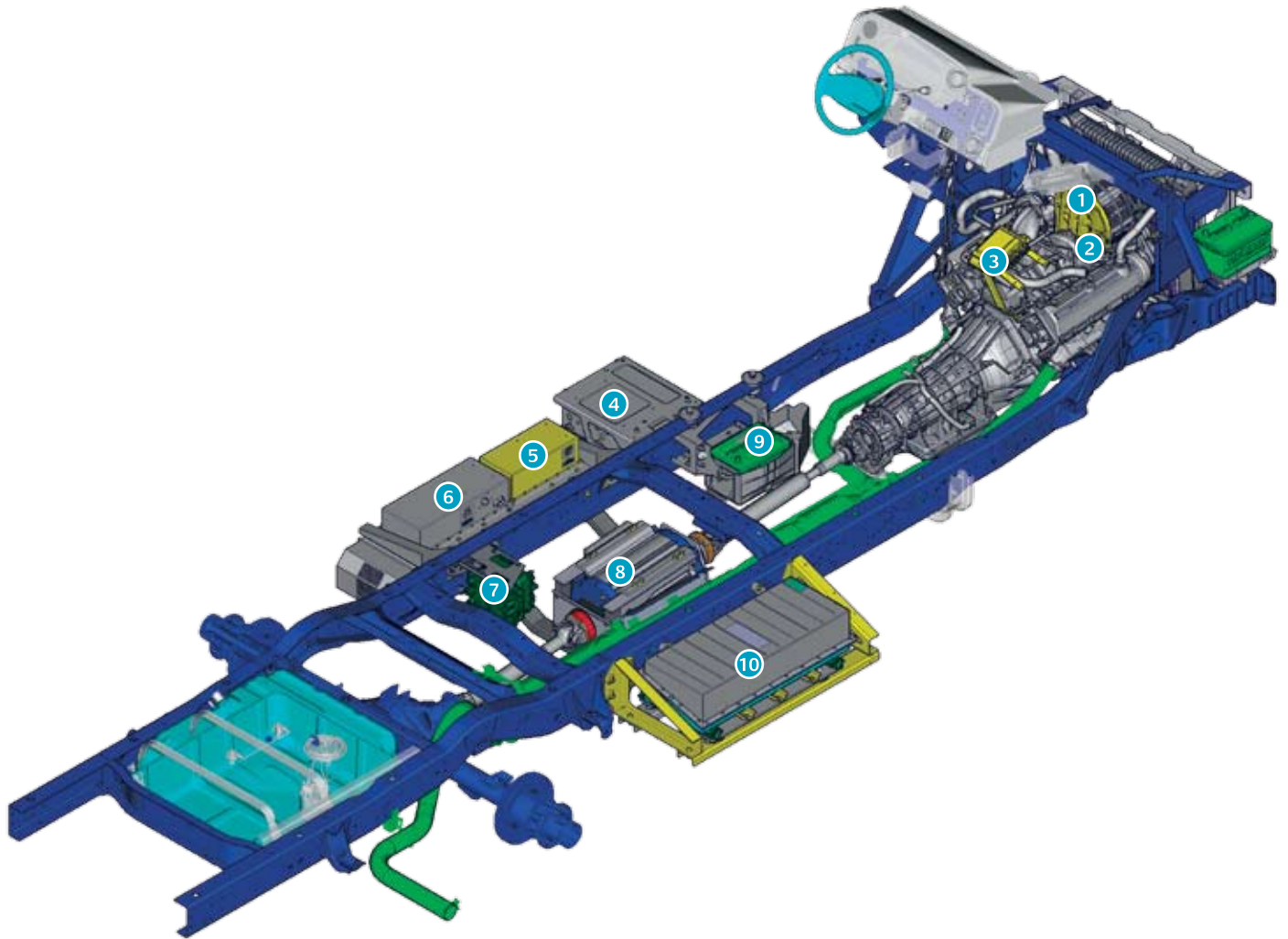
The vehicle is propelled by the Traction Motor in parallel with the conventional gasoline engine and automatic transmission. The Traction Motor assists acceleration and captures energy during regenerative braking events. This energy is stored in the Energy Storage System (ESS).

When the vehicle comes to a stop (e.g. at a red light), the engine will typically shut off in order to save fuel. When this happens, the power assist function, A/C compressor, interior heat and 12 volt charging systems are all maintained.

The vehicle also has an Integrated Starter Generator (ISG) mounted to the front of the engine which is used to provide quick re-starts of the engine when accelerating from a stop. It also generates power to charge the ESS and is used to operate the Front Engine Accessory Drive (FEAD) when it is de-clutched from the engine.

The high voltage system is self-contained and it does not have to be plugged in to an external power source for charging.

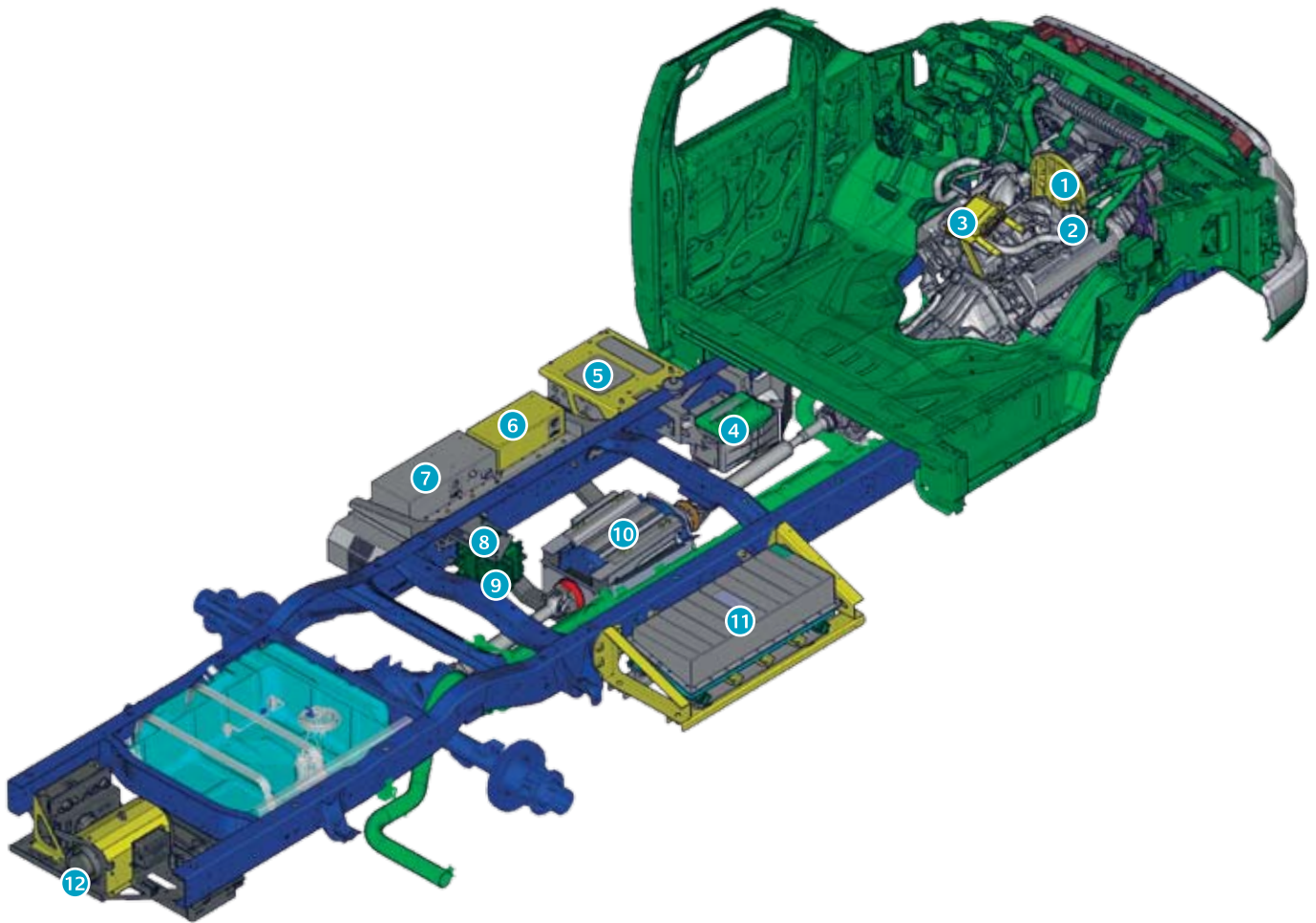
BALANCE™ HYBRID ELECTRIC ARCHITECTURE* — COMMERCIAL TRUCK



* Balance™ Hybrid Electric Architecture diagram is representative, not actual.

- 1. INTEGRATED STARTER/GENERATOR (ISG)**
Used to start the engine and to generate power.
- 2. CLUTCHED FEAD**
Clutch at crank shaft opens when engine off & ISG then spins the disconnected Front Engine Accessory Drive (FEAD) system (power steering/brake pump, water pump, alternator & A/C compressor).
- 3. VEHICLE CONTROL UNIT (VCU)**
Controls all hybrid components and coordinates their operation with the Ford systems (e.g. start/stop).
- 4. HIGH VOLTAGE JUNCTION BOX**
Distributes DC power from battery to components and contains high voltage fuses.
- 5. ISG MOTOR CONTROLLER**
Converts DC from the battery to 3 phase AC for the ISG motor. Controls the speed and torque of the ISG motor.
- 6. TRACTION MOTOR CONTROLLER**
Converts DC from the battery to 3 phase AC for the traction motor. Controls the speed and torque of the traction motor.
- 7. DC/DC CONVERTER**
Converts high-voltage DC power to keep the 12V batteries charged and to supply power for 12V accessories.
- 8. TRACTION MOTOR**
Converts electrical energy to wheel torque in order to propel the vehicle. Speed & torque outputs are based on accelerator input as well as vehicle operating conditions.
- 9. 2ND 12 VOLT BATTERY**
An optional 2nd 12V battery is available, however not typically required.
- 10. ENERGY STORAGE SYSTEM (ESS)
HIGH VOLTAGE BATTERY PACK**
Liquid cooled high voltage Li-Ion battery pack. Stores energy and includes internal sensors and controller.

BALANCE™ HYBRID ELECTRIC ARCHITECTURE* — SHUTTLE BUS



* Balance™ Hybrid Electric Architecture diagram is representative, not actual.

- 1. INTEGRATED STARTER/GENERATOR (ISG)**
Used to start the engine and to generate power.
- 2. CLUTCHED FEAD**
Clutch at crank shaft opens when engine off & ISG then spins the disconnected Front Engine Accessory Drive (FEAD) system (power steering/brake pump, water pump, alternator & A/C compressor).
- 3. VEHICLE CONTROL UNIT (VCU)**
Controls all hybrid components and coordinates their operation with the Ford systems (e.g. start/stop).
- 4. 2ND 12 VOLT BATTERY**
2nd 12V battery desired by most shuttle bus customers due to high 12V loads.
- 5. HIGH VOLTAGE JUNCTION BOX**
Distributes DC power from battery to components and contains high voltage fuses.
- 6. ISG MOTOR CONTROLLER**
Converts DC from the battery to 3 phase AC for the ISG motor. Controls the speed and torque of the ISG motor.
- 7. TRACTION MOTOR CONTROLLER**
Converts DC from the battery to 3 phase AC for the traction motor. Controls the speed and torque of the traction motor.
- 8. DC/DC CONVERTER**
Converts high-voltage DC power to keep the 12V batteries charged and to supply power for 12V accessories.
- 9. 2ND DC/DC CONVERTER**
2nd DC/DC converter required for Balance™ shuttle bus due to high 12V loads.
- 10. TRACTION MOTOR**
Converts electrical energy to wheel torque in order to propel the vehicle. Speed & torque outputs are based on accelerator input as well as vehicle operating conditions.
- 11. ENERGY STORAGE SYSTEM (ESS)
HIGH VOLTAGE BATTERY PACK**
Liquid cooled high voltage Li-Ion battery pack. Stores energy and includes internal sensors and controller.
- 12. ELECTRIC AIR CONDITIONING UNIT**
Converts DC from the battery to 3 phase for the air conditioning compressor motor.

Hybrid Electric Drive System Specifications

Manufacturer	Azure Dynamics
Model Year	2011, 2012
Model	Balance™ Hybrid Electric (Parallel Hybrid)
Motor	100 kW AC induction w/ regenerative braking
Motor Controller	120 kW Inverter
Transmission	Elect. 5-Spd Torqshift Auto O/D Transmission
Battery	345V, 6.8 Ah, maintenance free Li-Ion Automatic high voltage disconnect in case of vehicle collision
System Voltage	345V DC Nominal
Power Steering/Brakes	Engine on – standard engine driven pump Engine off – engine pump driven by ISG
Low Voltage System (12V)	Alternator supplemented by DC/DC converter
Cooling ¹	Engine – Ford cooling system with electrified radiator cooling fans Hybrid system – Separate low temperature cooling loop
Engine	Ford 5.4L EFI FFV Gasoline V8 Engine (50 State)

Note:

- Overheating protection strategies may derate engine power when operated on extended grades above 4% when the ambient temperature is 43°C (110°F) or above.

Hybrid Electric Drive Specification (Shuttle Bus Only)

ITEM	DESCRIPTION
Body Air Conditioning	Standard Ford Engine driven dash air conditioning system. Body air conditioning provided by an electrically driven compressor (TM-16 recommended) which is capable of 55,000 BTU/hr (IMACA) capacity ^{1,2,3} .
Low Voltage System (12V)	Two DC/DC converters (1,500 watts each) required on shuttle bus to supplement Ford alternator.

Notes:

- As per the Azure Body Builders Layout Book Supplement, Document MAN501056
- This system has passed the Houston and MSBMA Pulldown tests when tested on 22 foot bus.
- When the vehicle is stationary, capacity may drop to 40,000 BTU (IMACA) after 10 minutes of idling at 110°F ambient temperature.

Added Curb Weight (lbs) due to Hybrid System

MODEL	WHEELBASE	FRONT	REAR	TOTAL
Stripped or Cutaway	158"	730	710	1440
Stripped or Cutaway	176"	800	640	1440
Cutaway Shuttle Bus prep.	158"	636	1029	1665

Note:

- These weights are estimates.

Ford E-450 Chassis Mandatory Specifications

ITEM	DESCRIPTION	FORD OPTION CODE
Model Year	Must be model year 2011 or 2012	
Chassis	E-450 Cutaway or Stripped Chassis	E45/E4F or E49/E4K
Engine	5.4L EFI FFV V8 Gas Engine	99L
Transmission	Elect. 5-Spd Auto O/D Transmission with Tow-Haul ⁴	44T
Alternator	225 Amp Alternator	63N
Front GAWR	Front Max GAWR (5000 lbs)	672
Wheelbase	158" or 176" (except shuttle bus—see below)	158WB or 176WB
GVWR	14,050 lbs	206
Rear Axle Ratio	4.56 Non-Limited Slip	X83
Emissions	50 State Emissions	425

Notes:

1. All customer desired chassis specs to be reviewed by Azure Dynamics in advance of order.
2. Single Rear Wheel (SRW) cannot be accommodated.
3. Suggest that the smallest fuel tank option be ordered with chassis to maximize payload or passenger capacity.
4. Although the tow-haul transmission feature is required (option 44T), this feature will not be selectable by vehicle operator since the hybrid system takes control of it.

Ford E-450 Shuttle Bus Chassis Mandatory Specifications (In addition to above)

ITEM	DESCRIPTION	FORD OPTION CODE
Battery	Battery, heavy duty auxiliary	634
Wheelbase	158" is the only wheelbase available	158WB

Incompatible Chassis Specifications

ITEM	DESCRIPTION	FORD OPTION CODE
Traction Control	Engine only traction control	15T
Anti-Theft	2 key recognition	CEI
Speed Control	Vehicle speed control (cruise control)	525
In Dash Computer	In Dash Computer / Touch Screen	98A
Crew Chief	Telematics System	85C
Auxiliary Heater/AC	Air Conditioning Connector Packages	57L & 57X
Trailer Towing Package	Trailer Tow Prep Package ¹	534

Note:

1. No trailer towing capacity available.

Ford Qualified Vehicle Modifier (QVM) Drop Ship & Ship Thru Codes

AZD has been QVM certified by Ford Motor Company and has been assigned the following codes:	
Drop Ship Code	860177 (to Utilimaster, Wakarusa, Indiana)
Ship Thru Code	31G, D9D

Note:

1. Additional fees apply to utilize Ford's ship thru process. Please contact AZD for pricing information.

Body Specification¹

Mud Guards	The Body Builder must install mud guards in front of rear wheels and behind front wheels in order to protect the hybrid components.
Heating	Cab heating supplied when engine is shut down.
Minimum Body Skirting	All bodies must extend to approximately the bottom of the frame rail in order to protect the hybrid components that are mounted to the frame rails.
Minimum Body Width	Minimum Body width must be at least 86.5 inches (inside) in order to clear the hybrid components that are mounted outboard of the frame rails.
Sign-off of Hybrid System	The Body Builder must follow the Azure Body Builders process for sign-off of the hybrid system.
End of Line Test	The Body Builder must complete a 20 minute end-of-line road test with the hybrid system enabled.

Note:

- As per the Azure Body Builders Layout Book Supplement, Document MAN501056

Performance Specifications

Top Speed	Electronically limited to 65 mph (105 kph) on strip chassis applications and 70 mph (113 kph) on cutaway chassis applications.
Acceleration	Acceleration power within 10% of stock vehicle.
Emissions	Engine meets all EPA and CARB emission standards – see data below for comparison to baseline conventional chassis, however configurable on all to 65, 70 or 75 mph.
Anti-Idle	Anti-Idle Compliant – Auxiliary systems 100% capable with engine off: <ul style="list-style-type: none"> • 12V DC (low voltage) • Air Conditioning (shuttle bus only) • Power Steering/Braking Engine runs to charge the high voltage energy storage system and automatically shuts down.
Braking	Braking deceleration rates same as conventional. Regenerative braking reduces brake wear.
Engine Starting	Nearly all engine starting is managed by an integrated starter motor/generator, the rest is handled by the conventional starter. Significant improvements in conventional starter life will be experienced.
Reliability	Redundant systems keep the vehicle operational in case of hybrid system fault.

Fuel Economy & Emissions Testing Results

	FUEL ECONOMY*		EMISSIONS (g/mile)*		
	(mpg)	HC	CO	NO _x	CO ₂
Baseline	4.87	0.719	6.694	0.398	1821
Hybrid	6.75	0.539	8.608	0.206	1306
Percentage Improvement	39%	25%	-29%	48%	28%

*NYCC Chassis Dynamometer Cycle—Results on model year 2011 E-450

Warranty Coverage at a Glance*

COVERAGE	TIME	MILEAGE	PROVIDER
Ford System	See Ford Warranty Policy—Standard warranty applies		Ford
Hybrid System	5 Years	60,000 miles	Azure

* The warranty coverage applies until the maximum time or mileage, whichever comes first. The warranty remains with the vehicle regardless of ownership.

Note:

- The above warranty information is intended as an overview only for on-road applications.

Available Azure Balance™ Hybrid System Options

Choose Chassis type (S/C, C/A, or C/A SB) and then circle the standard or optional item for ID's 1 thru 10:

ID	ITEM	DESCRIPTION	CHASSIS (circle one of each)			REQUIRED FORD OPTION CODE	AZURE OPTION CODE
			S/C	C/A	C/A SB		
1.	Base Ford Chassis Wheelbase	158" wheelbase	s	s	m	158WB	158WB
		176" wheelbase	o	o	-	176WB	176WB
2.	12 Volt Battery	Single 12V battery	s	s	-	-	1BAT
		Addition of second 12V battery located inside left framerail	o	o	m	634	2BAT
3.	Secondary DC/DC Converter	Single DC/DC converter	s	s	-	-	1DC
		Addition of a second DC/DC converter	o	o	m	-	2DC
4.	CARB Label	CARB label required for California vehicles only	o	o	o	-	CARB
5.	Cab Air Conditioning	No cab air conditioning	s	o	-	57D	NOCAC
		Cab air conditioning	o	s	m	57Z	CAC
6.	Body Heater Option	Body heater coolant lines to rear of cab (Cutaway Only)	-	o	o	57L or 57X	BHTR
7.	Body Air Conditioning	Optional rear body air conditioning package (Shuttle Bus Only)	-	-	m	-	BAC
8.	HV Battery Key Removal	Delivery to body builder with battery key removed	o	o	o	-	HVBSKR

S/C = Stripped Chassis; C/A = Cut Away Chassis; SB = Shuttle Bus; s = standard feature; o = option; m = mandatory

Note:

- Customer is responsible for ordering selected Ford options when ordering their chassis.



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