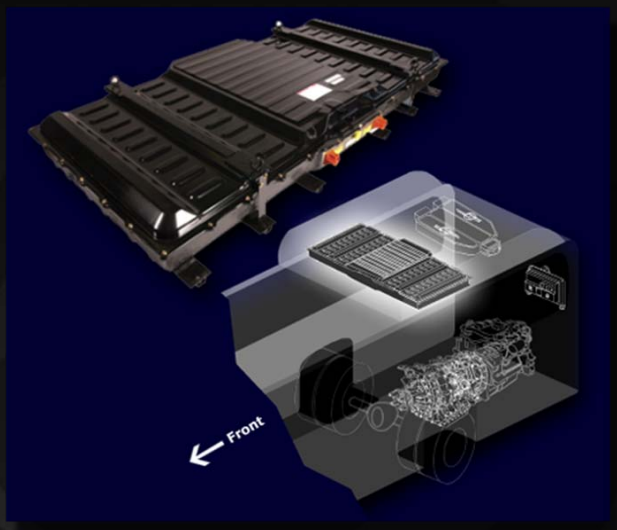
Allison Transmission Instructor Led Training

Energy Storage System (ESS)

Overview

- The Energy Storage System (ESS) stores high voltage DC energy.
- The ESS is charged by the drive unit motors during regenerative braking and normal operation.
  - *The ESS does not require off-board charging.*
- High voltage DC energy is transferred only between the ESS and the DPIM.
- Self diagnostics constantly monitor for proper state of charge and high voltage DC energy isolation.



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ESS THEORY OF OPERATION

The Energy Storage System (ESS) provides electrical energy in the form of high voltage direct current (DC). DC from the ESS is inverted to three-phase alternating current (AC) by power electronics in the Dual Power Inverter Module (DPIM) to operate Motors A and B in the E^V Drive™. High voltage DC is sent from the DPIM to the ESS to maintain the ESS State of Charge (SOC) only while the E^P 40/50 System™ is operational. The ESS does not need off-board charging to maintain its SOC. Electrical energy to charge the ESS is generated by the E^V Drive™ motors during regenerative braking and during normal operation.

ENERGY STORAGE SYSTEM (ESS)

The high voltage DC positive and negative for the ESS are shared only with the high voltage DC positive and negative at the DPIM. The high voltage DC circuits are not referenced to any other positive, negative, or ground circuit. Self-diagnostics constantly monitor the high voltage DC circuits to make sure they remain isolated from the vehicle chassis.

The ESS communicates with the TCM over the J1939 data link. The ESS reports real time data regarding SOC, temperature, cooling, fan status, and many other operating parameters. The ESS reports internal faults to the TCM and takes appropriate action based upon its self-diagnostic capabilities.

NOTE: This resource link has multiple pages and information changes frequently. Reference the source document for complete, current information.

Section Seven

ENERGY STORAGE SYSTEM

7–1. ENERGY STORAGE SYSTEM OVERVIEW

The Energy Storage System (ESS) provides electrical energy in the form of high voltage direct current (DC). DC from the ESS is inverted to three-phase alternating current (AC) by power electronics in the Dual Power Inverter Module (DPIM) to operate Motors A and B in the EV Drive™.

High voltage DC is sent from the DPIM to the ESS to maintain the ESS State of Charge (SOC) only while the EP 40/50 System™ is operational. The ESS does not need off-board charging to maintain its SOC. Electrical energy to charge the ESS is generated by the EV Drive™ motors during regenerative braking and during normal operation.

The high voltage DC positive and negative for the ESS are shared only with the high voltage DC positive and negative at the DPIM. The isolated high voltage DC circuits are for use of the ESS and DPIM only. The high voltage DC circuits are not referenced to any other positive, negative, or ground circuit. Self-diagnostics constantly monitor the high voltage DC circuits to make sure they remain isolated from the vehicle chassis.

The ESS communicates with the TCM over the J1939 data link. The ESS reports data regarding SOC, temperature, cooling, fan status, and many other operating parameters. The ESS reports internal faults to the TCM and takes appropriate action based upon its self-diagnostic capabilities.

A. Engine Exhaust Brake and ESS

Engine braking is used to contain ESS Amp Hour throughput during regenerative braking. If the ESS SOC is at a high level, engine exhaust braking is activated to bleed off energy while retaining a consistent retarder effect.

Based upon the ESS SOC, the TCM may request engine exhaust braking from the engine controller. If engine conditions are permissible (less than 1000 rpm, zero engine fueling, and throttle at idle position), the engine controller closes a butterfly valve at the engine exhaust manifold.

The electrical energy from regenerative braking spins Motor A, which motors the engine against the exhaust brake, turning electrical energy into heat and rotational energy, thus controlling ESS Amp Hour throughput and consistent vehicle deceleration.

7–2. ENERGY STORAGE SYSTEM COMPONENTS

WARNING:

To help avoid electrocution, death, or bodily injury, only Allison approved technicians with proper credentials for working with high voltage equipment may remove the top cover of the ESS. Under no circumstances remove the top cover of the ESS without being properly trained and credentialed for working with high voltage equipment. The ESS contains dangerous voltages even if an HVIL switch is open or the vehicle ignition key is "OFF".

Energy Storage System (ESS) components are contained in a fiberglass lower housing or "tub", covered by a metal upper cover that is bolted to the lower housing. All external electrical connections, as well as the HVIL switches, are mounted in the sidewalls of the lower housing. Hydrogen vent hoses direct hydrogen gas, a product of battery charging, out of the tub. Typically the vehicle OEM mounts the ESS on the vehicle roof.

A. ESS High Voltage Connections

High voltage DC energy enters the ESS through two high voltage connections, one positive polarity and one negative polarity, Both the positive and negative electrical connector have locking plastic covers to prevent inadvertent disconnection under load.

B. ESS Low Voltage Connections

The ESS low voltage 31-pin Deustch connector, located between the positive and negative high voltage connectors, interfaces the digital control circuits in the ESS.

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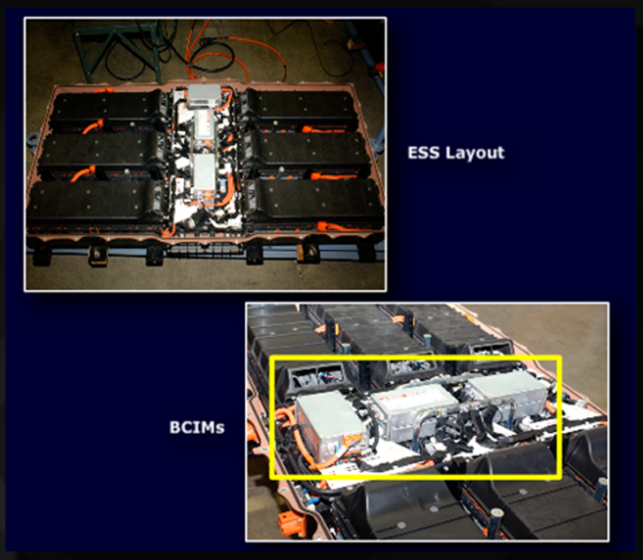
Energy Storage System (ESS)

Internal Configuration

- ESS internal components are contained in a vented fiberglass housing or “tub”.
- The ESS contains six battery subpacks each controlled by its own battery Control Interface Module (BCIM).
  - *BCIMs control ESS relays and monitor voltage, current, temperature and state of Charge (SOC) for the system TCM.*
- The ESS is cooled by ambient or vehicle A/C air circulated by six internal fans.



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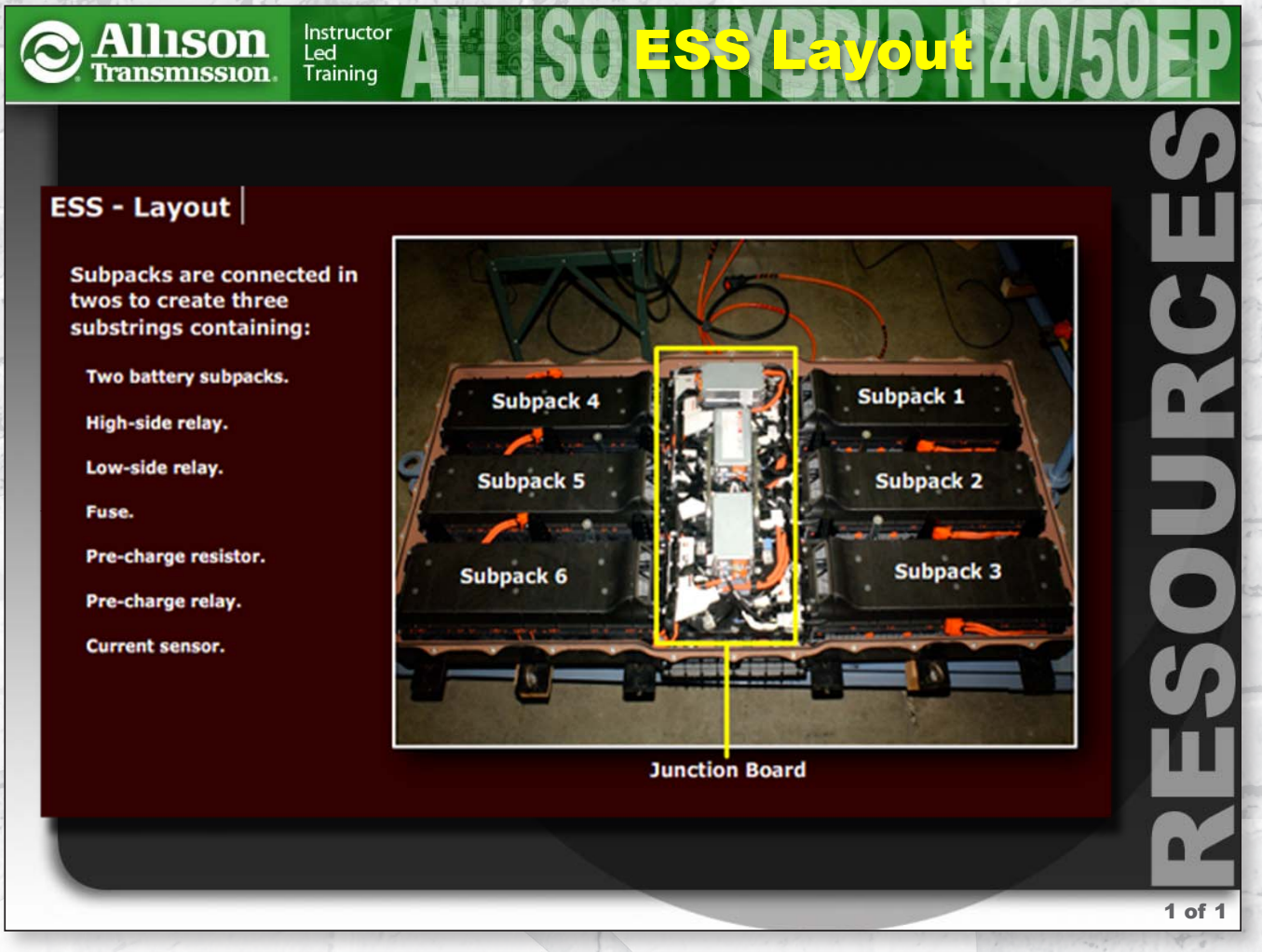
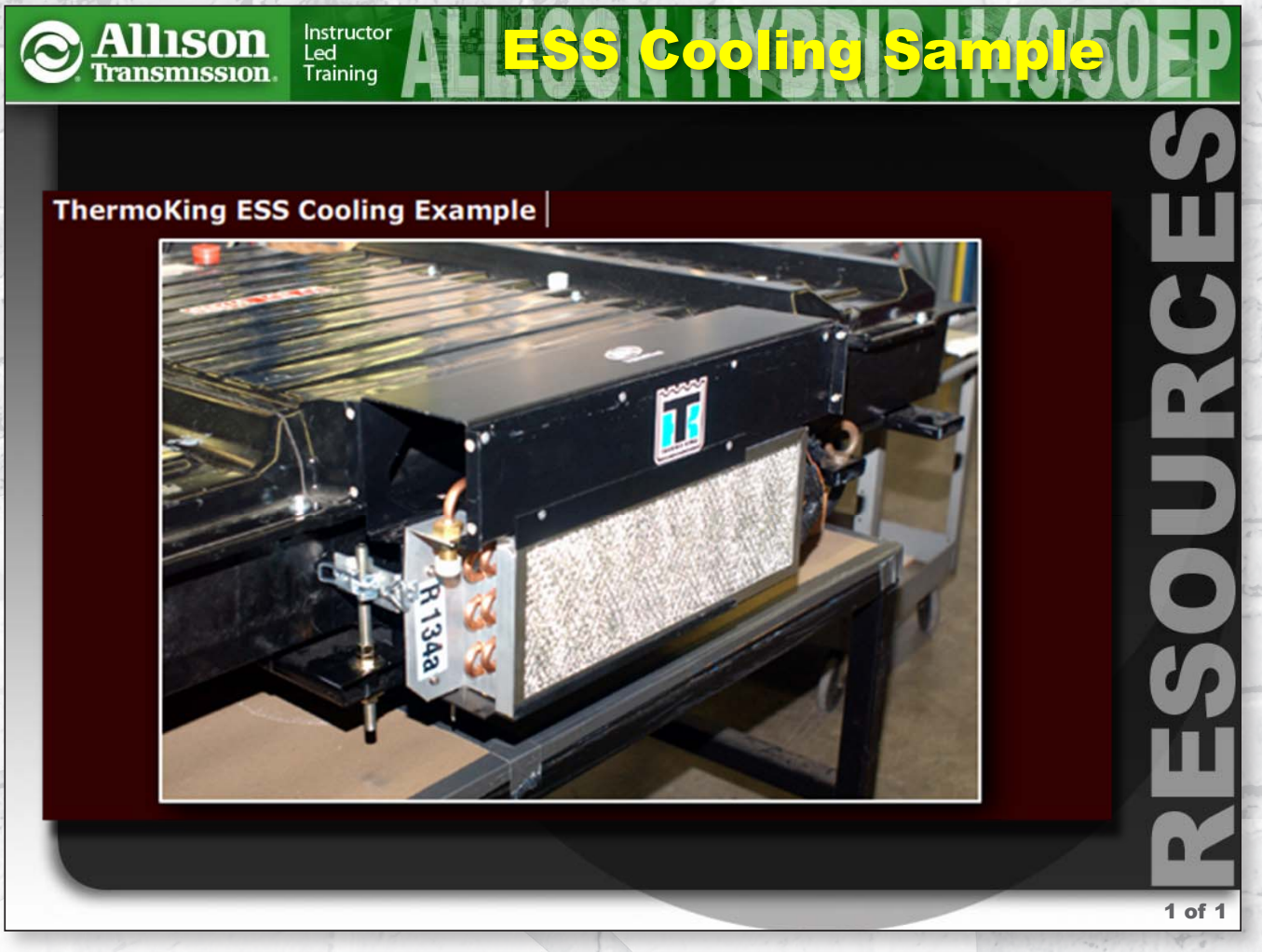
RESOURCES: ESS Layout



RESOURCES: BCIMs

RESOURCES: ESS Cooling Sample



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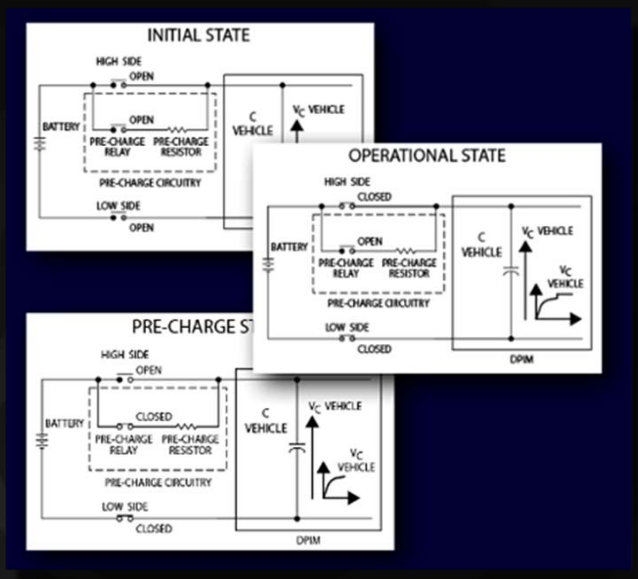
Energy Storage System (ESS)

Operating Modes

- **Initial State:**
  - *All relays are open and no current flows into our out of the ESS.*
- **Pre-Charge State:**
  - *Pre-charge relay and low-side relay are closed.*
  - *Current flows through the pre-charge resistor and voltage slowly increases on the DC bus.*
- **Operational State:**
  - *When voltage reaches 400V, the high-side relays close and the pre-charge relays open.*
  - *Full voltage is allowed to the DPIM.*



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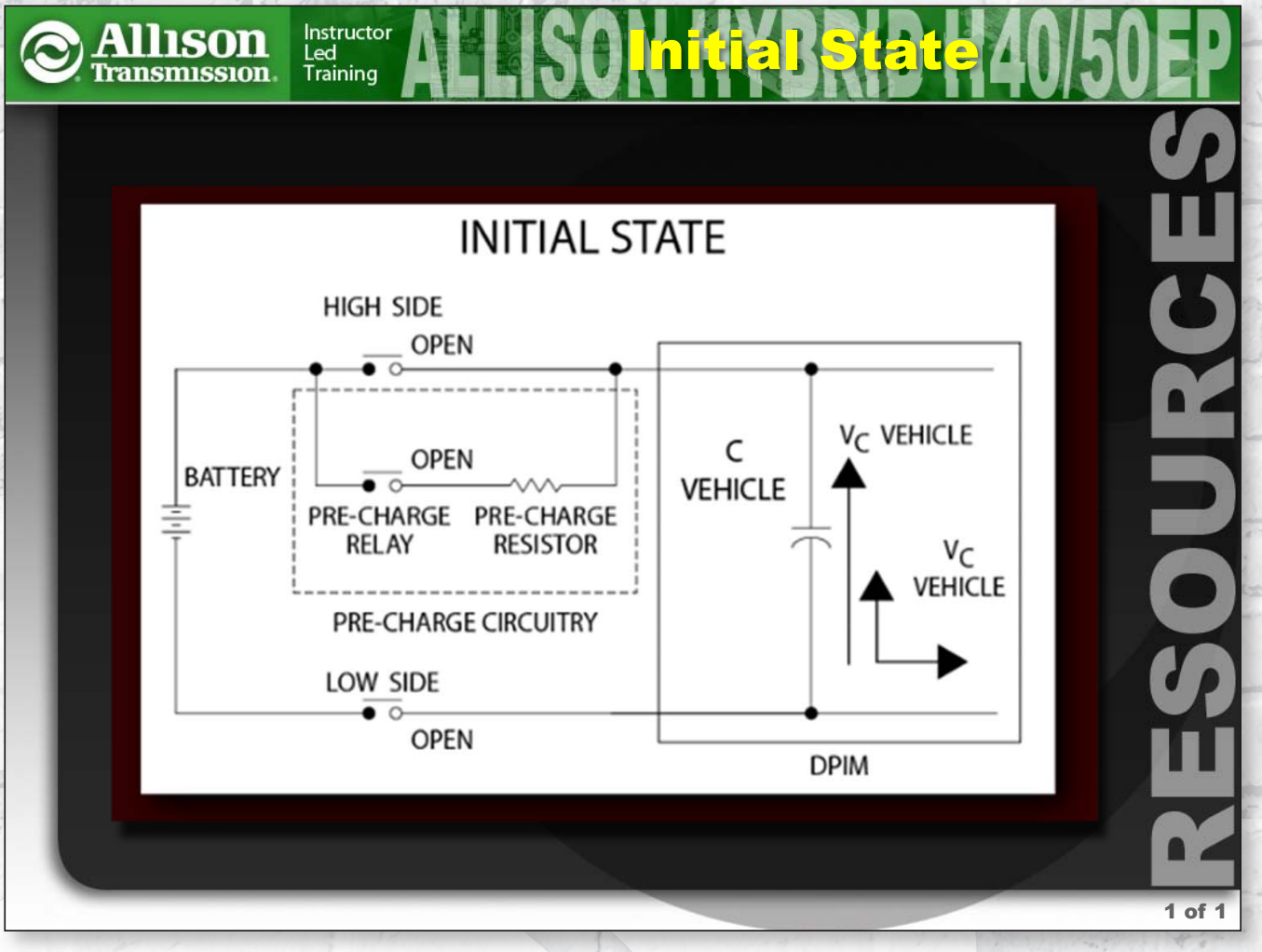
RESOURCES: Initial State



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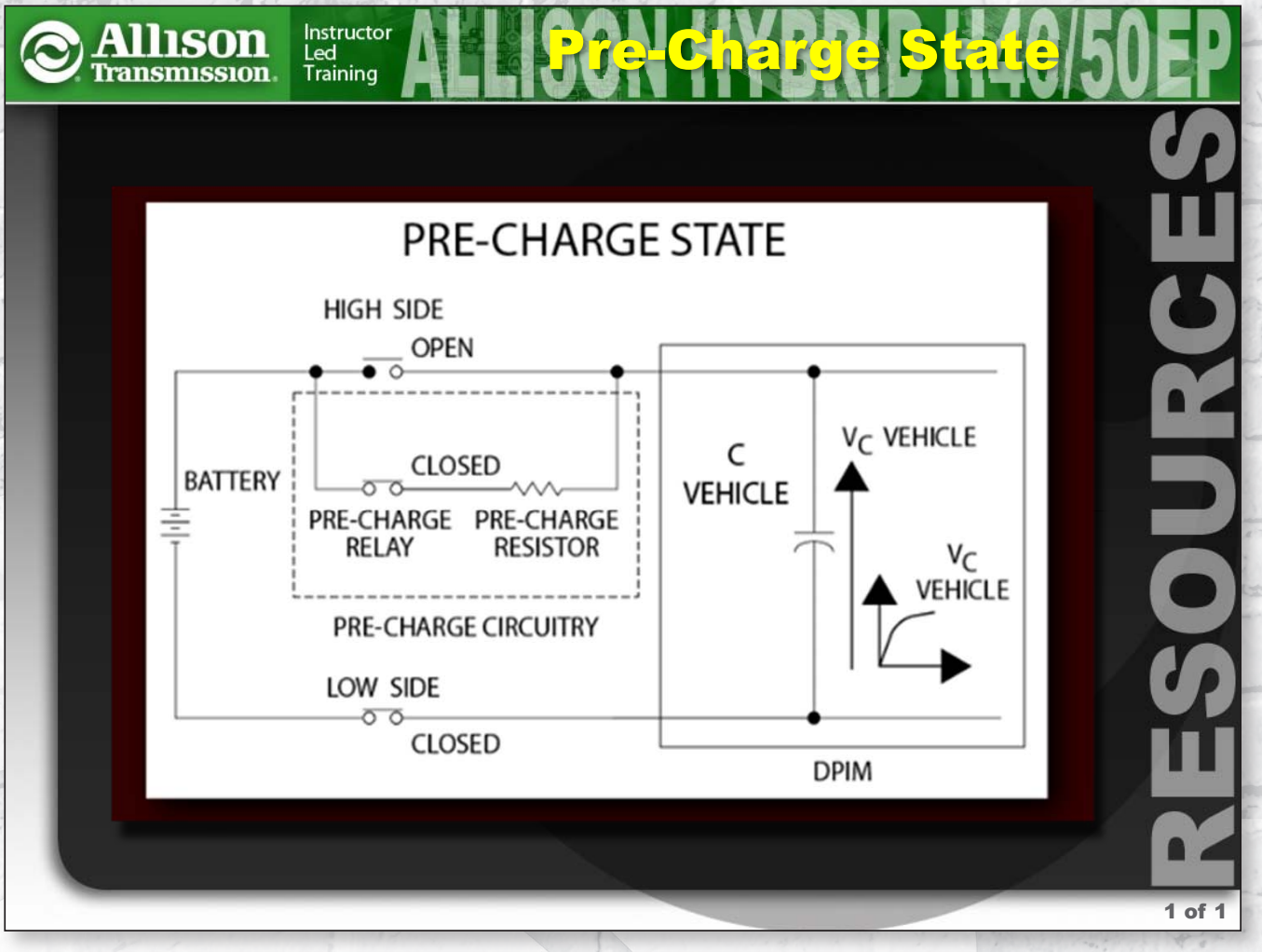
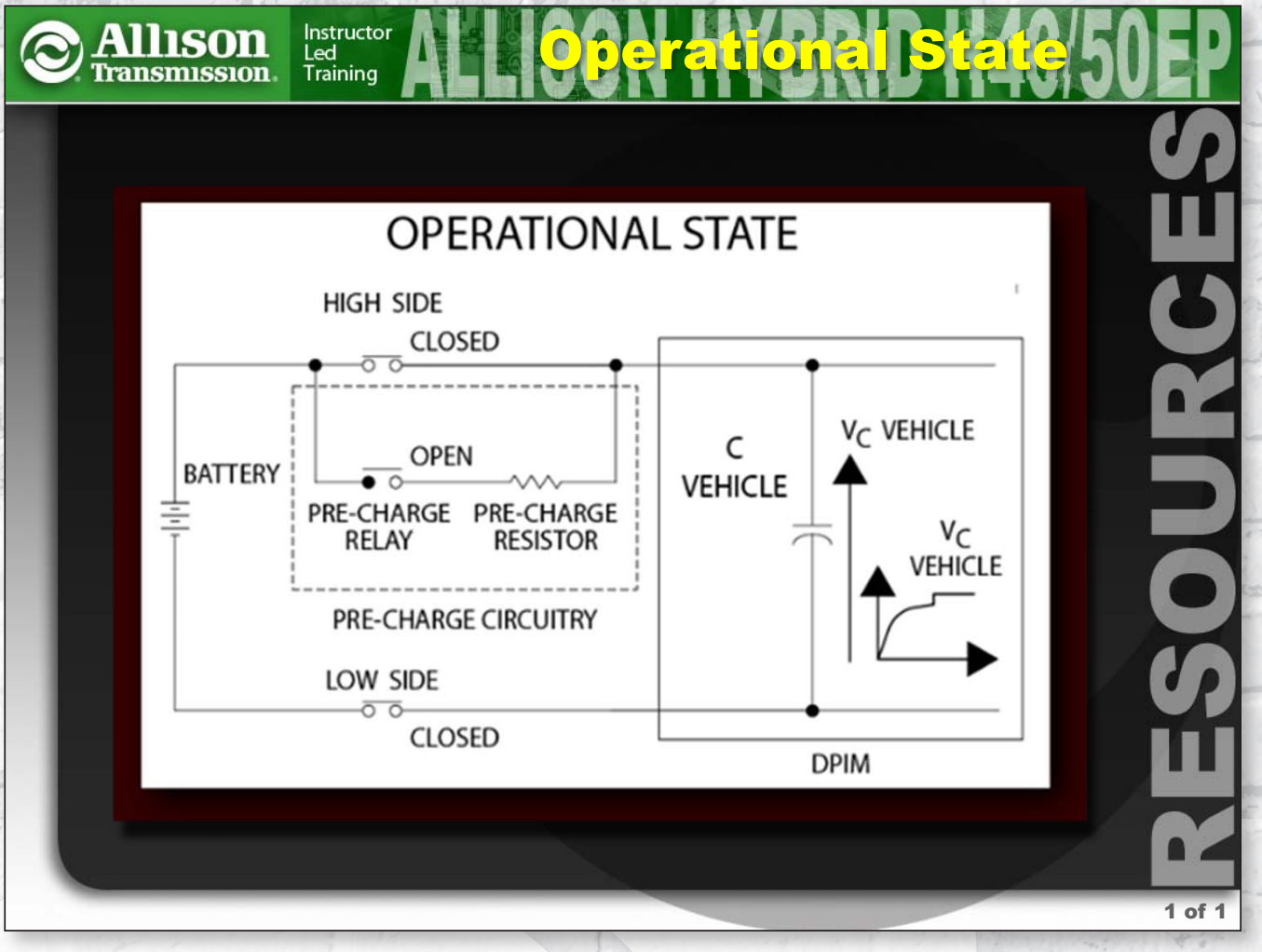
RESOURCES: Pre-Charge State



RESOURCES: Operational State



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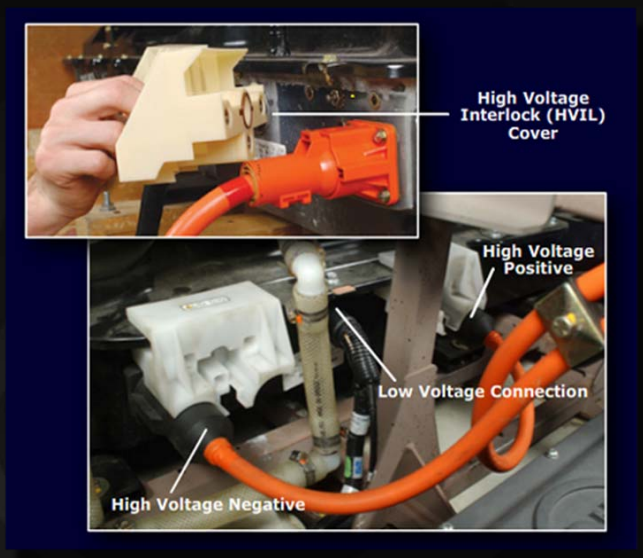
Energy Storage System (ESS)

Electrical Connections

- **High voltage connections:**
  - *DC energy enters the ESS through two connections – positive and negative.*
- **Low Voltage connections:**
  - *31-pin Deutsch connector located between the positive and negative high voltage connectors.*
  - *This interfaces the digital control circuits in the ESS.*



NOTE: Always follow the Electrical Disconnect Verification Procedure in Troubleshooting Manual TS3715 when performing any work on the H 40/50 EP System.

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RESOURCES: Electrical Disconnect Verify

NOTE: This resource link has multiple pages and information changes frequently. Reference the source document for complete, current information.

E^{P} 40/50 SYSTEM™ TROUBLESHOOTING MANUAL

ELECTRICAL SAFETY

WARNING!

The Allison Electric Drive E^{P} 40/50 System™ uses potentially hazardous electrical energy. All E^{P} 40/50 System™ components are identified with warning labels or symbols (see Figure 1, Figure 2, and Figure 3). DO NOT attempt to service components containing potentially hazardous electrical energy if you are not trained to do so.

All persons working with potentially hazardous electric energy should familiarize themselves with safe electrical work practices. Paragraph f in Electrical Safety section contains references to publicly available documentation that can assist a technician in developing the safe electrical work practices required to service the E^{P} 40/50 System™ electrical system.

E^{P} 40/50 System™ Normal Operating Conditions

ESS Voltage Range: 432–780VDC
DPIM Voltage Range: –350 to +350A

Figure 1. DPIM Warning Label

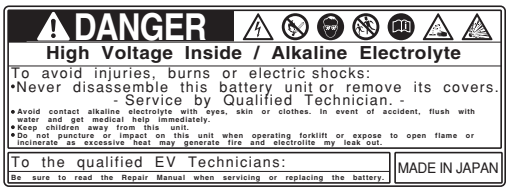
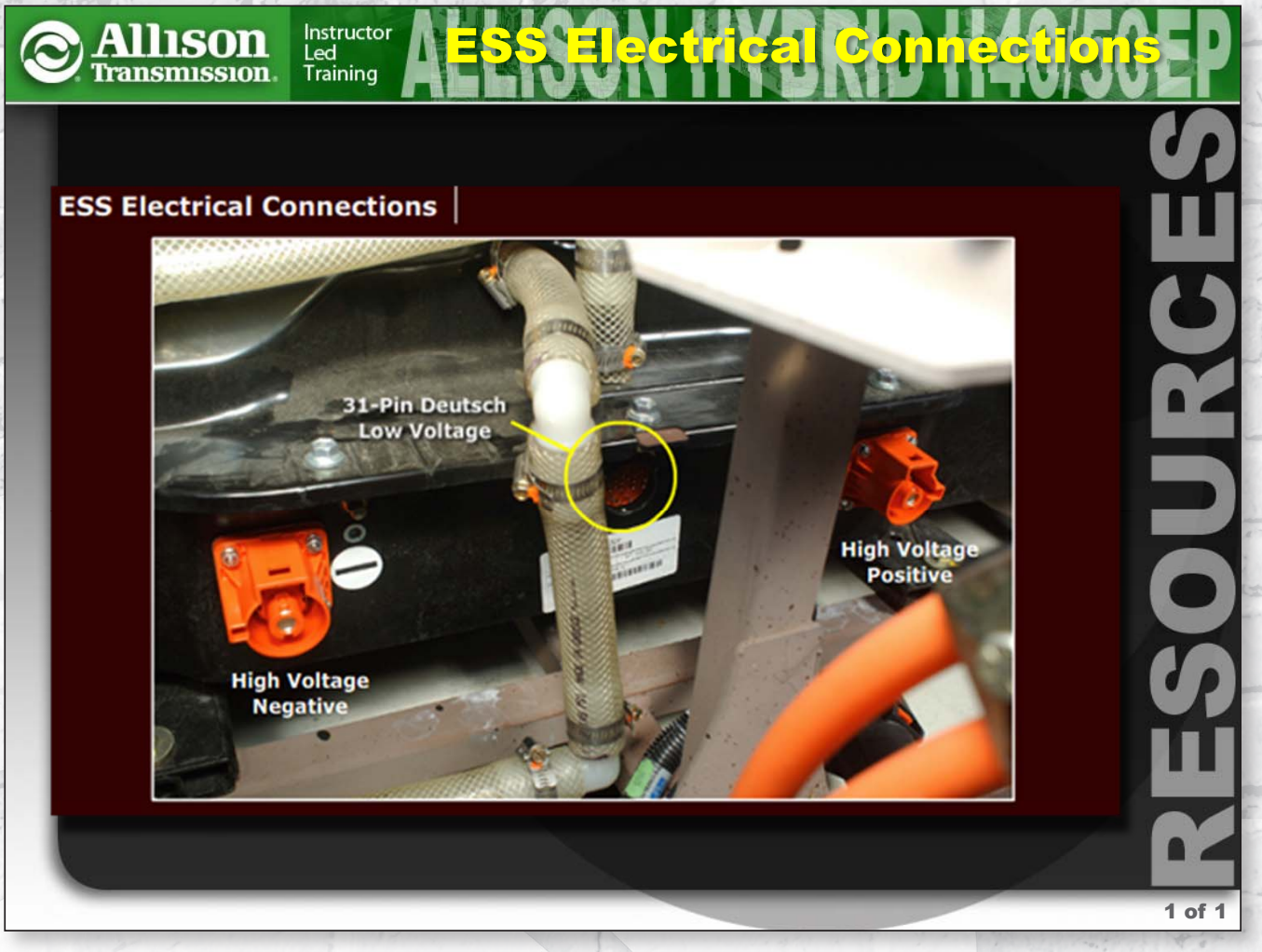


Figure 2. ESS Warning Label

RESOURCES: ESS Electrical Connections



RESOURCES: ESS High Voltage Check