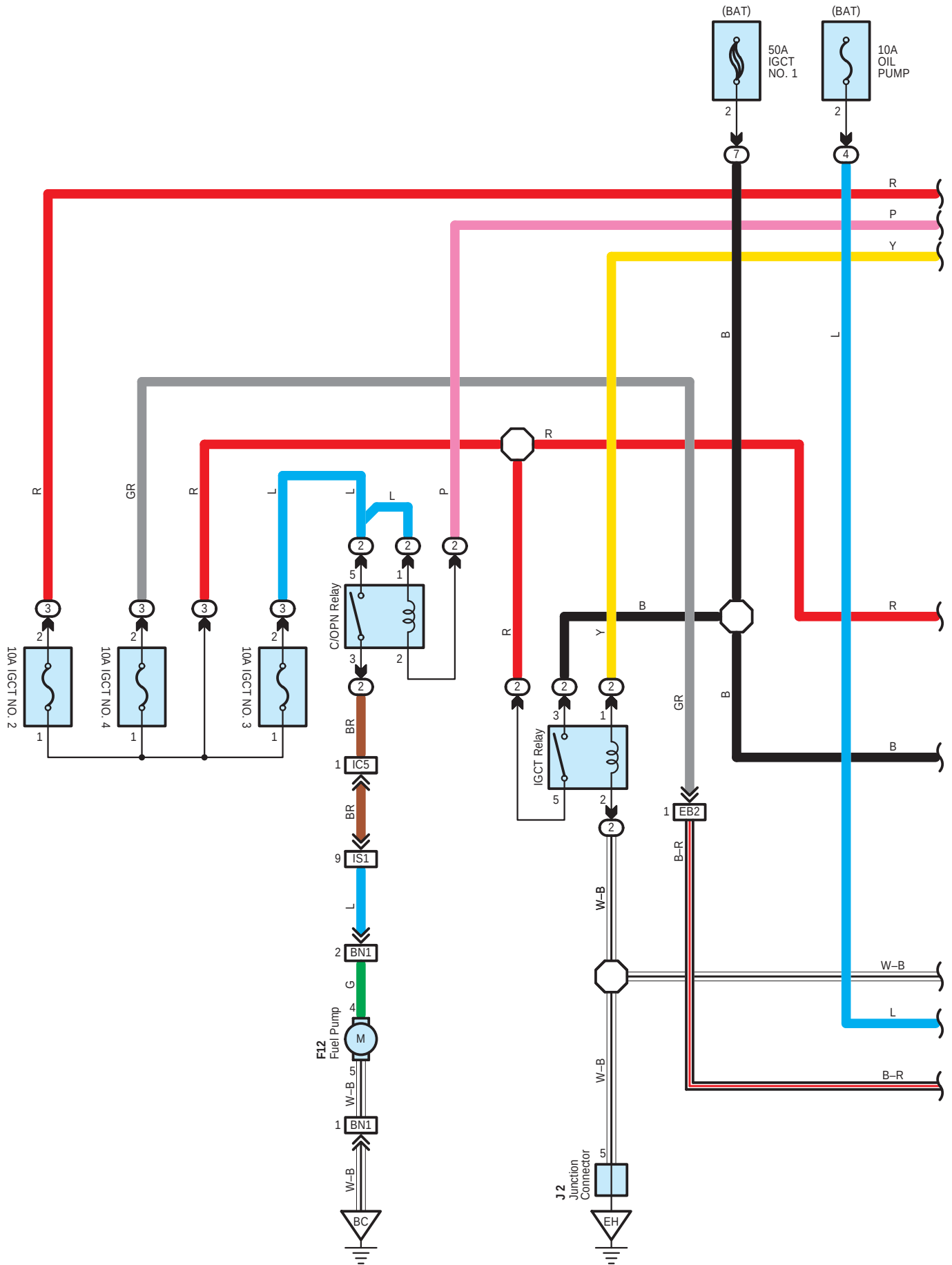
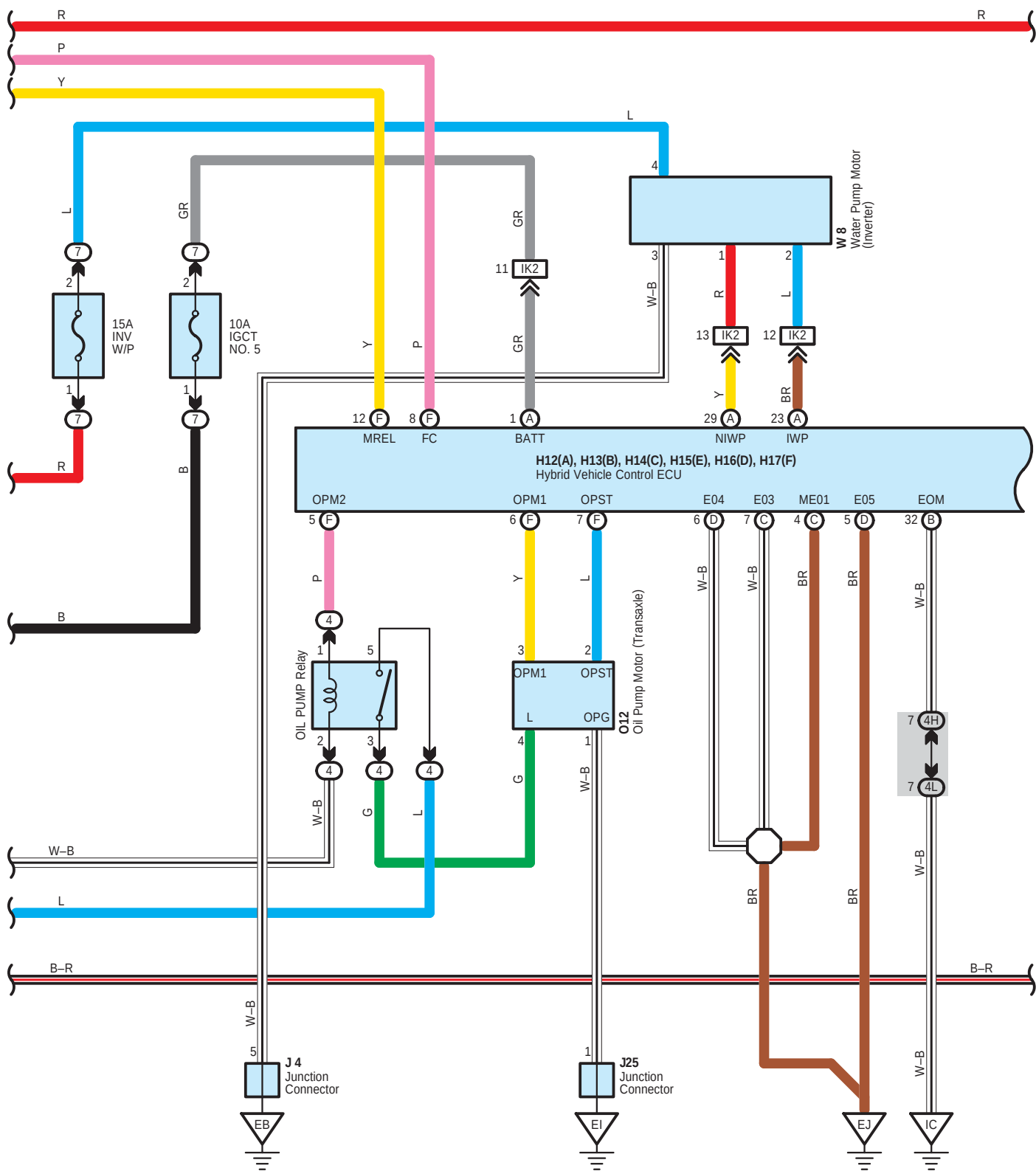
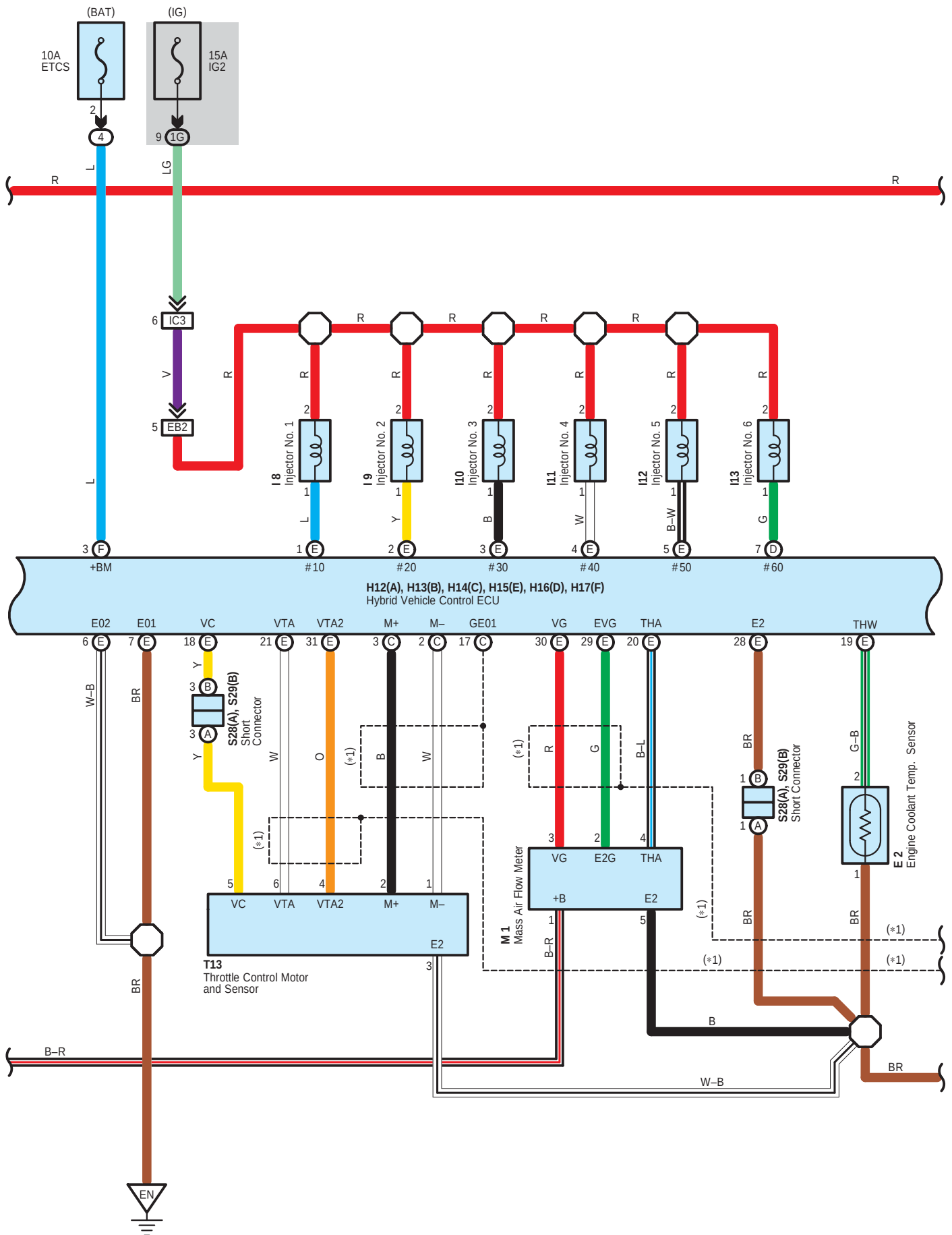
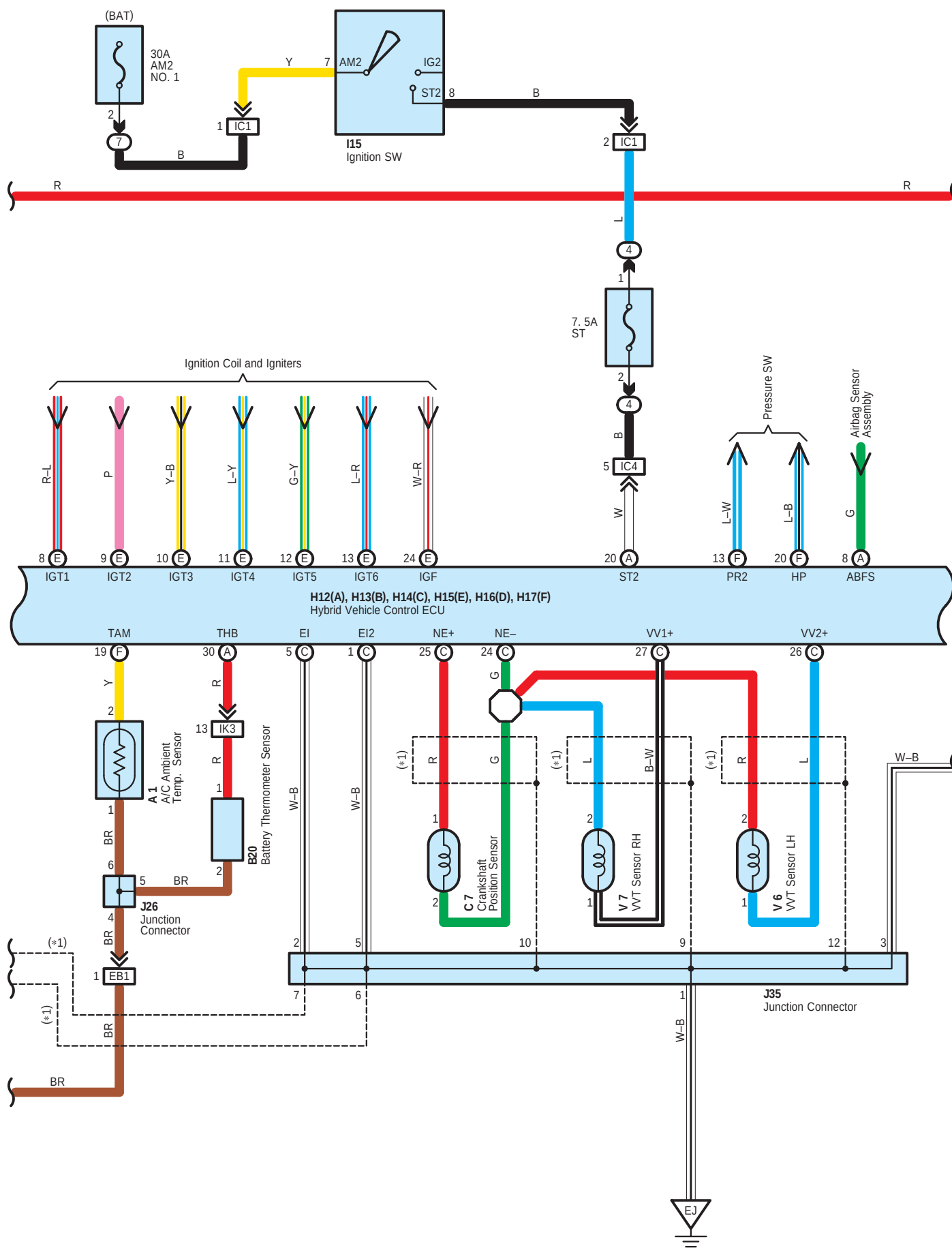


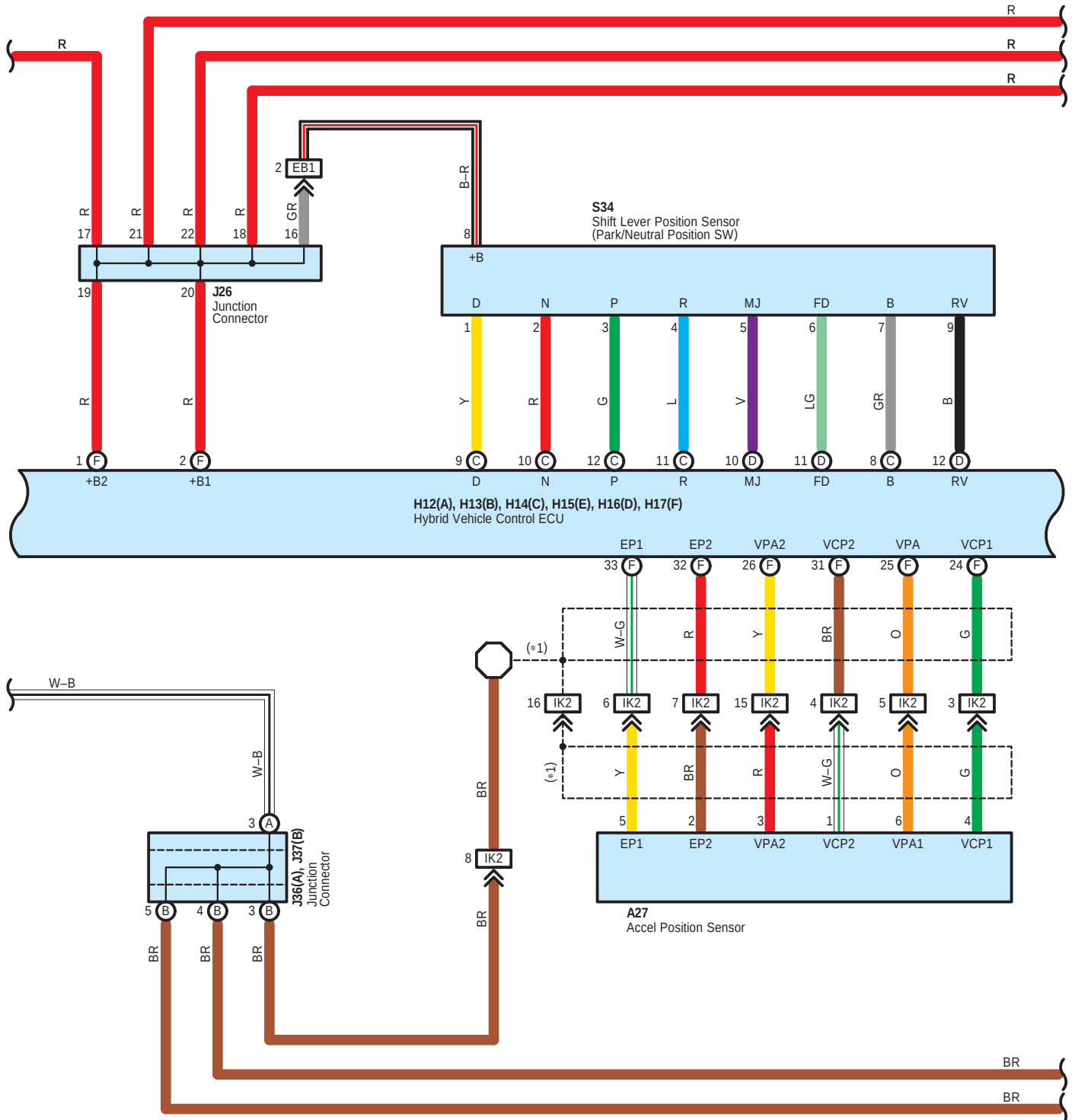


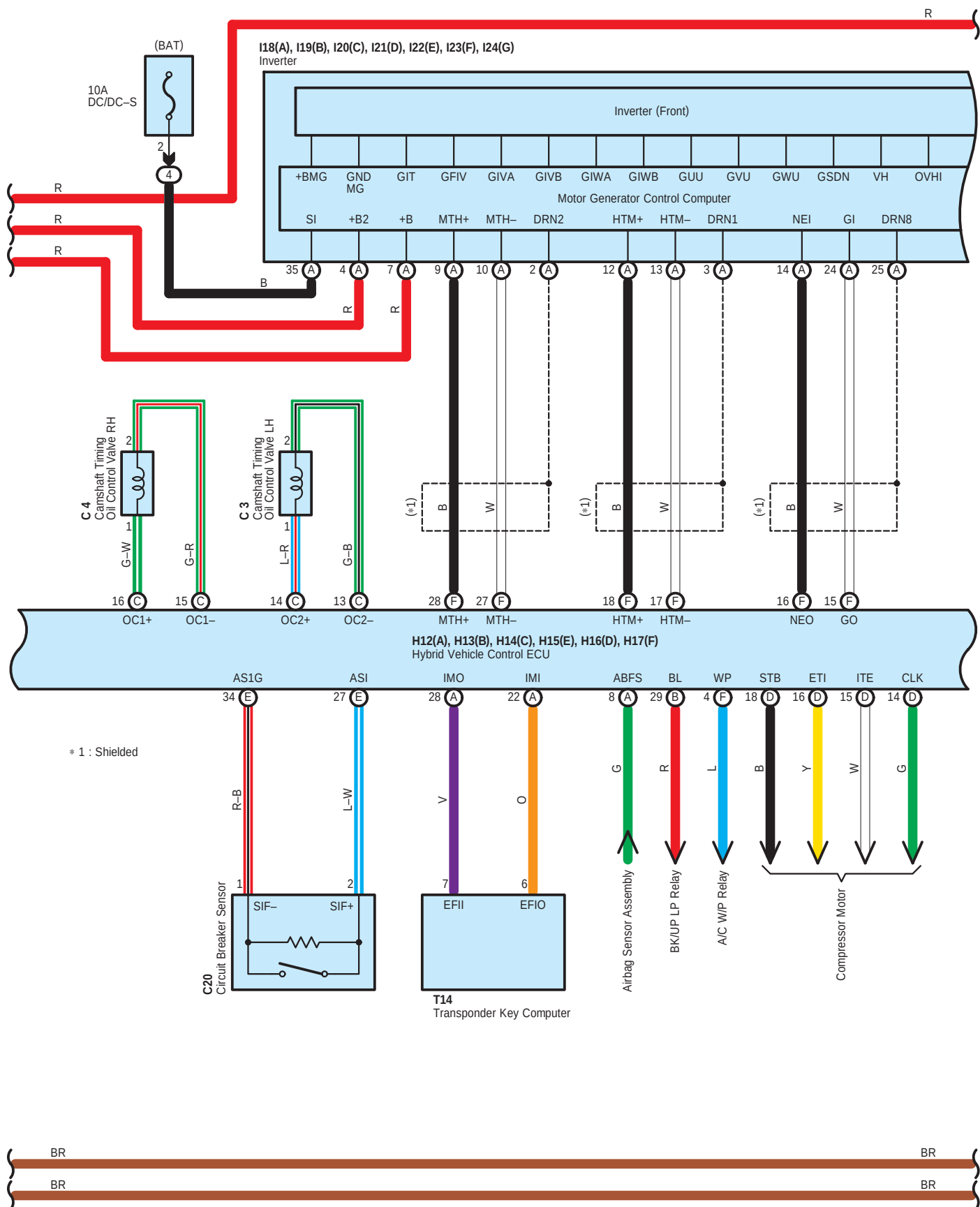


Hybrid System

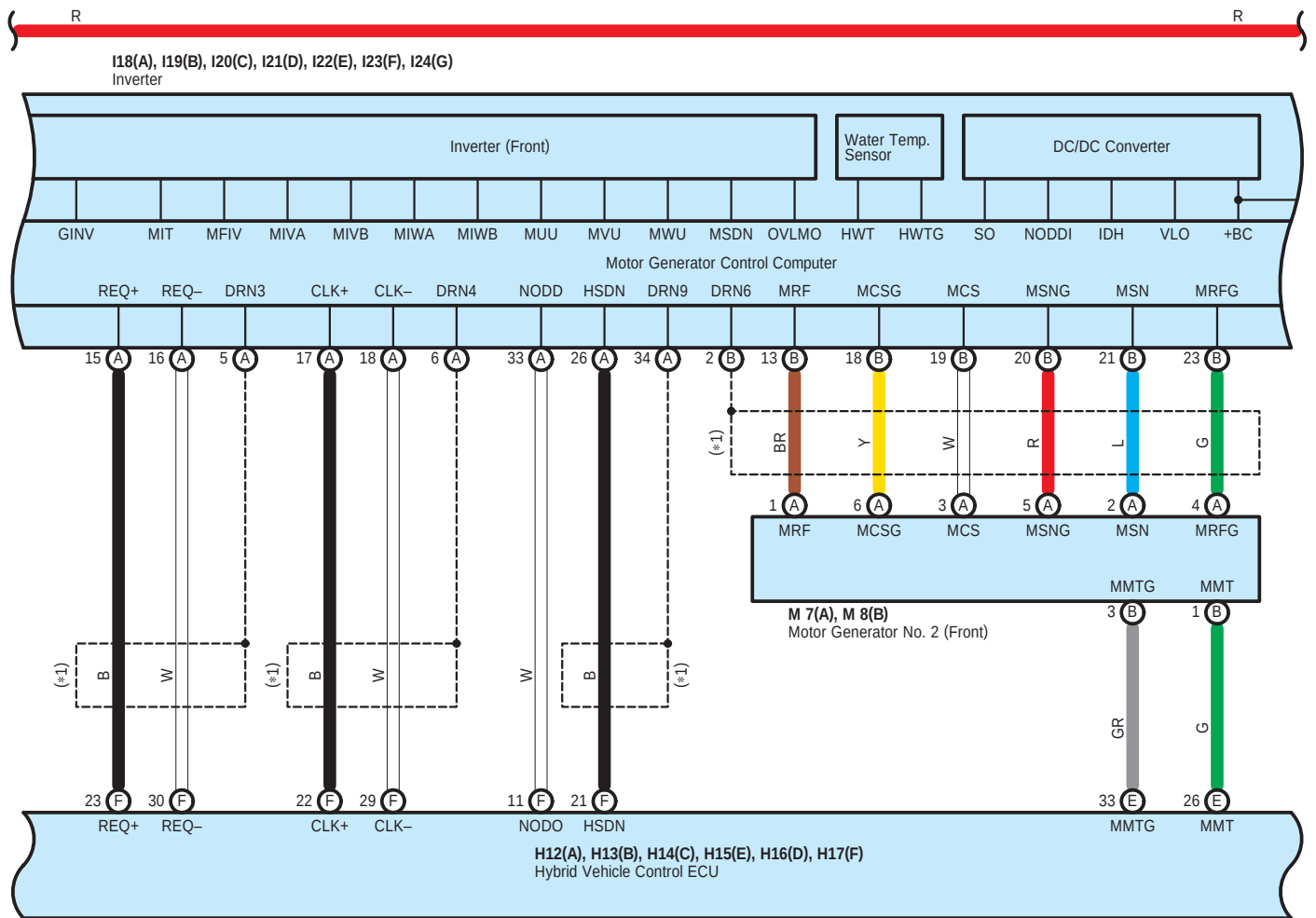


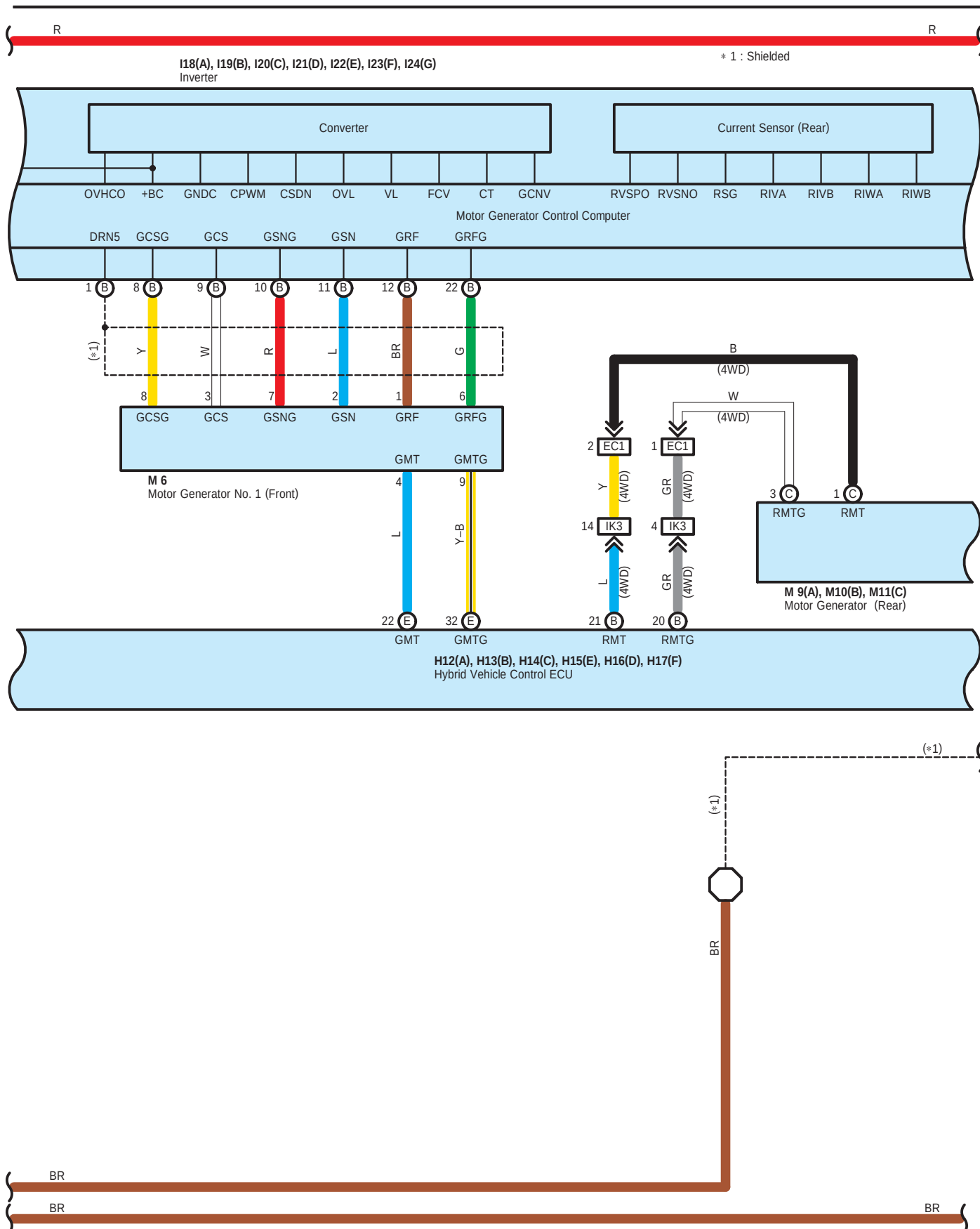




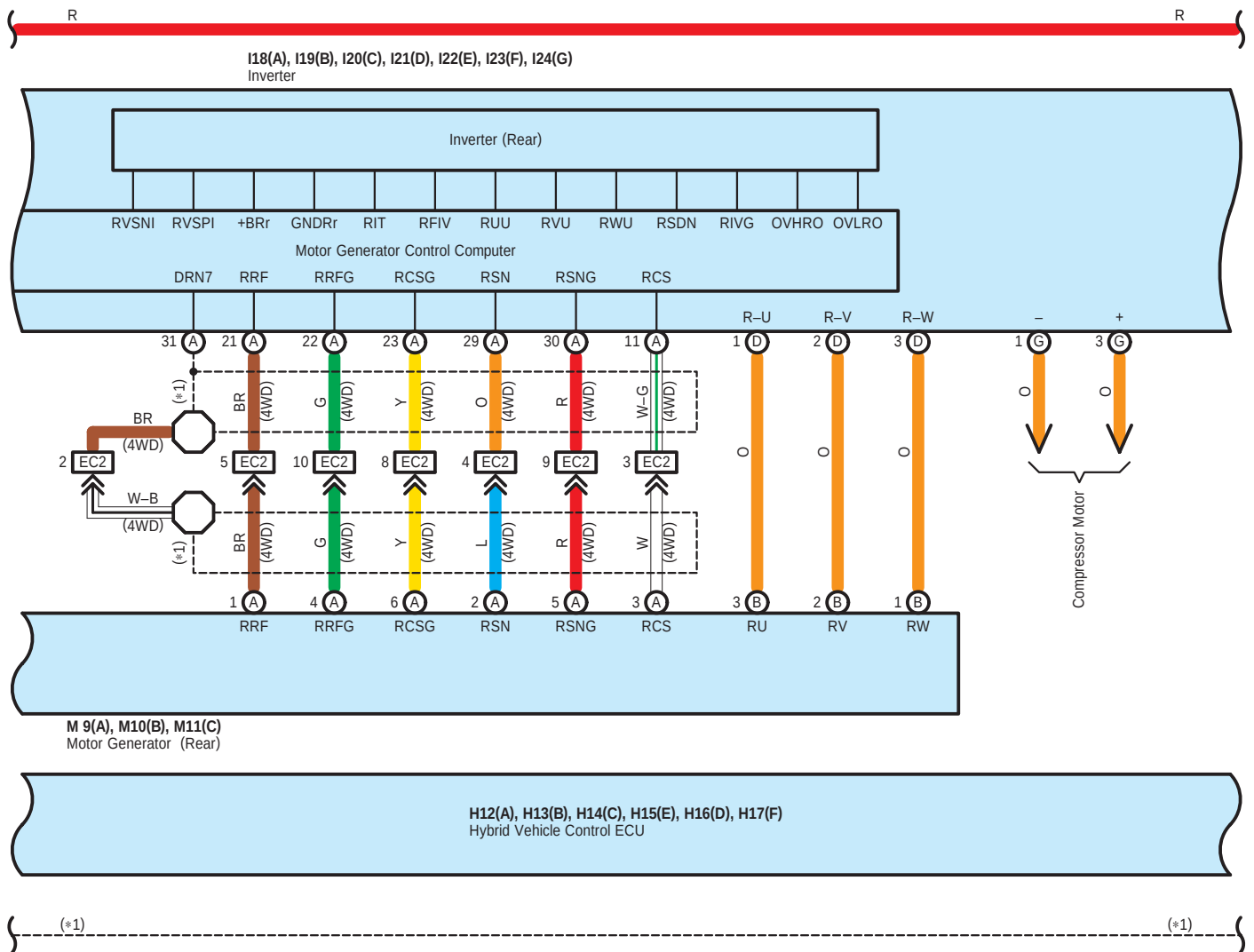


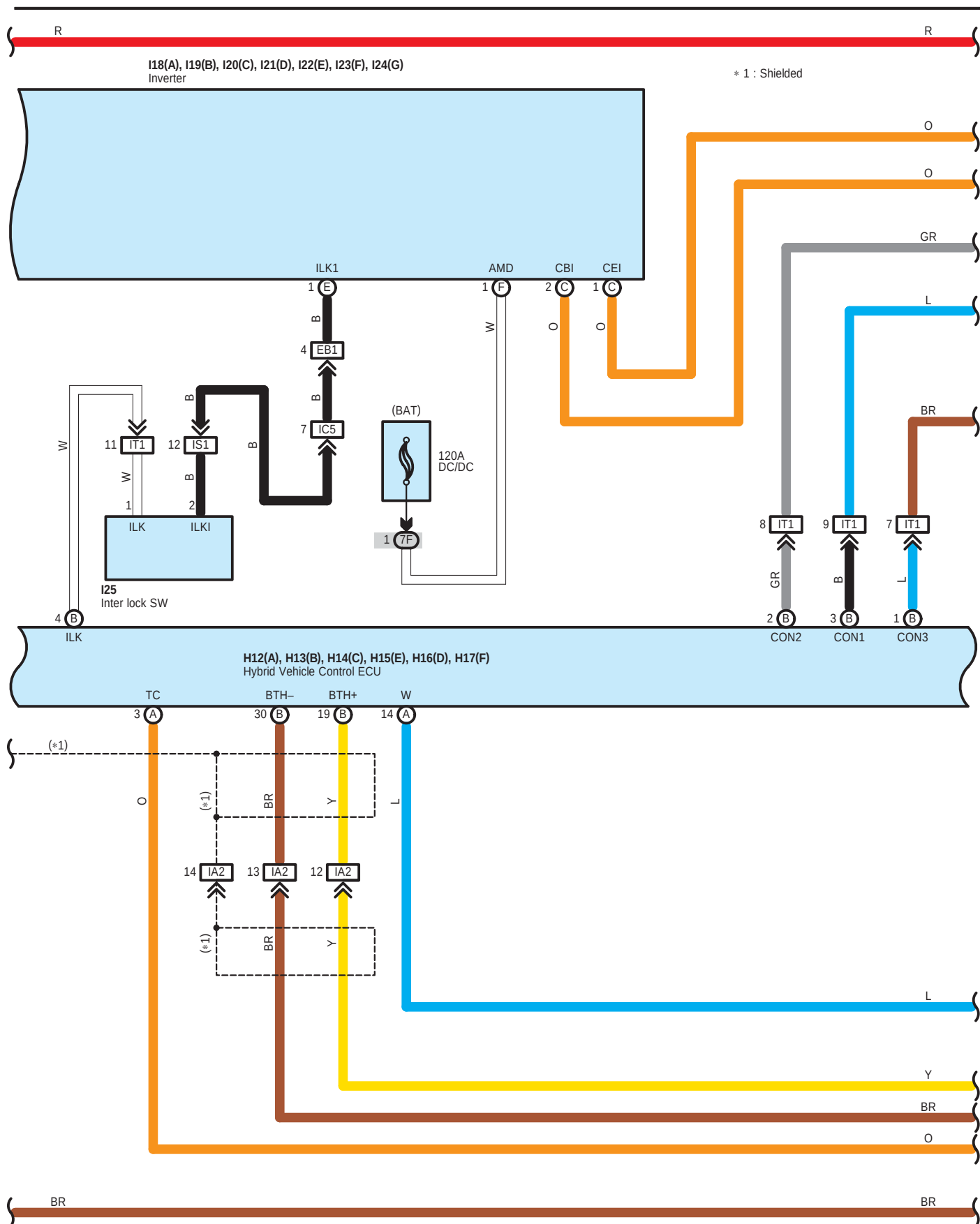
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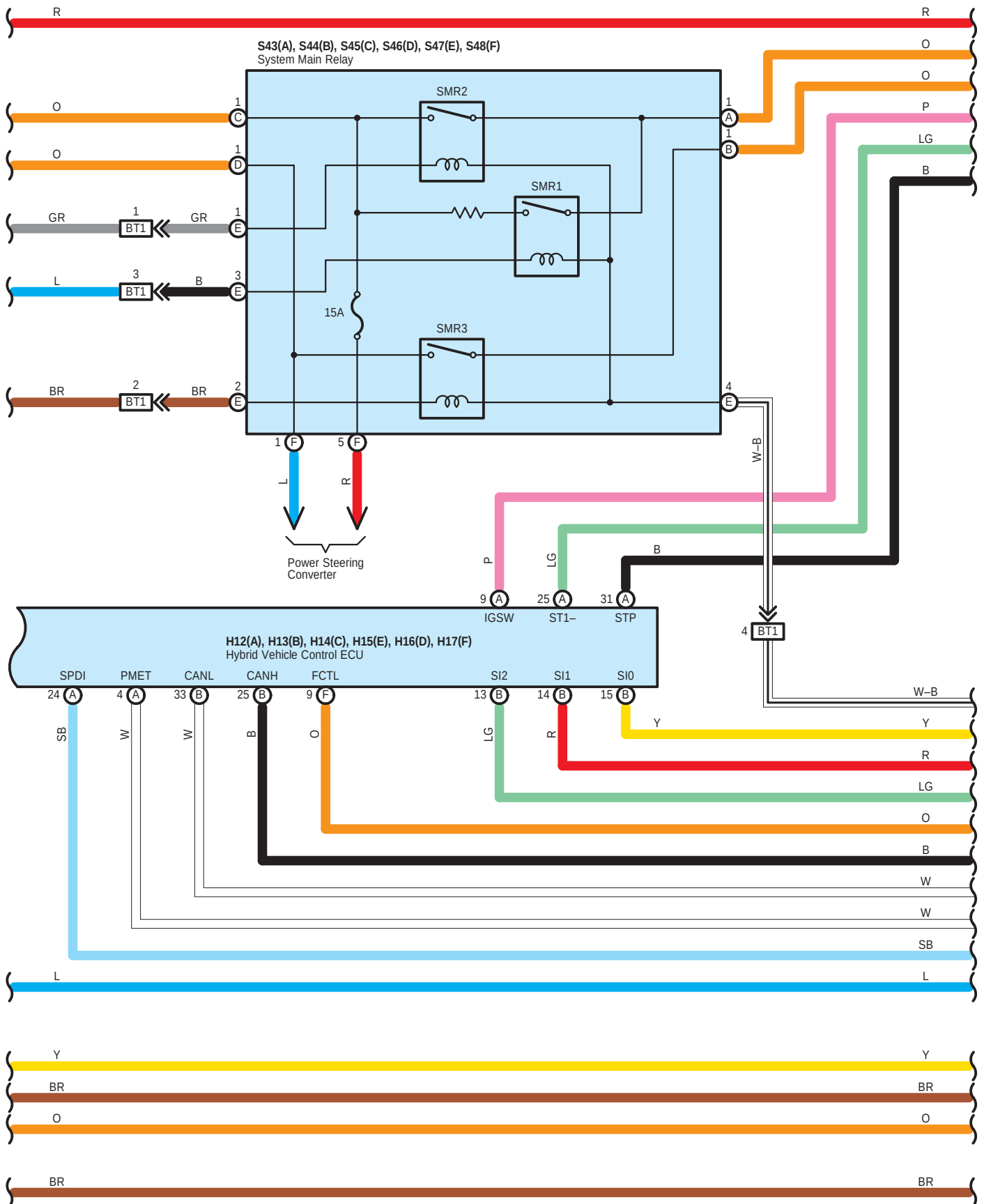


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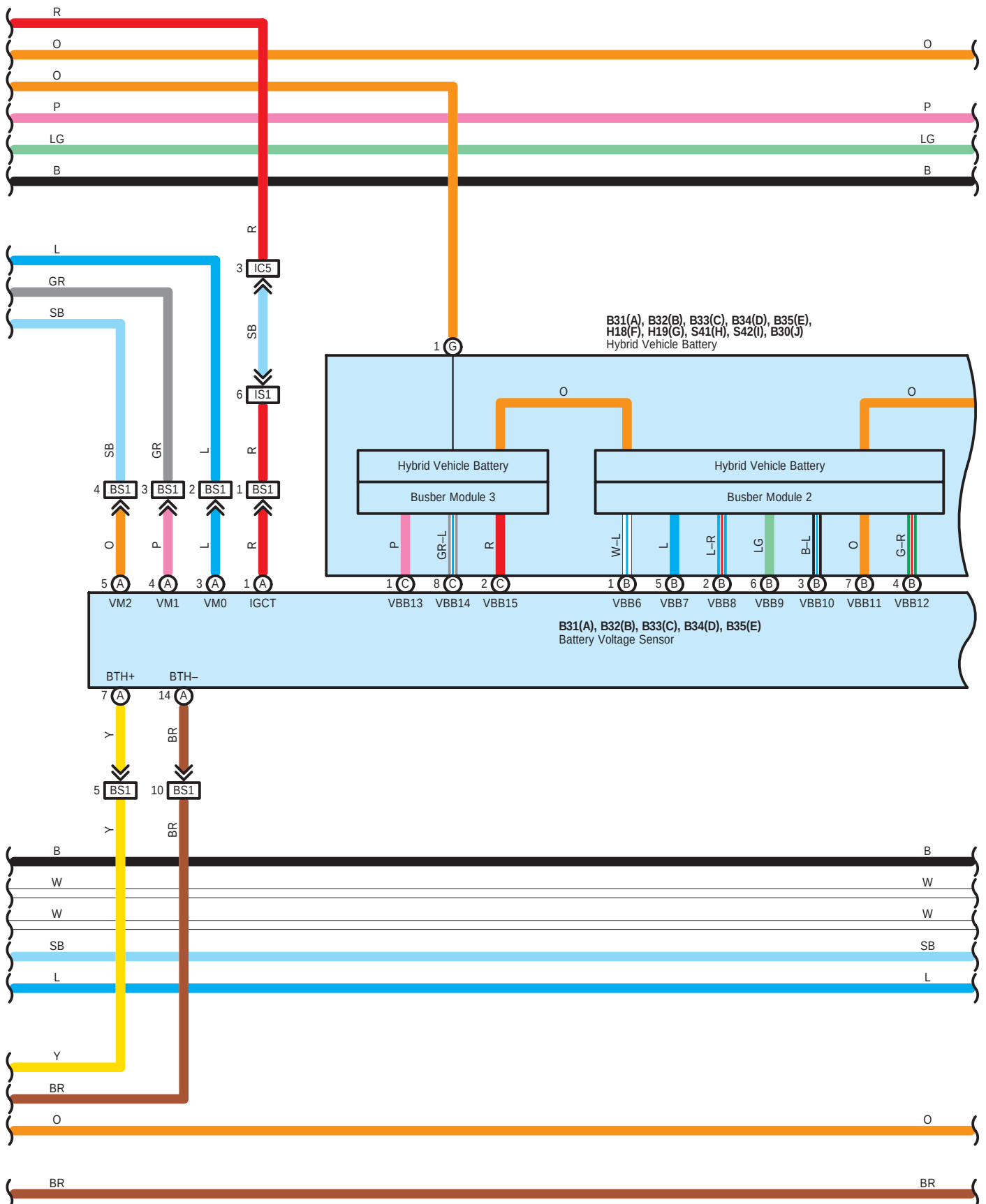


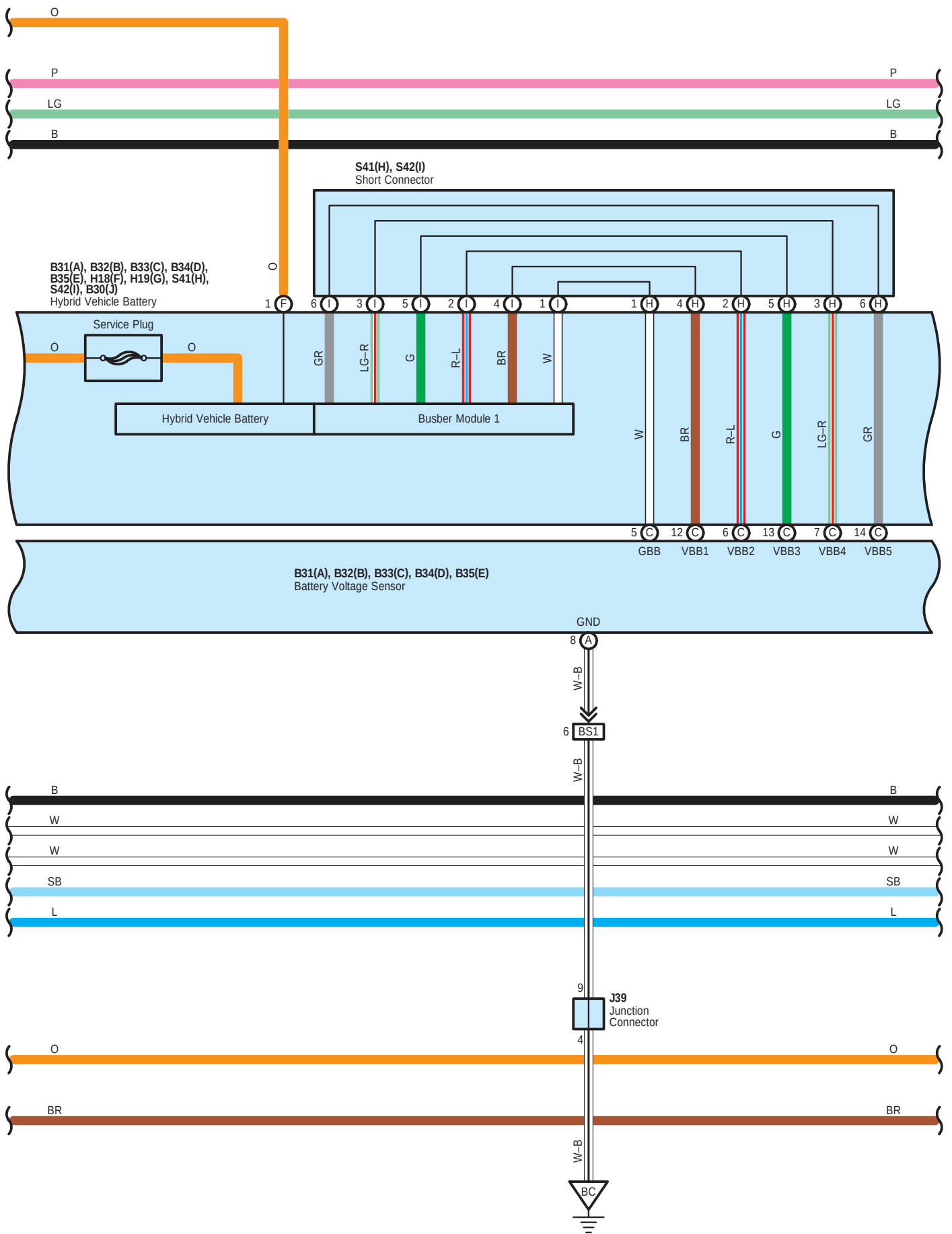


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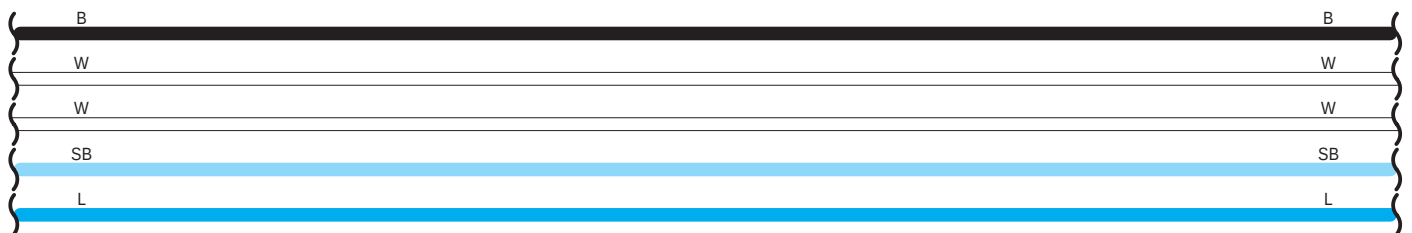
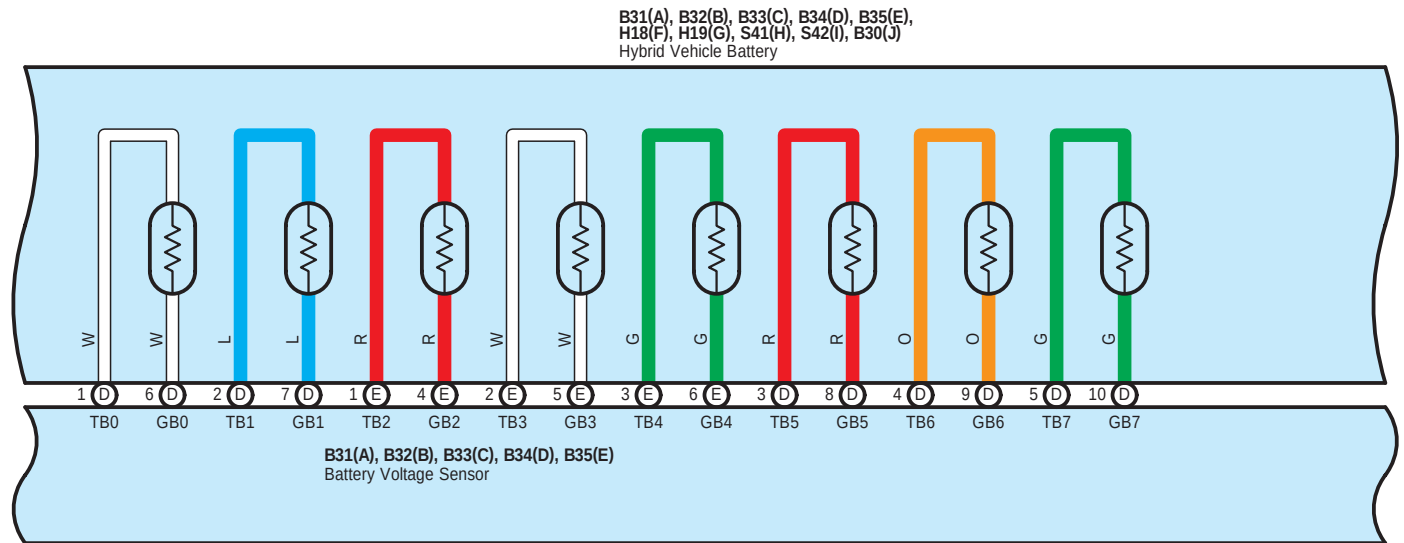


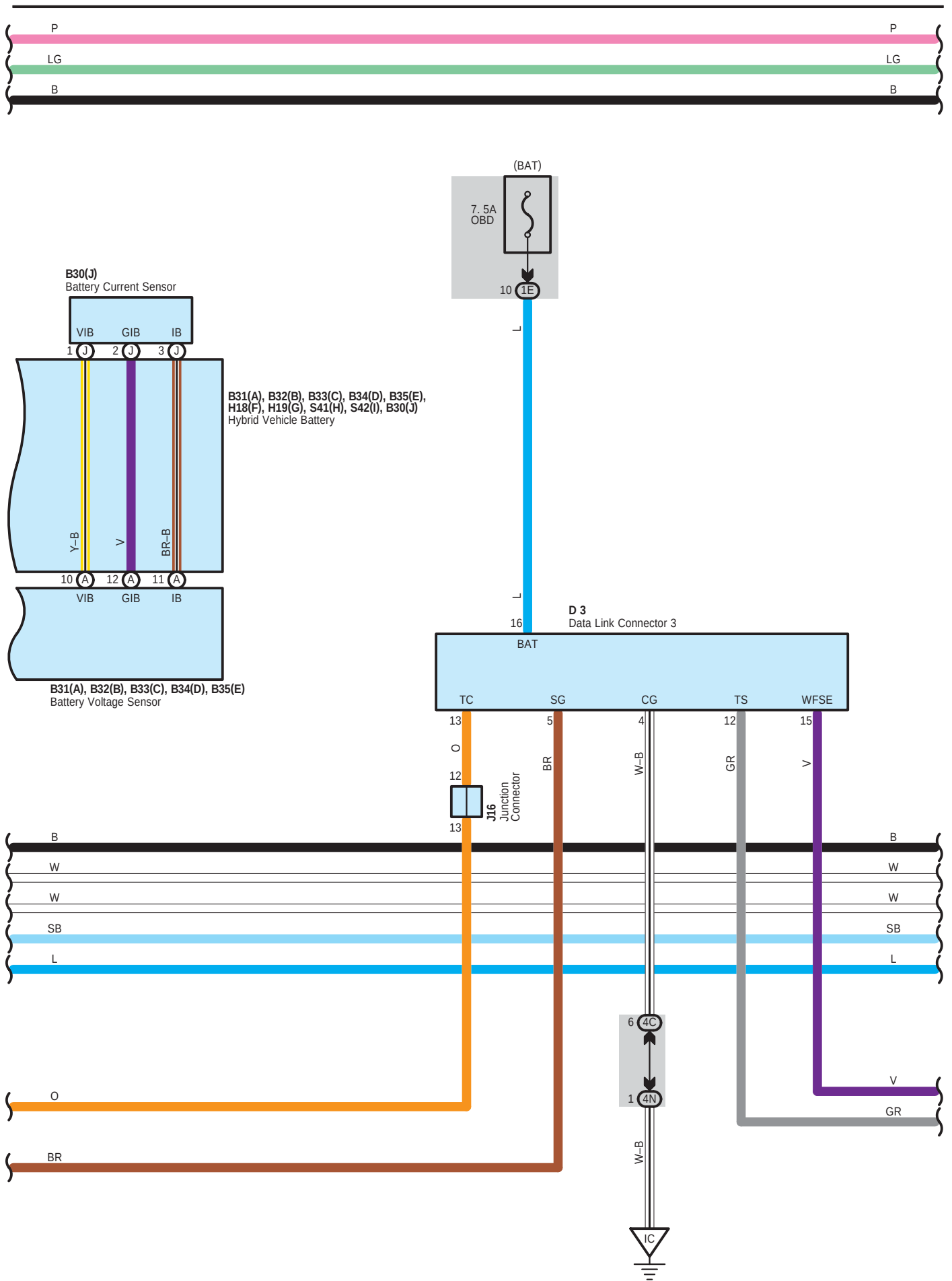
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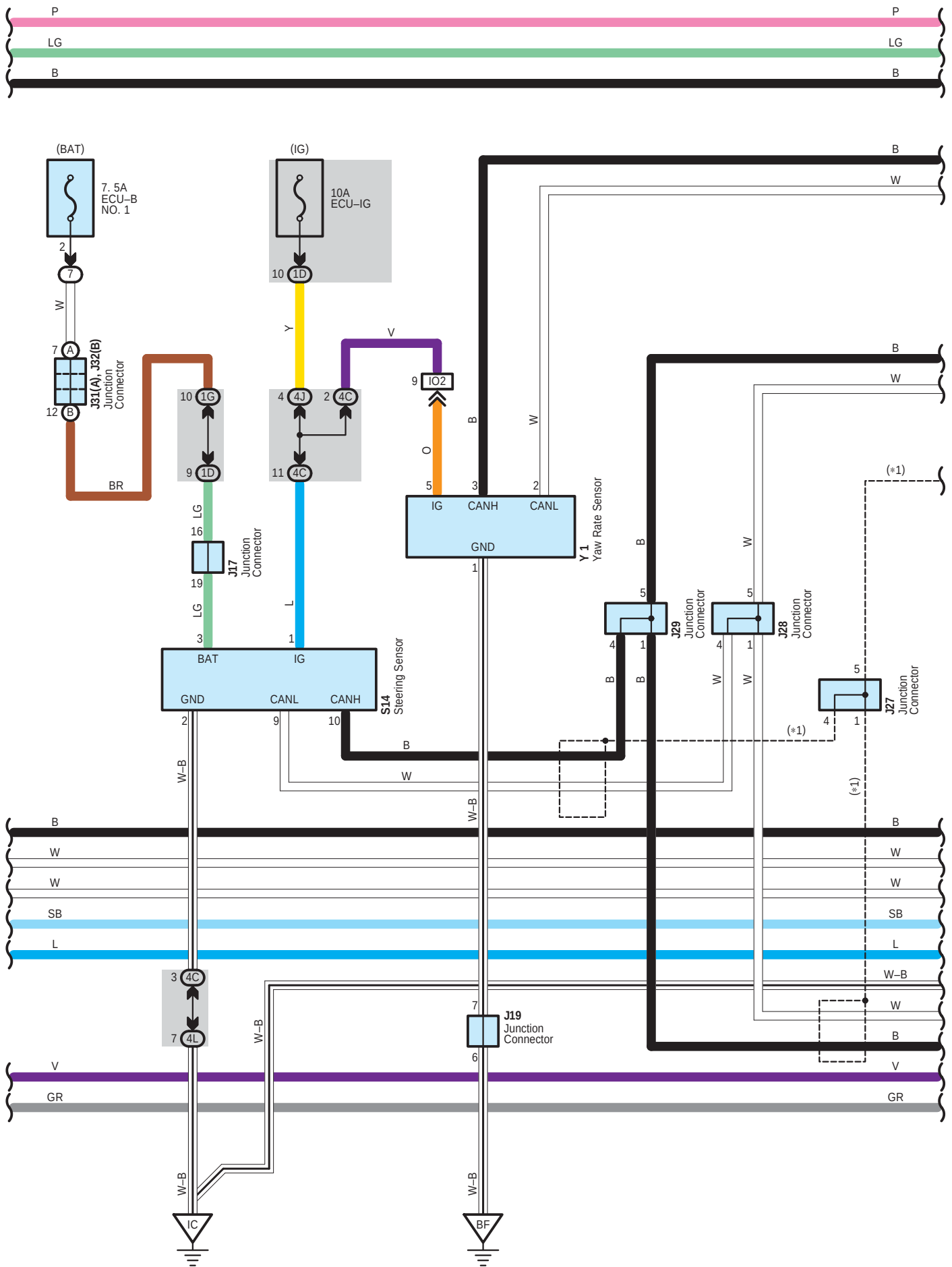


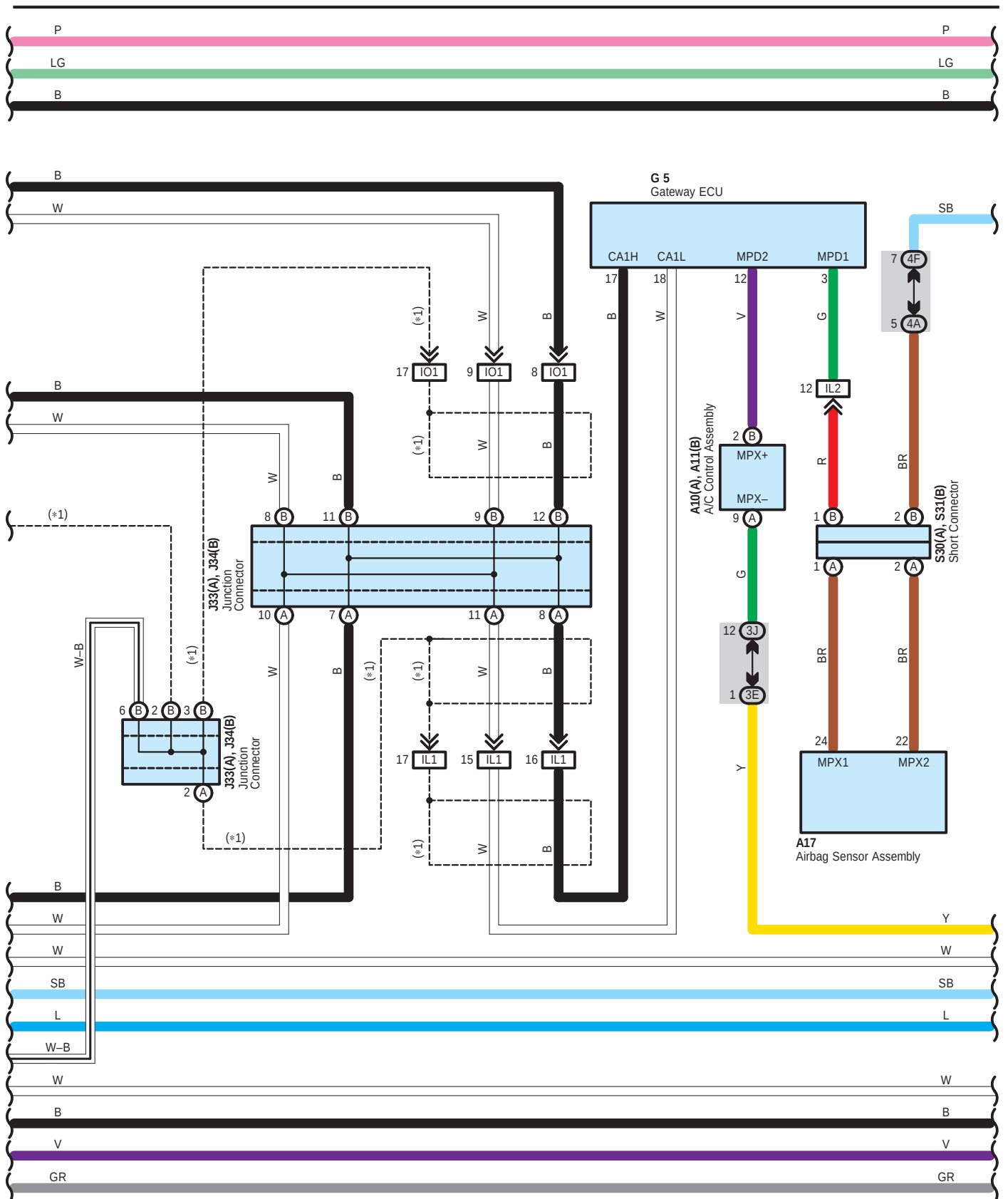
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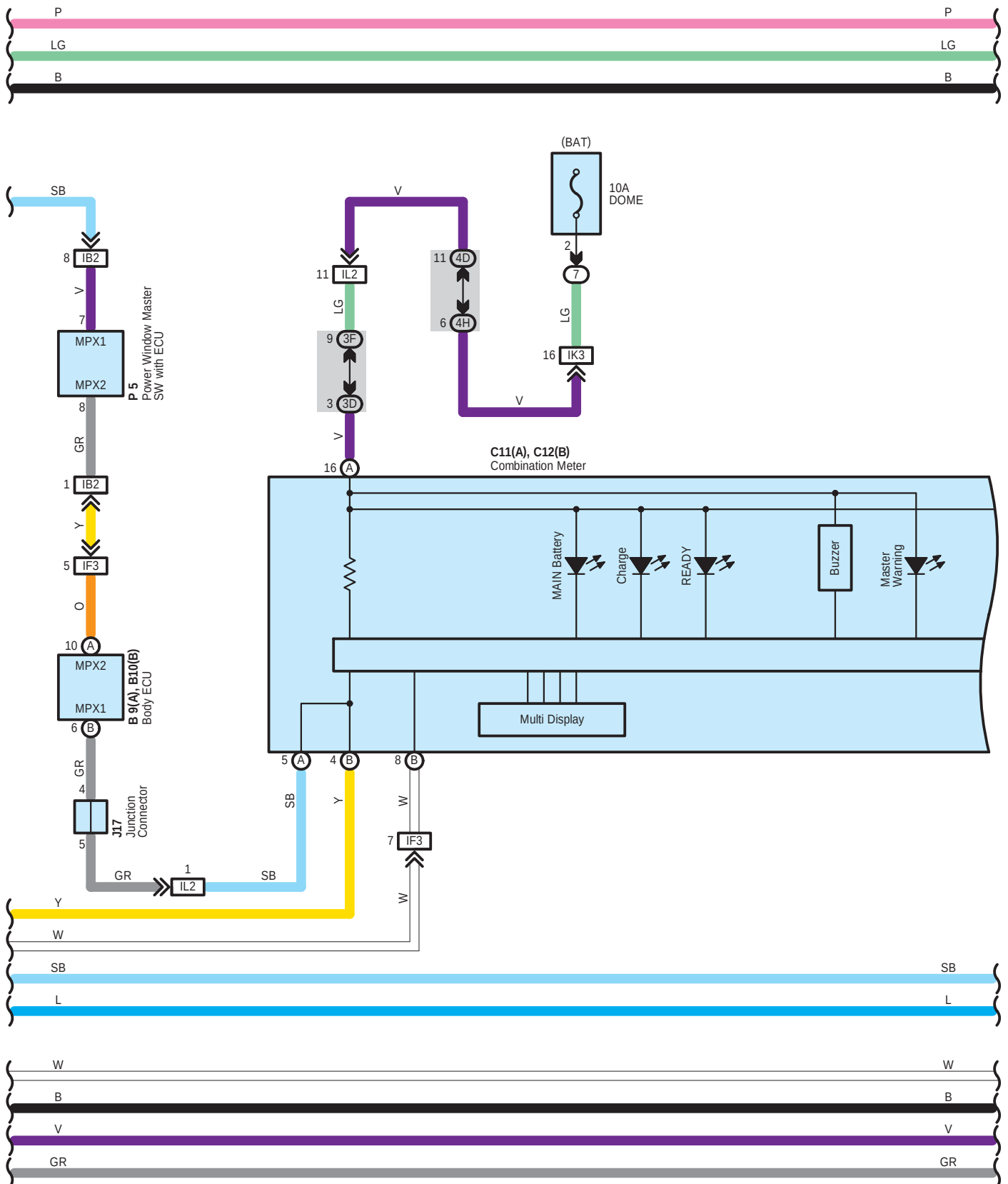
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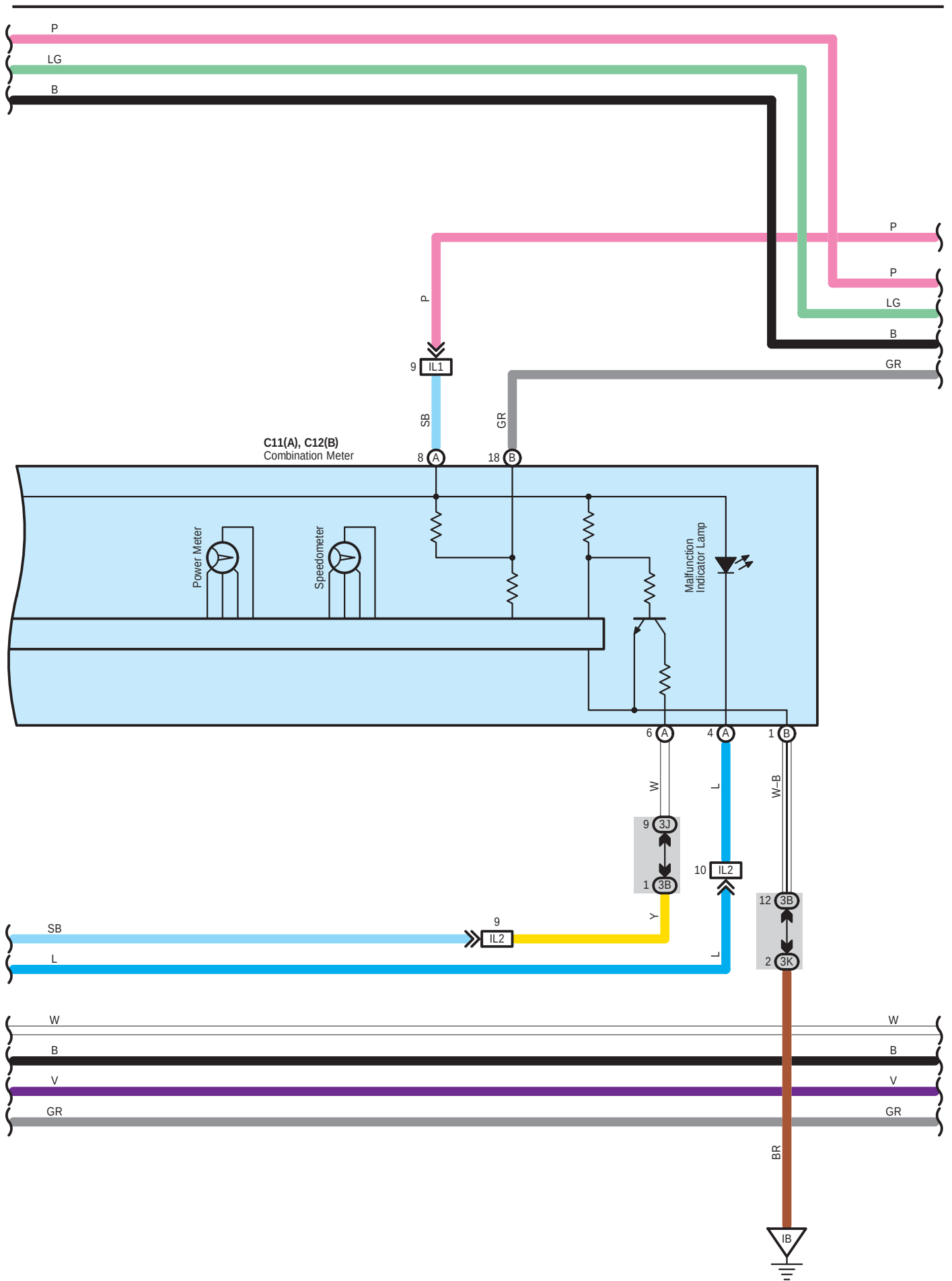


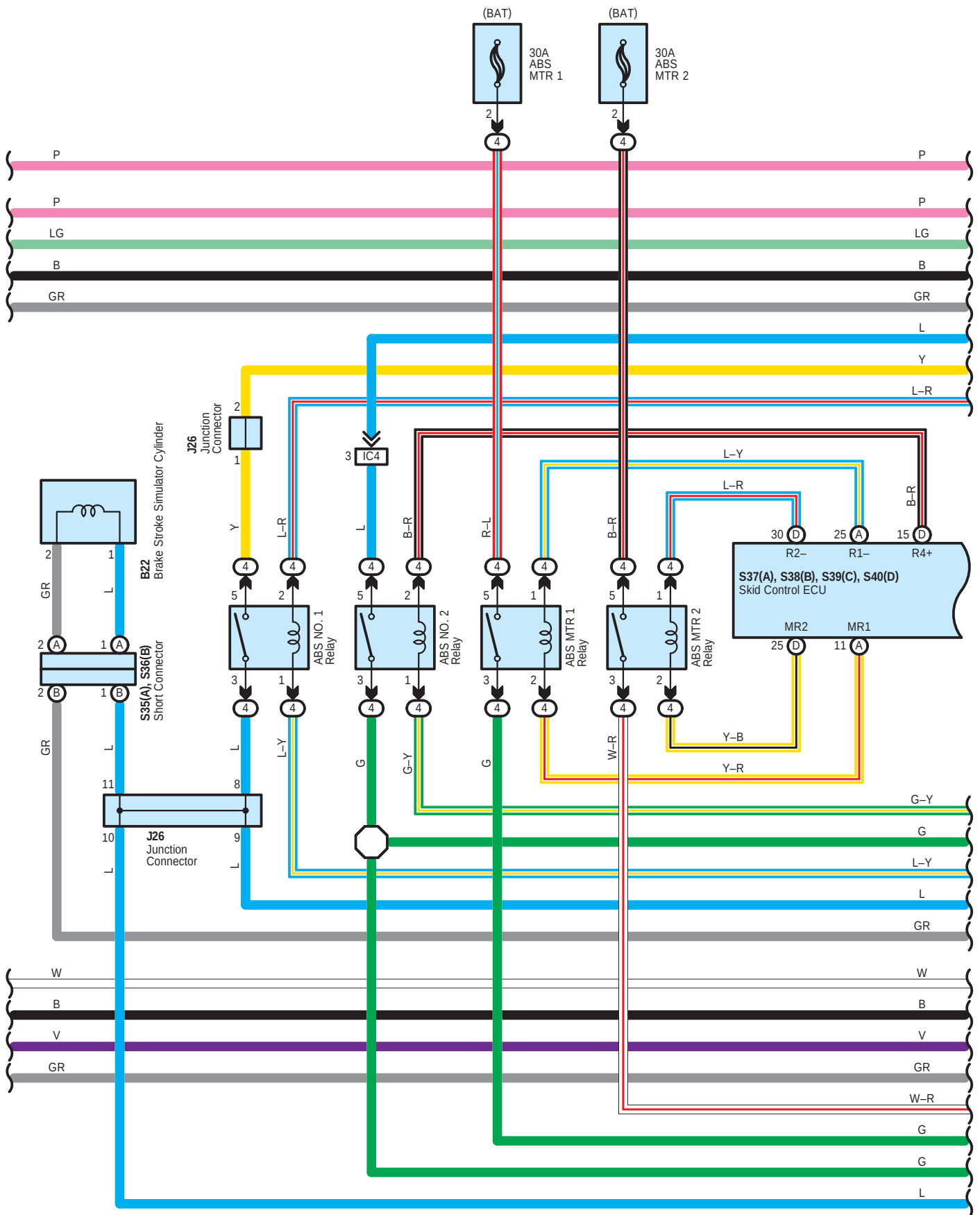


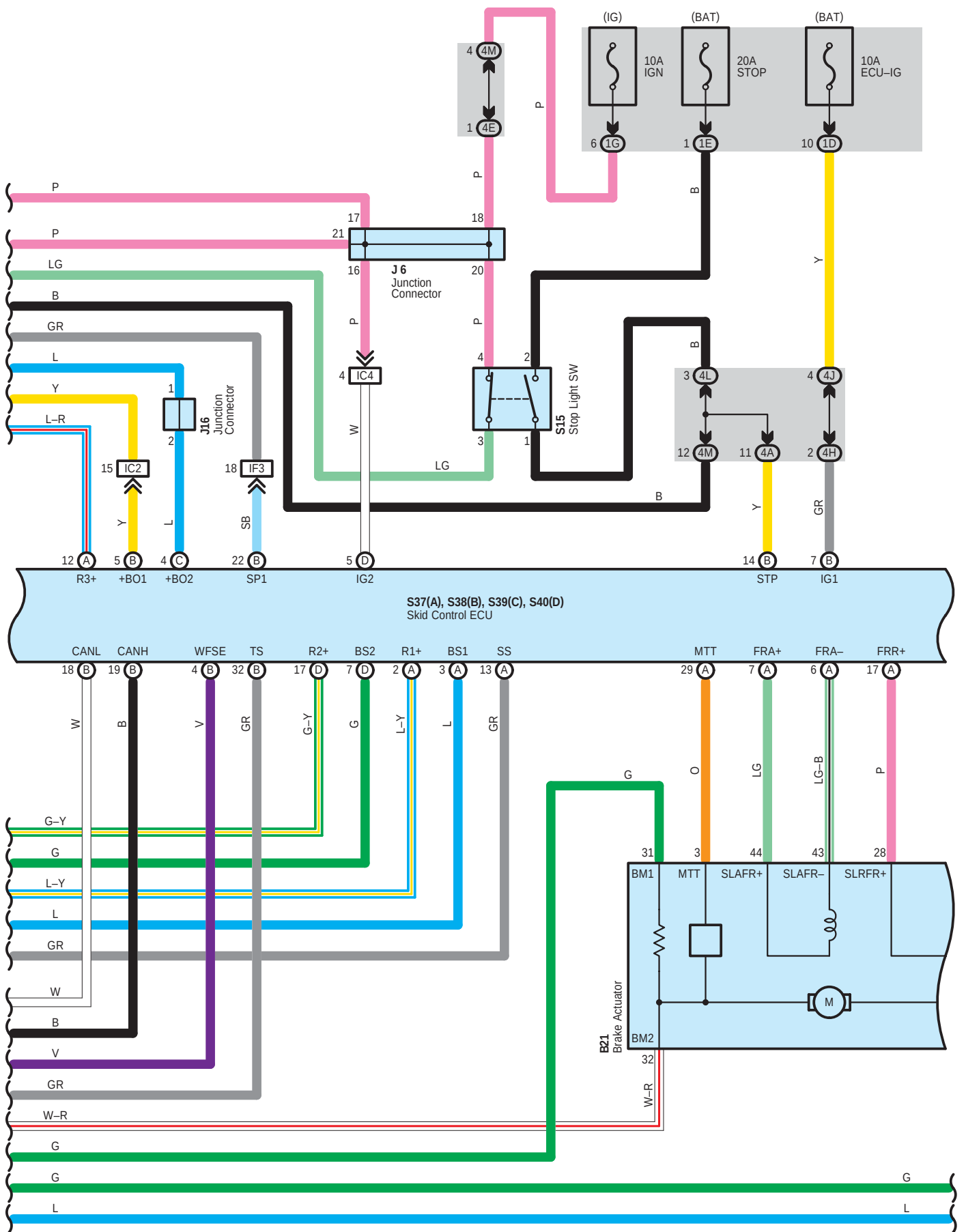
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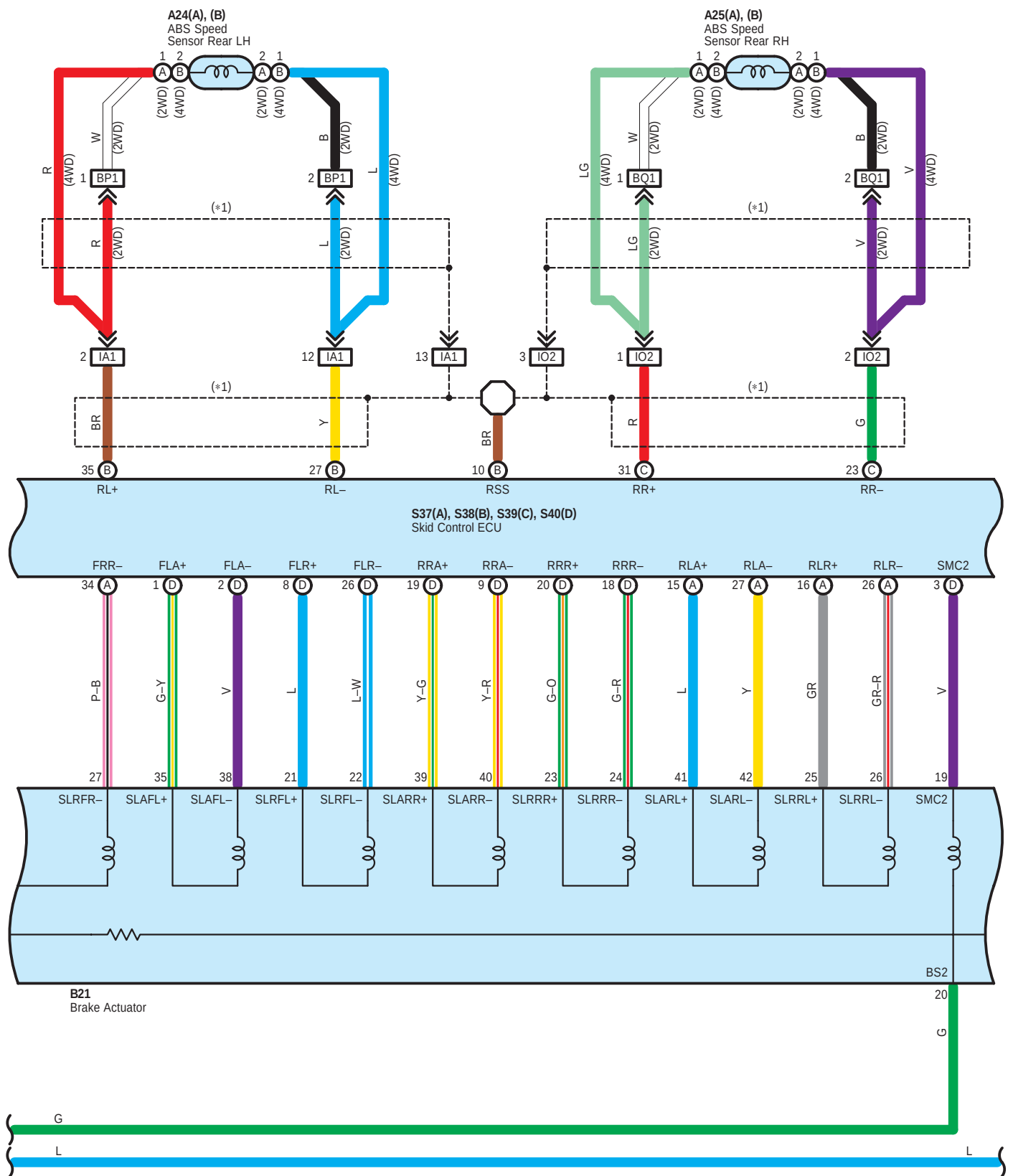
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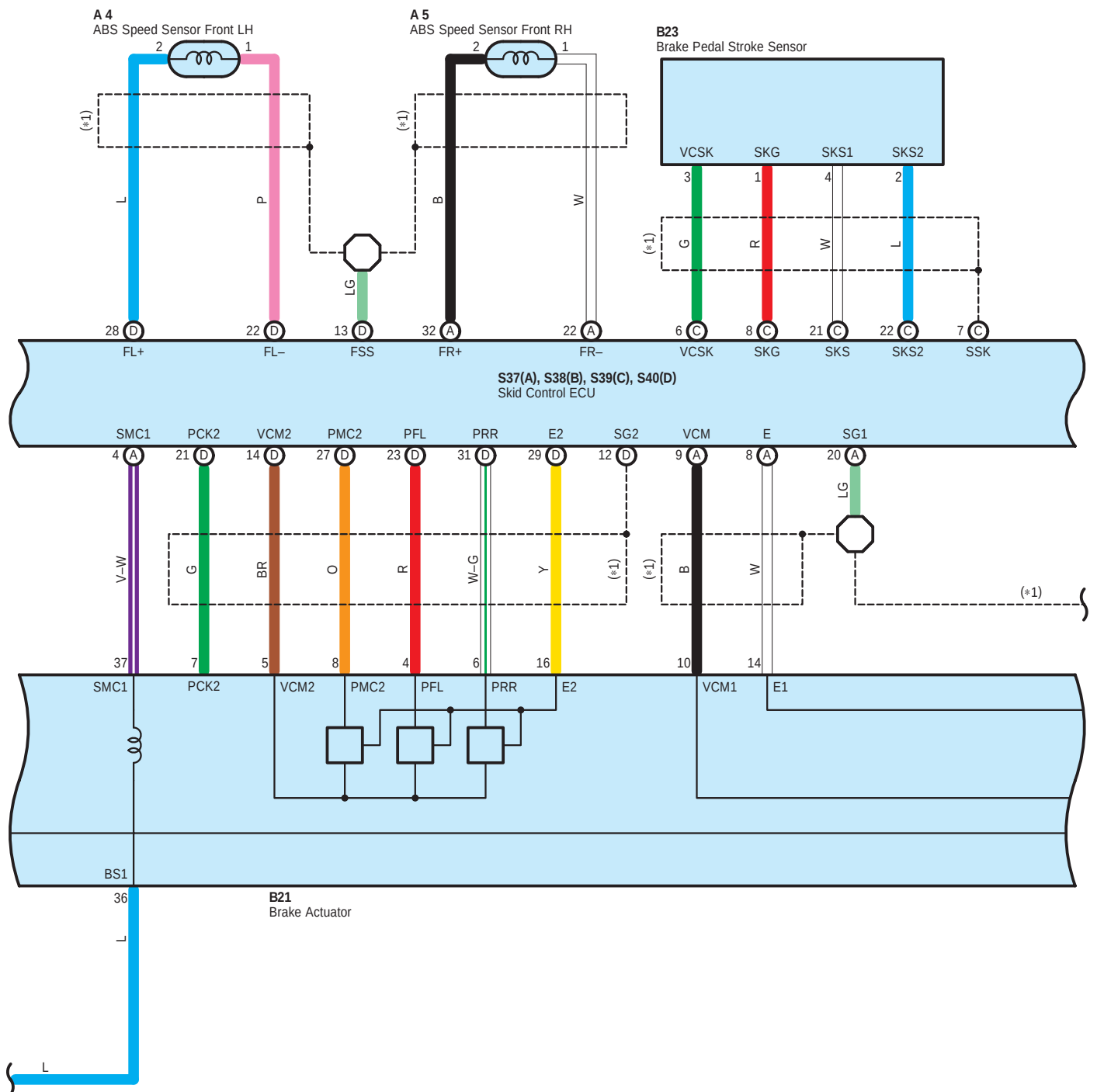


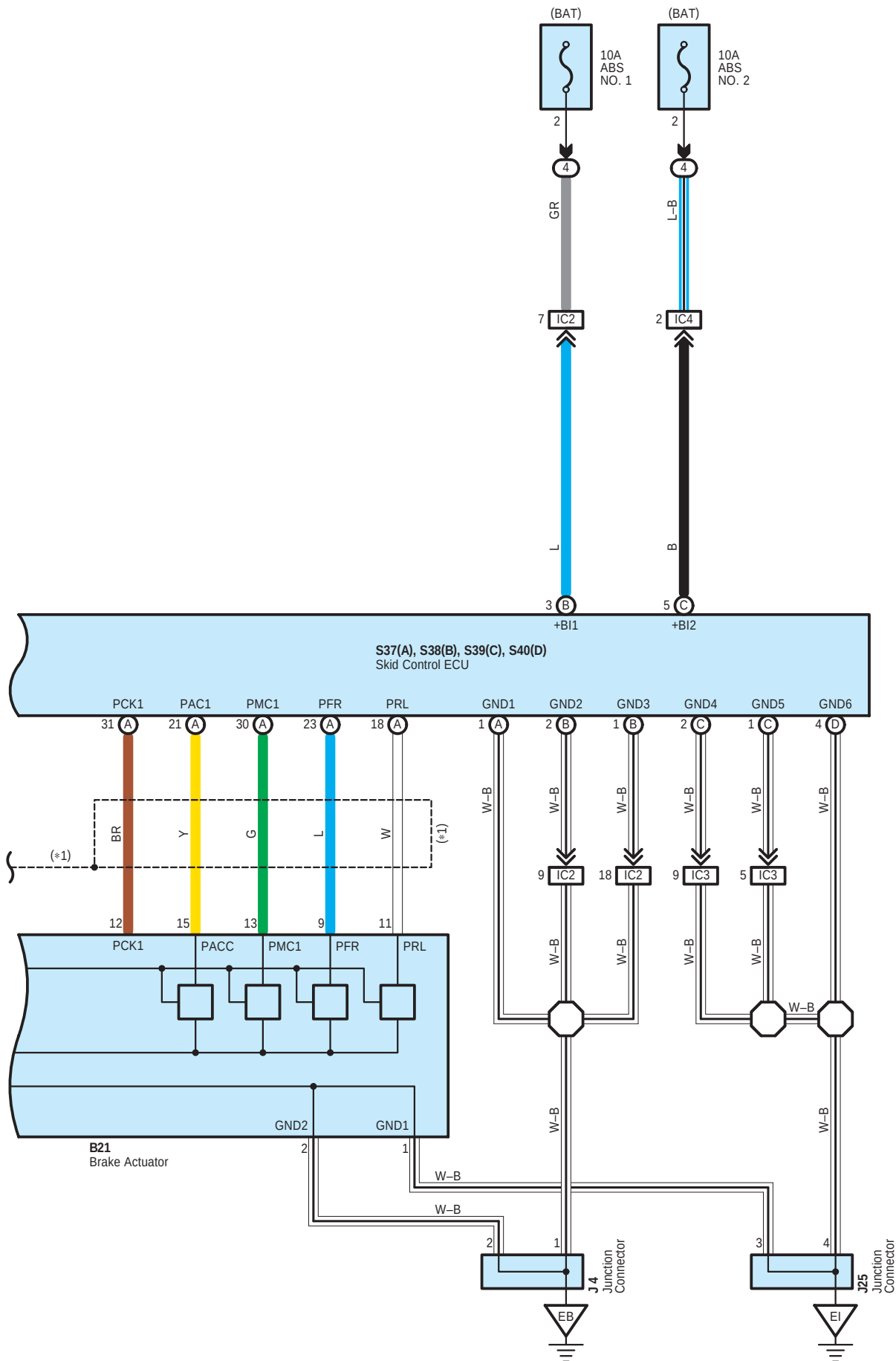












System Outline

This system controls the following modes in order to achieve the most efficient operations to match the driving conditions.

1. Motor Generator Condition

- (1) Supply of electrical power from the HV battery to motor generator no.2 (Front) provides force to drive the wheels.
- (2) While the tires are driven by the engine via the planetary gears, motor generator no.1 (Front) activates to supply electricity via the planetary gears to motor generator no.2 (Front) to drive the wheels.
- (3) When the vehicle is decelerating, kinetic energy from the wheels is recovered into electrical energy and used to recharge the HV battery by motor generator no.2 (Front).

The hybrid vehicle control ECU switches between these modes (1, 2, 1+2, or 3) according to the driving conditions. However, when the state of charge of the HV battery is low, the HV battery is charged by the engine turning motor generator no.1 (Front).

2. Inverter

- * The inverter converts high-voltage direct current of HV battery to three-phase alternating current for driving motor generator no.1 (Front) and motor generator no.2 (Front).
- * The activation of the power transistors is controlled by the motor generator control computer. In addition, the inverter transmits necessary information for current control, such as the output amperage or voltage, to the motor generator control computer.
- * Along with motor generator no.1 (Front) and motor generator no.2 (Front), the inverter is cooled by the exclusive radiator of the coolant system that is separated from that of the engine.
- * In vehicle collision, circuit breaker sensor installed in the inverter outputs collision signal to stop the system.
- * Boost converter has been adopted in the inverter, which increases rated voltage output from HV battery of DC 288V, to DC 650V. After increasing voltage, the inverter converts direct current to alternating current.

3. Converter

The power source for auxiliary equipment of the vehicle such as the lights, audio system, and the air conditioning system, as well as the ECUs, is based on a rated voltage of DC 12V system. Because the HV battery outputs at DC 288V, the converter is used to transform the voltage from rated voltage of DC 288V to DC 12V in order to recharge the auxiliary battery. The converter is installed on the underside of the inverter.

4. HV Battery

- * In HIGHLANDER Hybrid Vehicle, the sealed nickel hydride (Ni-MH) battery has been adopted. This HV battery has high power density, lightweight and longevity to match characteristics of hybrid system. Because hybrid system controls charge/discharge to maintain charge/discharge control to maintain SOC (State of charge) at constant level while the vehicle is operating normally, it does not have to rely on the use of external recharges.
- * The HV battery, battery voltage sensor, system main relay and the cooling fan are put in a signal case which is placed in the rear seat to make more effective use of vehicle space.
- * A service plug that shuts off circuit is provided in the middle of the 30 modules (Rated battery capacity = 288V). Before servicing any portion of the high-voltage circuits, make sure to remove the service plug. Please do not READY ON when you remove the service plug. There is a possibility that battery voltage sensor breaks down.
- * To ensure the HV battery's performance, the battery voltage sensor controls the operation of the cooling fan to avoid the heat that is generated in the HV battery during charging and discharging.

5. Regenerative System Operation

This system operates the motor as a generator to change the kinetic energy of the vehicle into the electricity when accel pedal is released or foot braking decelerates the vehicle speed, and store the electricity in the battery.

6. E-Four System

E-Four system realizes optimum motive force distribution under various driving conditions by changing from the front-wheel drive which focuses on fuel consumption to the four-wheel drive which focuses on traction performance. The change is brought by driving the front wheels with the motor generator no.2 (Front) and the rear wheels with the motor generator (Rear).

Hybrid System

○ : Parts Location

Code		See Page	Code		See Page	Code		See Page
A1		42	H15	E	44	J39		46
A4		42	H16	D	44	M1		43
A5		42	H17	F	44	M6		43
A10	A	44	H18	F	50	M7	A	43
A11	B	44	H19	G	50	M8	B	43
A17		44	I8		43	M9	A	50
A24	A	46	I9		43	M10	B	50
	B	46	I10		43	M11	C	50
A25	A	46	I11		43	O12		43
	B	46	I12		43	P5		46
A27		44	I13		43	S14		45
B9	A	44	I15		44	S15		45
B10	B	44	I18	A	43	S28	A	45
B20		42	I19	B	43	S29	B	45
B21		42	I20	C	43	S30	A	45
B22		42	I21	D	43	S31	B	45
B23		44	I22	E	43	S34		43
B27		50	I23	F	43	S35	A	43
B28		50	I24	G	43	S36	B	43
B29		50	I25		46	S37	A	45
B30	J	50	J2		43	S38	B	45
B31	A	50	J4		43	S39	C	45
B32	B	50	J6		45	S40	D	45
B33	C	50	J16		45	S41	H	50
B34	D	50	J17		45	S42	I	50
B35	E	50	J19		46	S43	A	50
C3		42	J20		46	S44	B	50
C4		42	J25		43	S45	C	50
C7		42	J26		45	S46	D	50
C11	A	44	J27		45	S47	E	50
C12	B	44	J28		45	S48	F	50
C20		42	J29		45	T13		43
D3		44	J31	A	45	T14		45
E2		42	J32	B	45	V6		43
F12		46	J33	A	45	V7		43
G5		44	J34	B	45	W8		43
H12	A	44	J35		45	Y1		47
H13	B	44	J36	A	45			
H14	C	44	J37	B	45			

○ : Relay Blocks

Code	See Page	Relay Blocks (Relay Block Location)
2	25	R/B No.2 (Engine Compartment Left)
3	26	R/B No.3 (Engine Compartment Left)
4	27	R/B No.4 (Engine Compartment Left)
7	24	Fusible Link Block (Engine Compartment Left)



: Junction Block and Wire Harness Connector

Code	See Page	Junction Block and Wire Harness (Connector Location)
1D	31	Cowl Wire and Instrument Panel J/B (Lower Finish Panel)
1E		
1G		
2D	28	Engine Room Main Wire and Engine Room J/B (Engine Compartment Left)
2E		
2G		
3B	34	Instrument Panel Wire and J/B No.3 (Behind the Instrument Panel Center)
3D		
3E		
3F	35	
3J		
3K		
4A	39	Cowl Wire and J/B No.4 (Right Side of Glove Box)
4C		
4D		
4E	38	
4F		
4H		
4J	38	
4L		
4M		
4N	24	Engine Room No.2 Wire and Fusible Link Block (Engine Compartment Left)
7F		



: Connector Joining Wire Harness and Wire Harness

Code	See Page	Joining Wire Harness and Wire Harness (Connector Location)
EB1	52	Engine Wire and Engine Room Main Wire (Front Side of Engine Room R/B No.4)
EB2		
EC1	52	Engine Room Main Wire and Frame No.3 Wire (Left Side of the Suspension Tower)
EC2		
IA1	54	Cowl Wire and Floor No.2 Wire (Left Kick Panel)
IA2		
IB2	54	Front Door LH Wire and Cowl Wire (Left Kick Panel)
IC1	54	Engine Room Main Wire and Cowl Wire (Left Cowl Side Panel)
IC2		
IC3		
IC4		
IC5		
IF3	54	Instrument Panel Wire and Cowl Wire (Right Side of Instrument Panel J/B)
IK2	55	Engine Room Main Wire and Cowl Wire (Right Cowl Side Panel)
IK3		
IL1	55	Instrument Panel Wire and Cowl Wire (Right Cowl Side Panel)
IL2		
IO1	55	Cowl Wire and Floor Wire (Right Kick Panel)
IO2		
IS1	55	Floor No.2 Wire and Cowl Wire (Left Kick Panel)
IT1	55	Floor No.2 Wire and Cowl Wire (Under the Shift Lever)
BN1	56	Fuel Tank Wire and Floor No.2 Wire (Front Side of Rear Quarter Wheel House LH)
BP1	56	Skid Control LH Wire and Floor No.2 Wire (Left Rear Quarter Panel)
BQ1	56	Skid Control RH Wire and Floor Wire (Right Rear Quarter Panel)
BS1	60	Floor No.2 Wire and Battery Pack Wire (Near the HV Battery)
BT1	60	Floor No.2 Wire and Battery Pack No.2 Wire (Near the HV Battery)

Hybrid System



: Ground Points

Code	See Page	Ground Points Location
EB	52	Right Front Fender Apron
EH	52	Under the Left Headlight
EI	52	Right Front Fender Apron
EJ	52	Right Side of the Cylinder Head
EN	52	Left Side of the Cylinder Head
IB	54	Right Instrument Panel Brace
IC	54	Right Cowl Side Panel
BC	56	Left Side of Rear Cross Member
BF	56	Near the Rear Side Marker Light RH

