

2002 STARTING & CHARGING SYSTEMS

Starters

DESCRIPTION & OPERATION

All models use Nippondenso 4-brush, solenoid-actuated, reduction gear type starters, equipped with overrunning clutches. The brush holder assembly retains 4 brushes and springs in the starter housing.

Reduction gear type starters contain an integral solenoid attached to drive housing, a reduction idler gear and bearing installed into starter housing, and a clutch drive assembly. The clutch drive assembly is mounted to starter housing and is driven by the reduction idler gear from armature shaft. The brush holder assembly retains 4 brushes and 4 springs in the end cover of field frame housing.

All models use a starter relay to energize starter. Manual transmission vehicles use a clutch start switch and automatic transmission vehicles use a park/neutral switch to energize starter relay. On models with theft deterrent system, theft deterrent system ECU provides ground for starter relay.

Tacoma, Tundra and 4Runner models with 4WD and M/T use an optional clutch start cancel switch. When this switch is turned on, it will allow engine to be started without depressing clutch pedal when transmission is in Neutral. This allows vehicle to be driven out of difficult situations by cranking the engine with the clutch engaged.

TROUBLE SHOOTING

NOTE: See TROUBLE SHOOTING article in GENERAL INFORMATION.

NO-START

1. If a no-start condition exists and battery is known to be good, connect test light or voltmeter between starter solenoid terminal No. 50 and ground. See [Fig. 9](#) or [Fig. 10](#).
2. Turn ignition switch to START position. If test light or voltmeter does not indicate voltage, check main fusible links and large ampere main fuses in engine compartment relay box. If fusible links and fuses are okay, see [IGNITION SWITCH CONTINUITY TEST](#) and/or [STARTER RELAY TEST](#) under ON-VEHICLE TESTING.

ON-VEHICLE TESTING

NOTE: Before testing, ensure battery is fully charged, battery cables and terminal ends are tight and clean, and engine grounds are secure.

CLUTCH START SWITCH TEST

Switch is located above clutch pedal on bracket. Disconnect wiring harness connector from switch. Connect ohmmeter between clutch start switch terminals. Depress clutch pedal. If continuity does not exist, adjust or

replace clutch start switch. If continuity exists, switch is functioning properly.

CLUTCH START CANCEL SWITCH TEST

Tacoma & 4Runner

1. Remove clutch start cancel switch. Switch is located on left side of instrument panel. Connect negative lead of ohmmeter to terminal No. 1. See **Fig. 1** . Check for continuity between clutch start cancel switch terminals No. 1 and 2, and terminals No. 1 and 3. If continuity does not exist, go to next step. If continuity exists, replace clutch start cancel switch.
2. Check for continuity between clutch start cancel switch terminals No. 2 and 3. If continuity exists, replace clutch start cancel switch. If continuity does not exist, check operation of switch by applying battery voltage to switch. Using jumper wires, connect positive battery lead to terminal No. 3 and negative battery lead to terminal No. 1 of clutch start cancel switch.
3. Connect ohmmeter positive lead to terminal No. 2 and negative lead to terminal No. 1 of clutch start cancel switch. Continuity should not exist. Depress clutch start cancel switch. Continuity should exist and indicator light on clutch start cancel switch should be on. If switch does not test as specified, replace switch.

Tundra

1. Locate switch on left side of instrument panel. Remove left lower instrument panel. Disconnect wiring harness connector from switch pigtail connector. Remove switch base from instrument panel. Remove switch from base.
2. Check for continuity between clutch start cancel switch connector terminals No. 1 and 3. See **Fig. 2** . If continuity exists, replace clutch start cancel switch. If continuity does not exist, go to next step.
3. Using jumper wires, connect positive battery terminal to clutch start cancel switch connector terminal No. 7 and ground terminal No. 5. No continuity should exist between terminals No. 1 and 3. Press switch and ensure switch light illuminates. With switch pressed, continuity should exist between terminals No. 1 and 3.
4. Remove jumper wire from clutch start cancel switch connector terminal No. 5. Ensure continuity does not exist between clutch start cancel switch connector terminals No. 1 and 3. If continuity is not as specified, replace clutch start cancel switch.

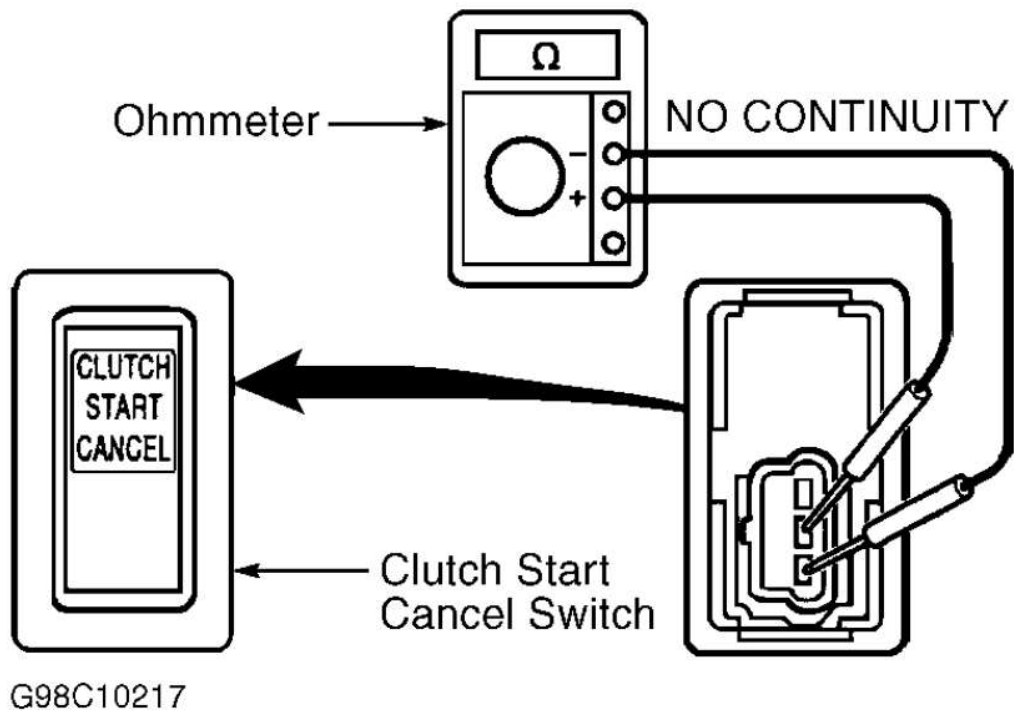
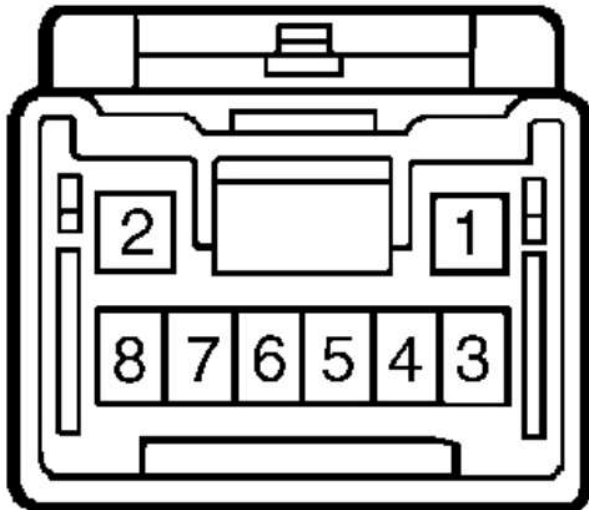


Fig. 1: Clutch Start Cancel Switch Connector ID (Tacoma & 4Runner)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.



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Fig. 2: Clutch Start Cancel Switch Connector ID (Tundra)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

IGNITION SWITCH CONTINUITY TEST

Celica

1. Deactivate air bag system. See AIR BAG RESTRAINT SYSTEMS article. Disconnect negative battery cable. Remove driver's lower instrument panel cover. Remove upper and lower steering column covers if needed. Locate ignition switch wiring harness 6-pin connector. See **Fig. 3**.
2. With ignition switch in LOCK position, there should be no continuity between any terminals. With ignition switch in ACC position, there should be continuity between terminals No. 1 and 3. With ignition switch in ON position, there should be continuity between terminals No. 1, 2 and 3, and between terminals No. 5 and 6. With ignition switch in START position, there should be continuity between terminals No. 1 and 2, and between terminals No. 4, 5 and 6. If continuity is not as specified, replace switch.

All Others

1. Deactivate air bag system. See AIR BAG RESTRAINT SYSTEMS article. Disconnect negative battery cable. Remove driver's lower instrument panel cover. Remove upper and lower steering column covers if needed. Locate ignition switch wiring harness 8-pin connector. See **Fig. 4**.

2. With ignition switch in LOCK position, there should be no continuity between any terminals. With ignition switch in ACC position, there should be continuity between terminals No. 2 and 3. With ignition switch in ON position, there should be continuity between terminals No. 2, 3 and 4, and between terminals No. 6 and 7.
3. With ignition switch in START position, there should be continuity between terminals No. 1, 2 and 4, and between terminals No. 6, 7 and 8. If continuity is not as specified, replace switch.

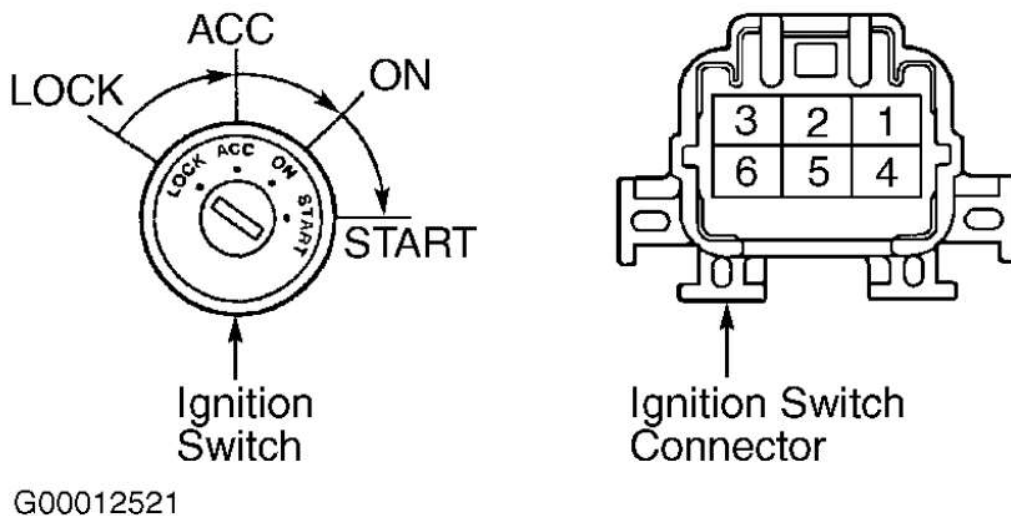


Fig. 3: Ignition Switch 6-Pin Connector (Celica, ECHO & MR2)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

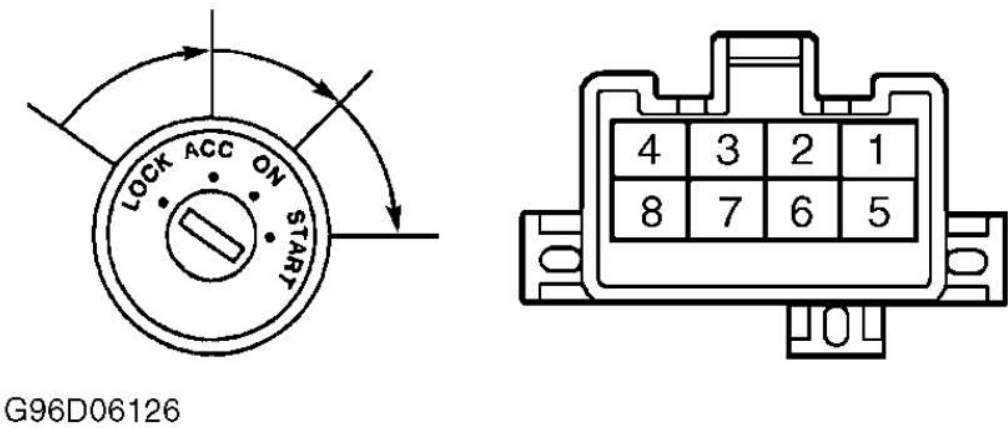


Fig. 4: Ignition Switch 8-Pin Connector (All Others)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

PARK/NEUTRAL SWITCH

NOTE: If vehicle will not start with shift lever in Park/Neutral position, verify correct park/neutral switch adjustment. If park/neutral switch is correctly adjusted, verify switch continuity.

Adjusting Park/Neutral Switch

Locate park/neutral switch at transmission or transaxle. Loosen park/neutral position switch bolt(s) and verify shift selector is in "N" position. Align switch shaft groove with neutral basic line on switch. Hold switch in position and tighten bolt(s) to specification. See **TORQUE SPECIFICATIONS** .

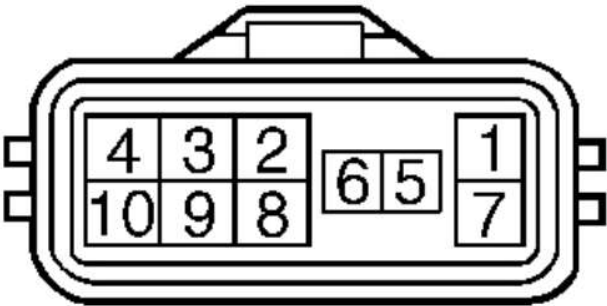
Park/Neutral Switch Continuity Check

Disconnect electrical connector from park/neutral switch at transmission or transaxle. Using ohmmeter, check for continuity at specified terminals with gearshift lever in proper positions. See **Fig. 5** or **Fig. 6** . See **PARK/NEUTRAL SWITCH SPECIFICATIONS** table. If continuity is not as specified, replace switch.

PARK/NEUTRAL SWITCH SPECIFICATIONS

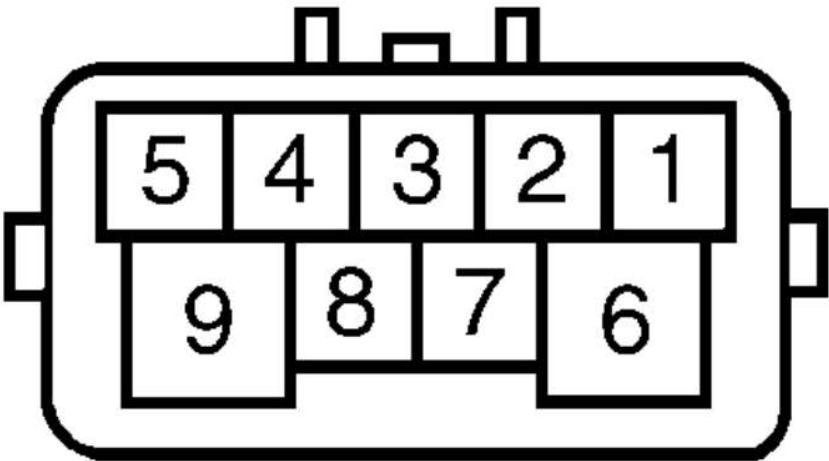
Application & Gearshift Lever Position	Continuity Between Terminals No.
Avalon, Camry, Camry Solara, Corolla & Sienna	
Park	5 & 6, 2 & 7
Reverse	2 & 8
Neutral	5 & 6, 2 & 9
Drive	2 & 10

2	2 & 3
Low	2 & 4
Celica, Highlander, Land Cruiser, RAV4, Sequoia & 4Runner	
Park	6 & 9, 3 & 1
Reverse	3 & 2
Neutral	6 & 9, 3 & 5
Drive	3 & 7
2	3 & 4
Low	3 & 8
ECHO	
Park	3 & 5, 6 & 9
Reverse	3 & 4
Neutral	1 & 3, 6 & 9
Drive	3 & 8
2	2 & 3
Low	3 & 7
Tacoma	
Park	5 & 6, 4 & 7
Reverse	4 & 8
Neutral	5 & 6, 4 & 10
Drive	4 & 9
2	4 & 2
Low	4 & 3
Tundra	
Park	4 & 7, 5 & 6
Reverse	4 & 8
Neutral	4 & 10, 5 & 6
Drive	4 & 9
2	4 & 2
Low	4 & 3



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Fig. 5: Identifying Park/Neutral Switch Terminals (All Others)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.



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Fig. 6: Identifying Park/Neutral Switch Terminals (Celica, ECHO, Highlander, RAV4, Sequoia &

4Runner)

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

STARTER RELAY TEST**Land Cruiser**

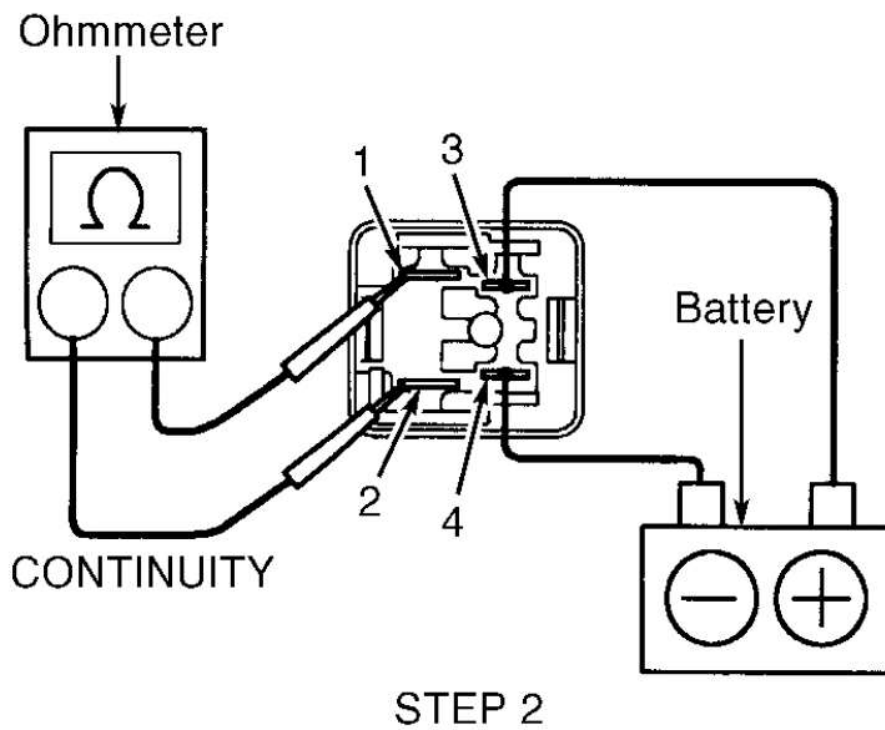
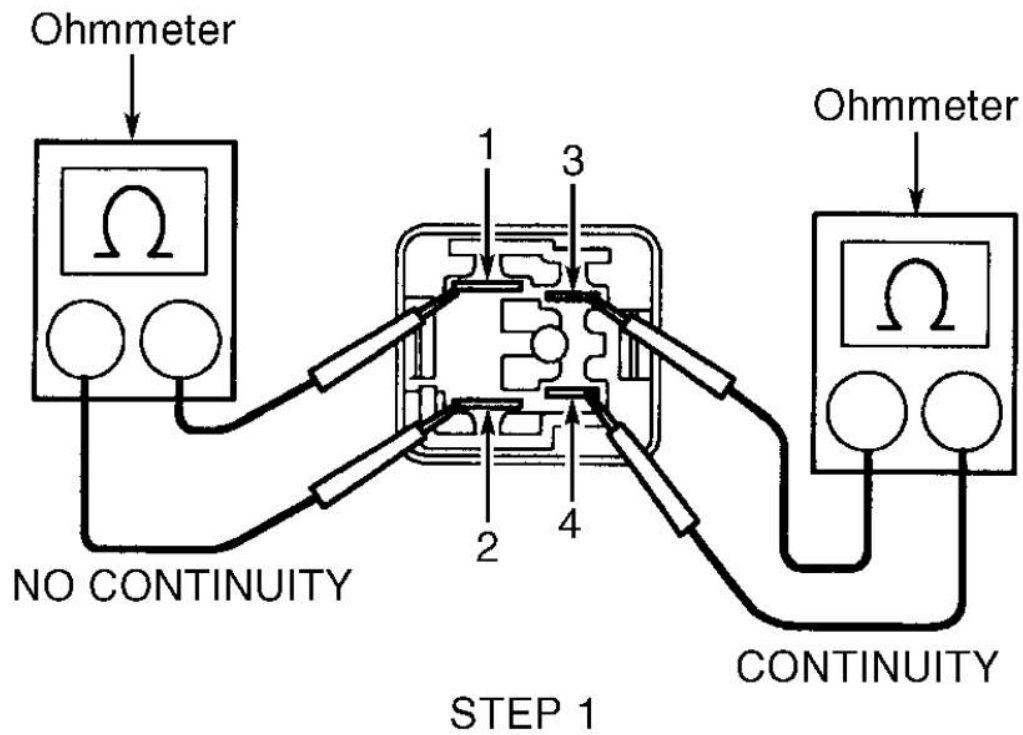
1. Locate and remove starter relay. Starter relay is marked "ST". See **STARTER RELAY LOCATION** table. Using ohmmeter, verify continuity exists between relay terminals No. 3 and 4. See STEP 1. See **Fig. 7** . Continuity should not exist between terminals No. 1 and 2. If continuity is not as specified, replace relay.
2. Check relay operation by applying battery voltage to terminals No. 3 and 4. See STEP 2. See **Fig. 7** . Continuity should now exist between terminals No. 1 and 2. If relay does not test as indicated, replace relay.

All Others

1. Locate and remove starter relay. Starter relay is marked "ST". See **STARTER RELAY LOCATION** table. Using ohmmeter, verify continuity between relay terminals No. 1 and 2. See **Fig. 8** . Continuity should not exist between terminals No. 3 and 5. If continuity is not as specified, replace relay.
2. Check relay operation by applying battery voltage through terminals No. 1 and 2. See **Fig. 8** . Continuity should now exist between terminals No. 3 and 5. If relay does not test as indicated, replace relay.

STARTER RELAY LOCATION

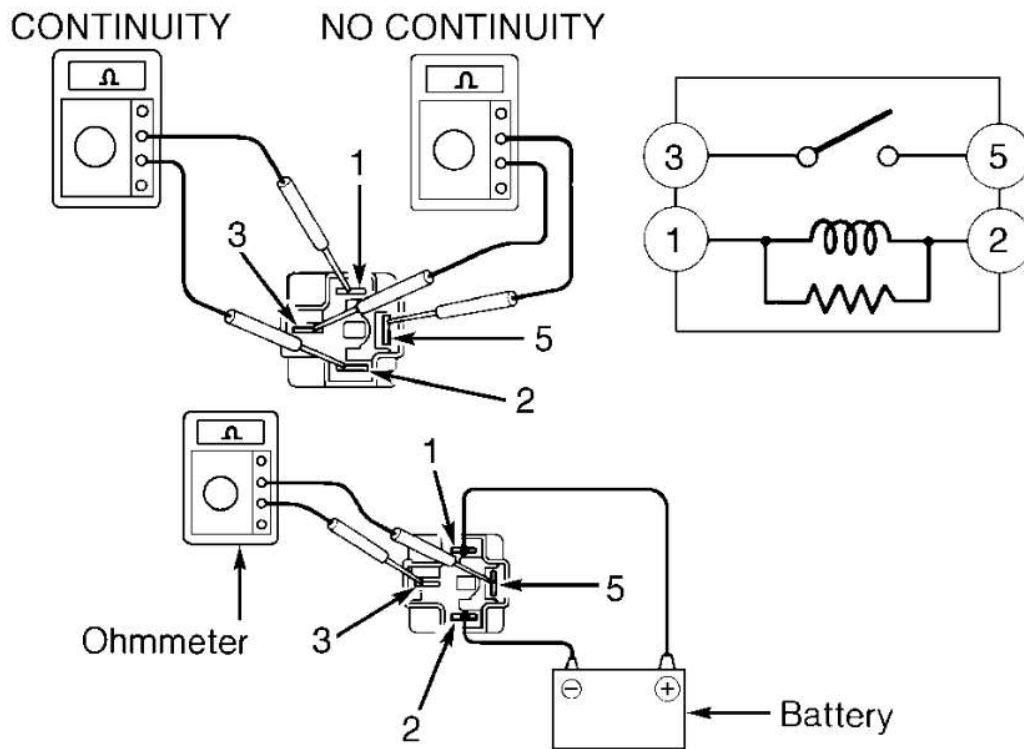
Application	Location
Avalon & Corolla	In Engine Compartment Junction Block
Camry, Camry Solara & Sienna	In Engine Compartment Junction Block No. 2
Celica	In Engine Compartment Junction/Relay Block No. 2
Land Cruiser	In Engine Compartment Junction Block
ECHO, Highlander, RAV4, Sequoia, Tundra, 4Runner	In Engine Compartment Relay Block
MR2	In Engine Fuse Link Block
Tacoma	In Engine Compartment Relay Block No. 2



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Fig. 7: Testing Starter Relay (Land Cruiser)

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.



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Fig. 8: Testing Starter Relay (All Others)

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

BENCH TESTING

NO-LOAD TEST

CAUTION: DO NOT engage starter solenoid for more than 5 seconds during testing, or damage to coil winding will result.

1. Remove starter. Connect ammeter in series between starter motor terminal No. 30 (battery terminal) and a fully charged 12-volt battery. Connect battery negative lead to starter case ground. See **Fig. 9** or **Fig. 10**. Connect voltmeter to battery to observe voltage draw readings.
2. Connect remote starter or jumper wire to terminals No. 30 and 50 to engage starter. Starter drive pinion gear should extend quickly and spin smoothly. Verify starter amperage draw and battery voltage draw are within specifications. See **NO-LOAD TEST SPECIFICATIONS** table. Replace starter if not within

specification.

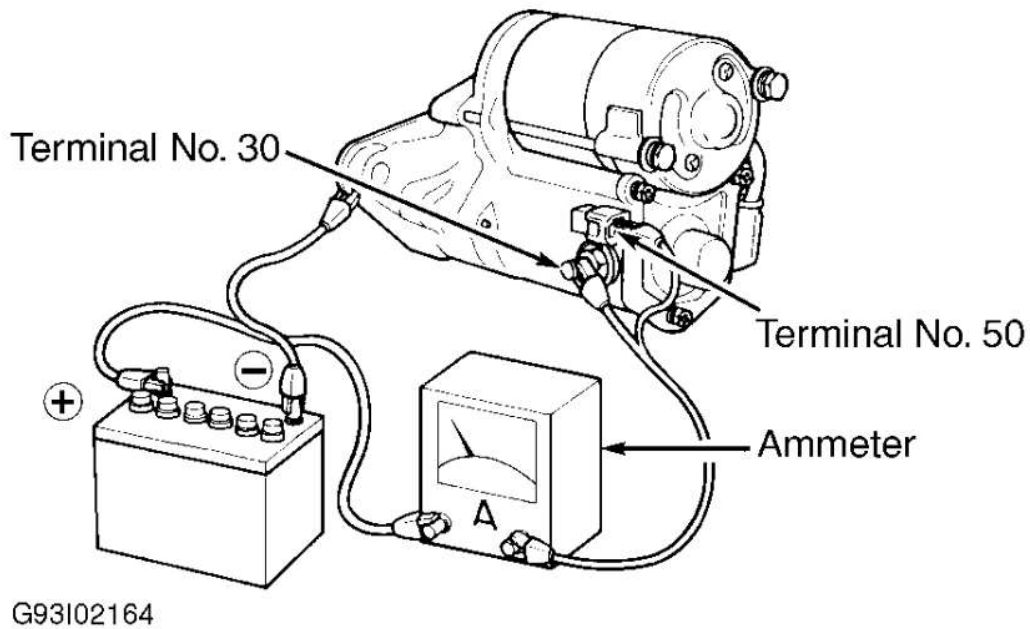


Fig. 9: Starter No-Load Test (Celica Shown; Land Cruiser, RAV4, Sequoia, Tacoma 4-Cyl. & 4Runner 4-Cyl. Are Similar)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

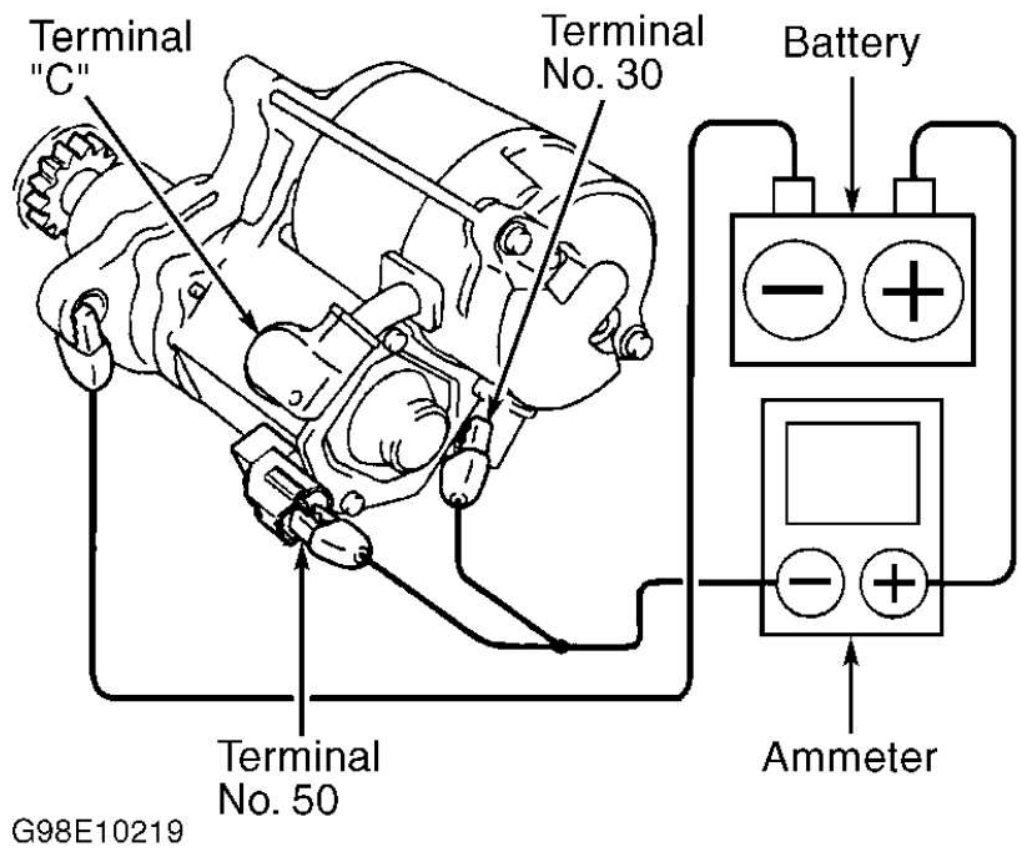


Fig. 10: Starter No-Load Test (Avalon & Sienna Shown; Camry, Camry Solara, Corolla, Highlander, Tacoma V6, Tundra & 4Runner V6 Are Similar)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NO-LOAD TEST SPECIFICATIONS

Application ⁽¹⁾	Max. Amps @ (Volts)	Minimum RPM
Avalon, Celica, MR2 & Sienna 1.4 kW	90 (11.5)	3000
Camry, Camry Solara, Corolla, Highlander & RAV4 1.2 & 1.4 kW	90 (11.5)	3000
ECHO		
0.8 kW	90 (11.5)	3000
Land Cruiser 2.0 kW	100 (11.5)	2500
Sequoia	100 (11.5)	3000
Tacoma, Tundra & 4Runner		
1.2 & 1.4 kW	90 (11.5)	3000

1.8 & 2.0 kW	100 (11.5)	2500
(1) Starter type and kilowatt (kW) rating can be found on a metal label attached to side of starter.		

SOLENOID TESTS

CAUTION: DO NOT engage starter solenoid for more than 5 seconds during testing, or damage to coil winding will result.

1. Pull-In Coil Test

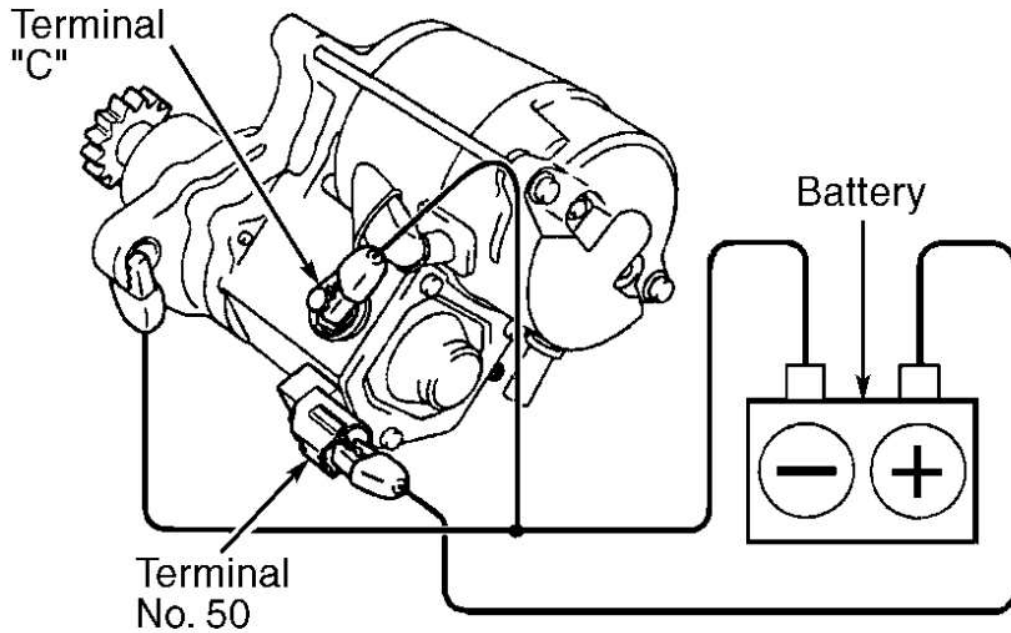
Disconnect field coil lead from terminal "C". Connect jumper wires from negative battery terminal to terminal "C" and to starter housing. When wire is connected from positive battery terminal to terminal No. 50, clutch pinion gear should extend fully. See **Fig. 11** or **Fig. 14**. If clutch pinion gear does not move, replace solenoid. If clutch pinion gear does move, go to next test.

2. Hold-In Coil Test

With battery connected as in previous test and clutch pinion gear still extended, disconnect jumper wire from starter terminal "C". See **Fig. 12** or **Fig. 15**. Clutch pinion gear should remain extended. If clutch pinion gear does not remain extended, replace solenoid. If clutch pinion gear does remain extended, go to next test.

3. Drive Pinion Return Test

Disconnect jumper wire from negative battery terminal to starter housing. See **Fig. 13** or **Fig. 16**. Pinion gear should now retract. If it does not retract, replace solenoid.



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Fig. 11: Solenoid Pull-In Coil Test (Avalon, Camry & Sienna Shown; Corolla, Highlander, Sequoia, Tacoma V6, Tundra & 4Runner V6 Are Similar)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

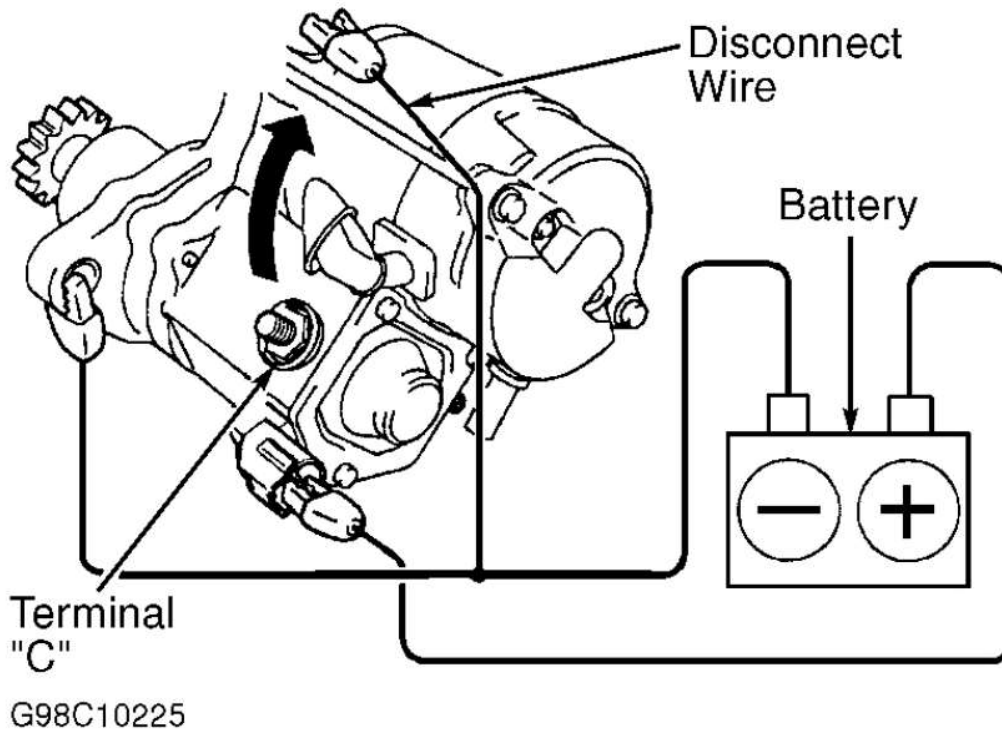


Fig. 12: Solenoid Hold-In Coil Test (Avalon, Camry & Sienna Shown; Corolla, Highlander, Sequoia, Tacoma V6, Tundra & 4Runner V6 Are Similar)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

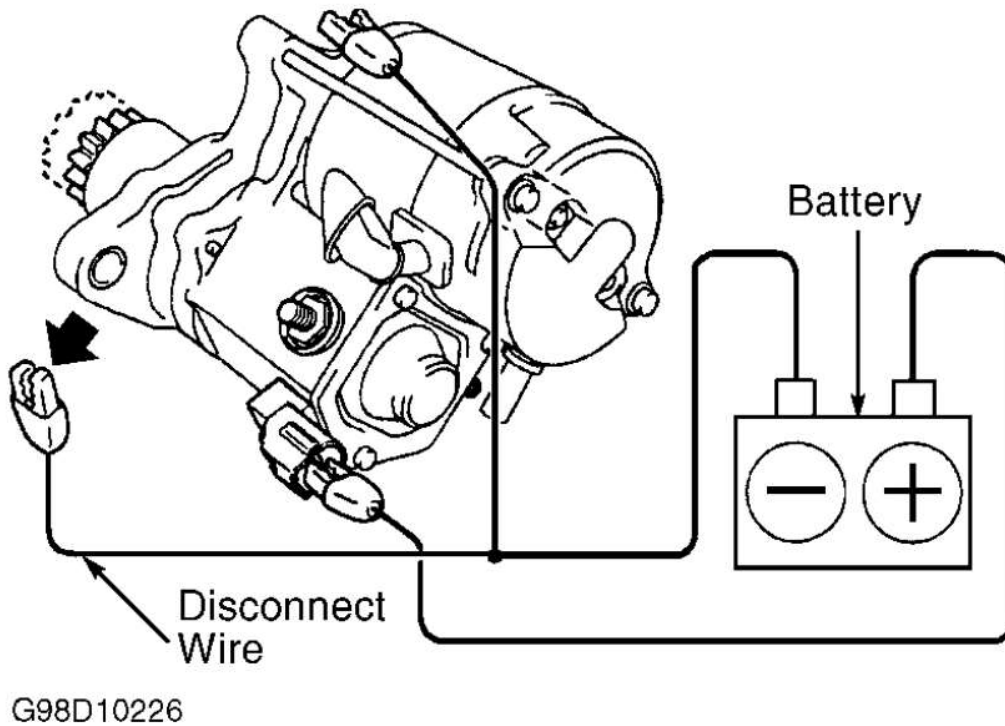


Fig. 13: Solenoid Drive Pinion Return Test (Avalon, Camry, Camry Solara & Sienna Shown; Corolla, Highlander, Sequoia, Tacoma V6, Tundra & 4Runner V6 Are Similar)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

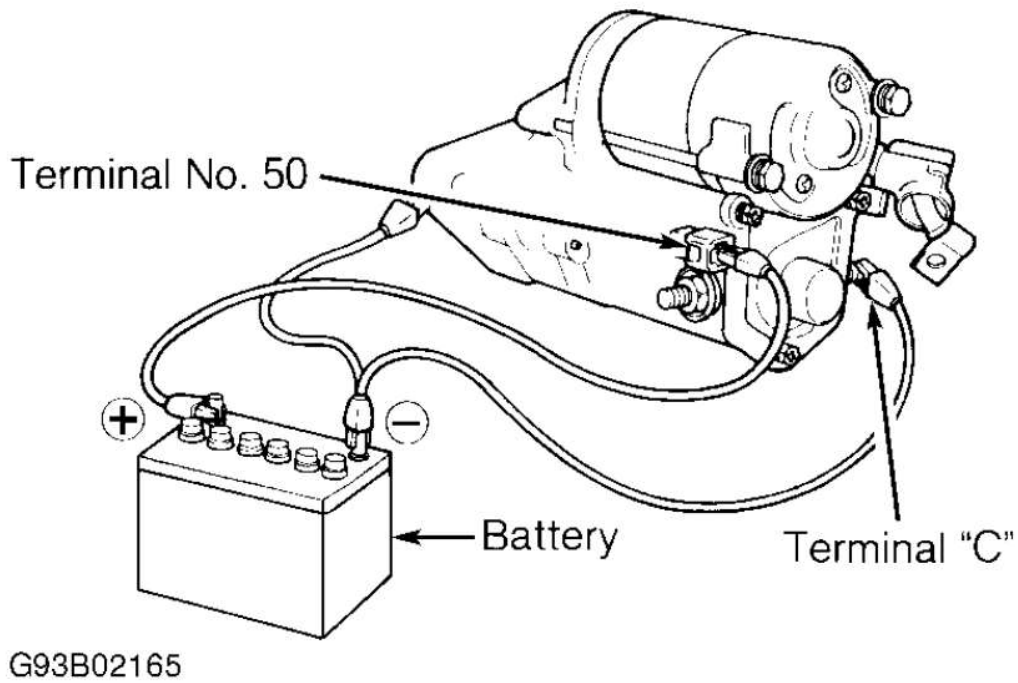


Fig. 14: Solenoid Pull-In Coil Test (Celica Shown; ECHO, MR2, Land Cruiser, RAV4, & Tacoma 4-Cyl. Are Similar)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

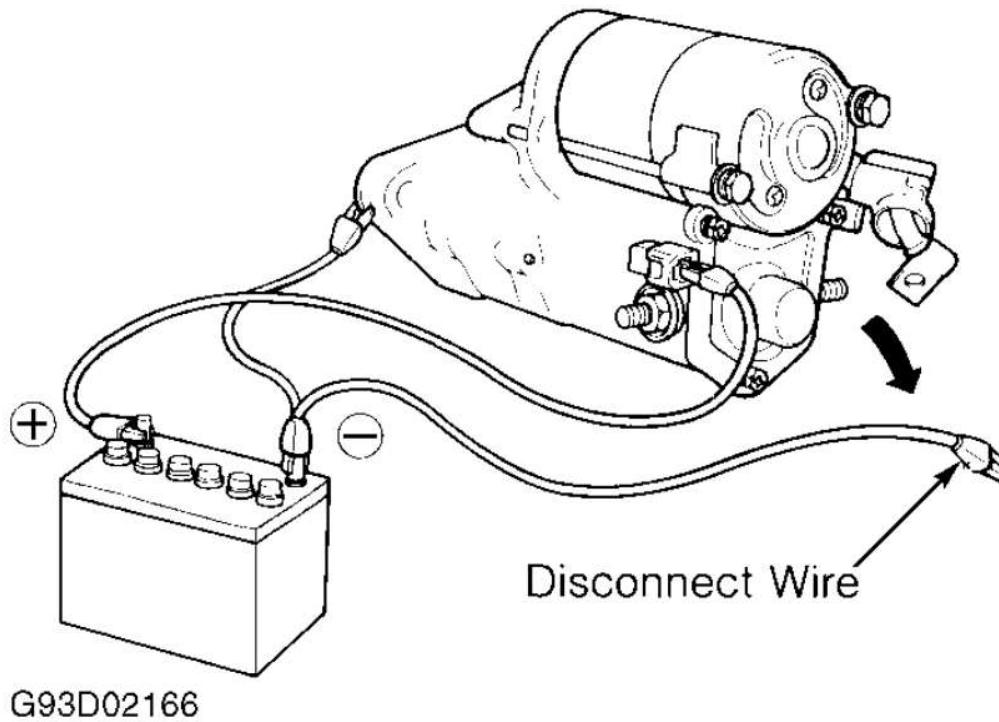


Fig. 15: Solenoid Hold-In Coil Test (Celica Shown; ECHO, MR2, Land Cruiser, RAV4, & Tacoma 4-Cyl. Are Similar)

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

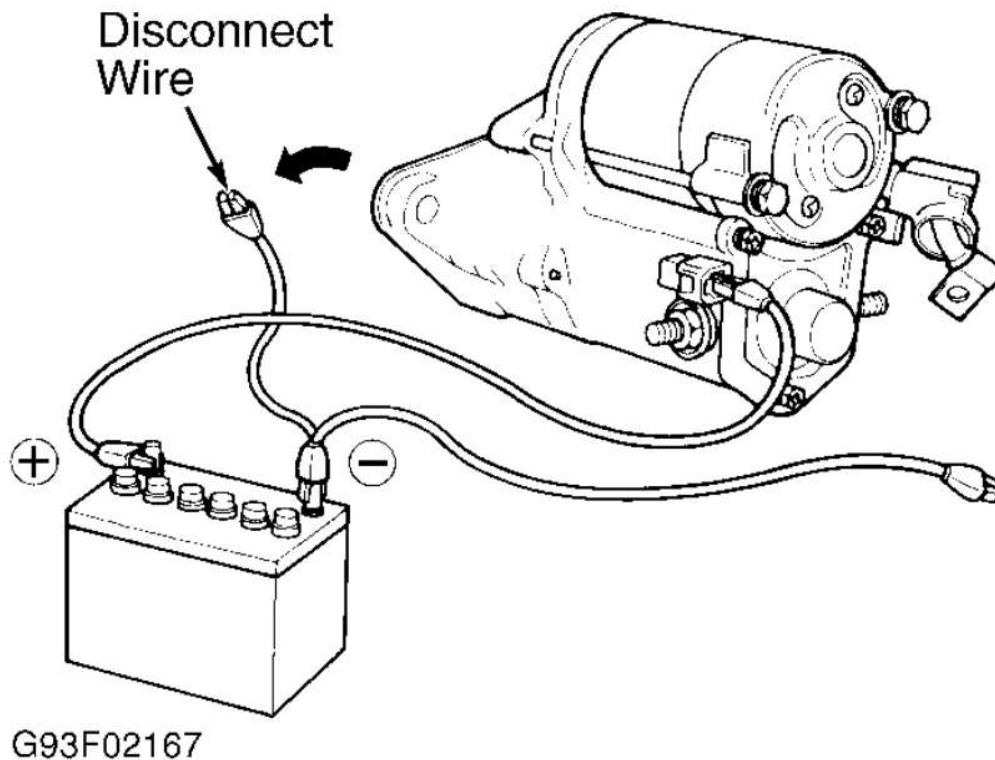


Fig. 16: Solenoid Drive Pinion Return Test (Celica Shown; ECHO, MR2, Land Cruiser, RAV4, & Tacoma 4-Cyl. Are Similar)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ARMATURE COIL

1. Using ohmmeter, check for continuity between armature coil core and insulation between commutator segments. If continuity is present, replace armature. Check armature for short circuits using a growler. Replace armature as necessary.
2. Check for continuity between segments of commutator. If continuity is not present between any segment, replace armature.

BRUSHES & SPRINGS

1. Check brush length. If length is less than specification, replace brushes. See **STARTER SPECIFICATIONS**. If brushes are okay, go to next step.
2. Check brush holders, springs, spring clip and insulation between positive and negative holders. Verify no continuity exists between positive and negative brush holders. Repair or replace components as needed.

CLUTCH ASSEMBLY & GEARS

1. Inspect teeth on pinion gear, idler gear and clutch assembly for wear or damage. If damaged, replace gear or clutch assembly and inspect flywheel ring gear for wear or damage.
2. Inspect clutch pinion gear by rotating pinion gear. Depending on engine, pinion gear will rotate freely in one direction and lock when rotated in opposite direction. On Avalon, Camry, Camry Solara, Celica, RAV4 and Sienna, clutch pinion gear will lock when rotated in a clockwise direction. On all other models, pinion gear will lock in a counterclockwise direction. Replace clutch assembly as necessary.

COMMUTATOR

1. If commutator surface is dirty or burnt, it can be cleaned with No. 400 grit sandpaper or on a lathe. If commutator runout (out-of-round) is more than .002" (.05 mm), turn commutator on a lathe. If commutator diameter is less than minimum, replace armature. See **STARTER SPECIFICATIONS**.
2. Ensure undercut depth between commutator segments are clean, free of debris, and that edges are smooth. Minimum undercut depth is .008" (.20 mm). If undercut depth is less than minimum, use a hacksaw blade to correct to a depth of .008-.024" (.20-.60 mm).

FIELD FRAME (FIELD COIL)

Verify continuity between lead wire and field coil brush lead. If continuity is not present, replace field coil. Verify there is no continuity between field coil end and field frame. If continuity exists, replace or repair field frame.

REMOVAL & INSTALLATION

STARTER

Removal & Installation (Avalon, Camry, Camry Solara & Sienna)

1. Disconnect negative battery cable and then positive cable. Remove battery and tray. If equipped with cruise control, remove cruise control actuator cover, cruise control actuator and actuator bracket from body mount.
2. On all models, remove starter terminal/wire cover and remove starter wires. Remove starter. To install, reverse removal procedure. Tighten starter bolts to specification. See **TORQUE SPECIFICATIONS**.

Removal & Installation (Celica)

1. Disconnect negative battery cable. Disconnect air intake temperature sensor connector from air cleaner assembly. If equipped, remove cruise control actuator cable from clamps.
2. On California models, remove air hose for idle-up from air cleaner hose. On all models, disconnect 4 clamps, and disconnect air cleaner cap from air cleaner case. Loosen hose clamp, and disconnect air cleaner hose from throttle body.
3. Remove air cleaner cap and air cleaner hose assembly. Remove air filter. Disconnect 2 engine wires from clamps on air cleaner case. Remove 3 bolts and air cleaner case. Remove battery. If equipped with cruise

control, disconnect cruise control actuator connector.

4. Remove 3 bolts, and disconnect actuator from body bracket. On all models, disconnect starter connector. Remove nut, and disconnect starter cable. Remove 2 bolts, and disconnect oxygen sensor connector and engine wire brackets from starter. Remove starter. To install, reverse removal procedure. Tighten starter bolts to specification. See **TORQUE SPECIFICATIONS** .

Removal & Installation (Corolla)

1. Disconnect negative battery cable and then positive cable. Remove battery and tray. Remove engine coolant reservoir. Remove engine splash shield from underneath right side of compartment.
2. Remove starter terminal/wire cover and remove starter wires. Remove starter bolts and starter. Note starter mounting bolt locations (bolts are different lengths). To install, reverse removal procedure. Tighten starter bolts to specification. See **TORQUE SPECIFICATIONS** .

Removal & Installation (Land Cruiser, Sequoia & Tundra V8)

1. Starter is located underneath intake manifold. See **Fig. 17** . Disconnect negative battery cable. Remove cover from top of engine. Remove air cleaner intake hose. Disconnect accelerator cable. Remove intake manifold. See CYLINDER HEAD & MANIFOLDS in 4.7L article in ENGINES.
2. Remove starter wires and remove starter. To install, reverse removal procedure. Tighten starter bolts to specification. See **TORQUE SPECIFICATIONS** .

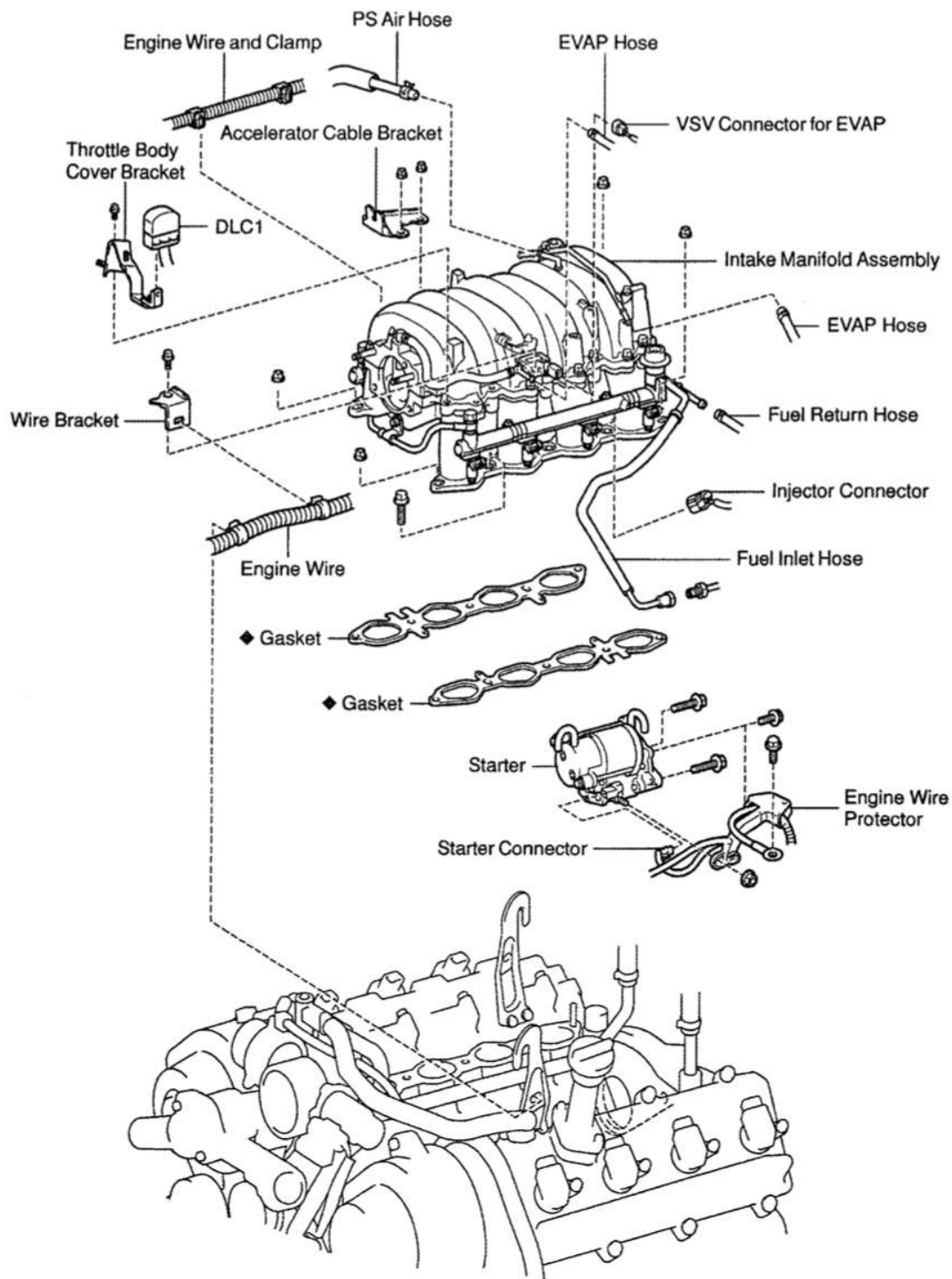


Fig. 17: Locating Intake Manifold & Starter Components (Land Cruiser, Sequoia & Tundra V8)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Removal & Installation (ECHO & MR2)

Disconnect negative battery cable. Remove front engine under cover. Disconnect starter connector. Remove starter cable nut. Disconnect starter cable. Remove starter wires and remove starter. To install, reverse removal procedure. Tighten starter bolts to specification. See **TORQUE SPECIFICATIONS** .

Removal & Installation (Highlander & RAV4)

Disconnect negative battery cable. Remove engine coolant reservoir. Disconnect relay connectors, PCV hose, intake air temperature sensor connector, air cleaner intake hose, remaining hoses and lines for air cleaner removal. Remove air cleaner assembly. Disconnect starter connector. Remove starter wires and remove starter. To install, reverse removal procedure. Tighten starter bolts to specification. See **TORQUE SPECIFICATIONS** .

Removal & Installation (Tacoma, Tundra V6 & 4Runner)

Removal and installation is basically an unbolt and bolt-on procedure. Tighten starter bolts to specification. See **TORQUE SPECIFICATIONS** .

OVERHAUL

NOTE: See **Fig. 18** for overhaul procedure.

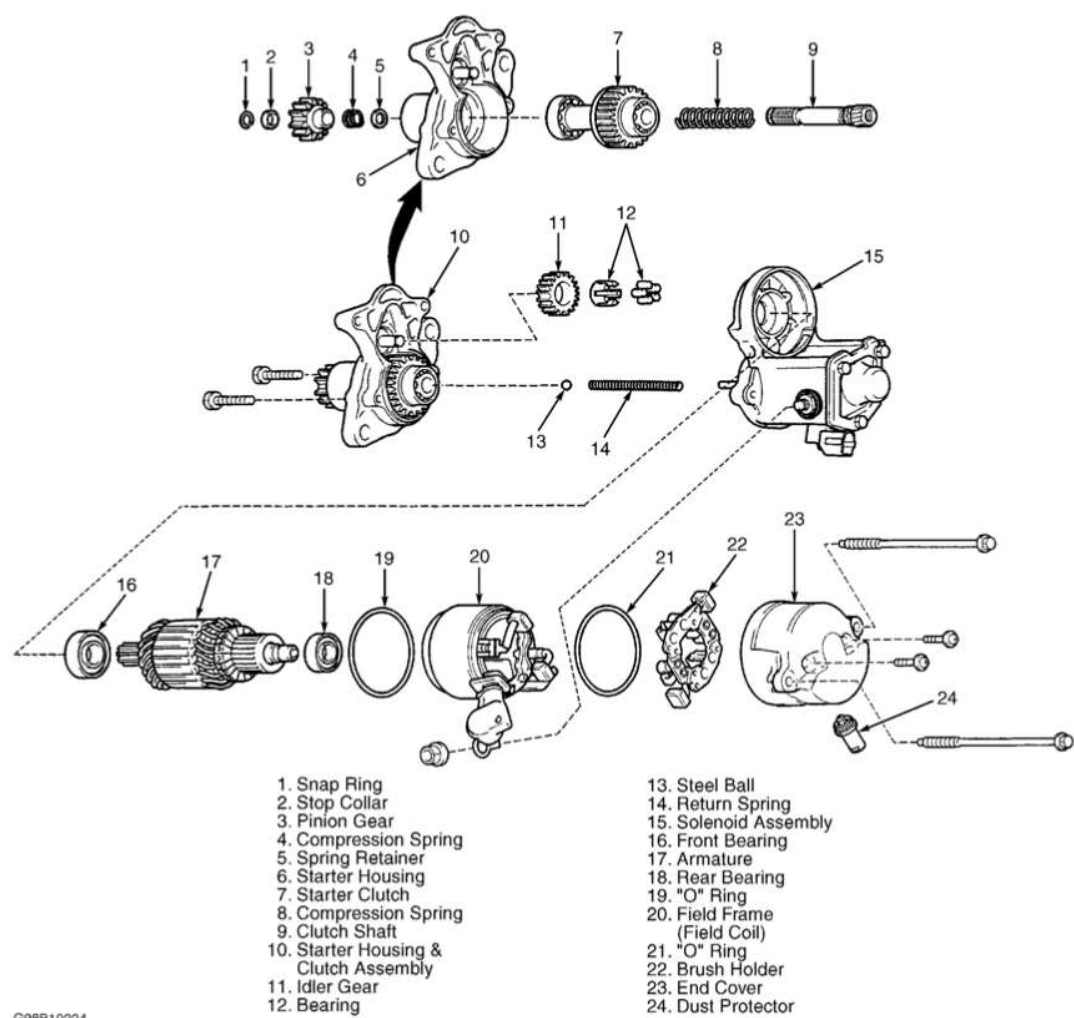


Fig. 18: Exploded View Of Reduction Gear Starter (Avalon Shown; All Others Are Similar)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

STARTER SPECIFICATIONS

STARTER SPECIFICATIONS (4-CYLINDER)

Application	Specification
Camry & Camry Solara	
Brush Holder Length	
Standard	.354" (9.00 mm)
Minimum	.157" (4.00 mm)
Commutator	
Runout	
Standard	.0008" (.020 mm)

Maximum	.0020" (.050 mm)
Length	
Standard	.1299" (3.300 mm)
Maximum	.1575" (4.000 mm)
Snap Ring End Gap	.1969" (5.000 mm)
Celica & Corolla	
Brush Length	
Standard	.610" (15.50 mm)
Minimum	.394" (10.00 mm)
Brush Spring Load	
1.2 kW	
Standard	3.09-4.41 Lbs. (1.4-2.0 kg)
Minimum	1.98 Lbs. (.9 kg)
1.4 kW	
Standard	3.97-5.29 Lbs. (1.8-2.4 kg)
Minimum	2.64 Lbs. (1.2 kg)
Commutator	
Diameter	
Standard	1.181" (30.00 mm)
Minimum	1.142" (29.00 mm)
Undercut Depth	
Standard	.024" (.60 mm)
Minimum	.008" (.20 mm)
Maximum Runout	.002" (.05 mm)
ECHO	
Brush Length	
Standard	.551" (14.00 mm)
Minimum	.354" (9.00 mm)
Brush Spring Load	
Standard	3.09-3.97 Lbs. (1.4-1.8 kg)
Minimum	1.98 Lbs. (.9 kg)
Commutator	
Diameter	
Standard	1.102" (28.00 mm)
Minimum	1.063" (27.00 mm)
Undercut Depth	
Standard	.024" (.60 mm)
Minimum	.008" (.20 mm)
Maximum Runout	.002" (.05 mm)
Highlander	
Brush Length	

	.610" (15.50 mm)
Minimum	.335" (8.50 mm)
Brush Spring Load	(1)
Commutator	
Diameter	
Standard	1.181" (30.00 mm)
Minimum	1.142" (29.00 mm)
Undercut Depth	
Standard	.024" (.60 mm)
Minimum	.008" (.20 mm)
Maximum Runout	.002" (.05 mm)
MR2	
Brush Length	
Standard	.610" (15.50 mm)
Minimum	.394" (10.00 mm)
Brush Spring Load	
Standard	3.97-5.29 Lbs. (1.8-2.4 kg)
Minimum	2.64 Lbs. (1.2 kg)
Commutator	
Diameter	
Standard	1.181" (30.00 mm)
Minimum	1.142" (29.00 mm)
Undercut Depth	
Standard	.024" (.60 mm)
Minimum	.008" (.20 mm)
Maximum Runout	.002" (.05 mm)
RAV4	
Brush Length	
Standard	.610" (15.50 mm)
Minimum	.334" (8.50 mm)
Brush Spring Load	
1.2 kW	
Standard	3.09-4.41 Lbs. (1.4-2.0 kg)
Minimum	1.98 Lbs. (.9 kg)
1.4 kW	
Standard	3.97-5.29 Lbs. (1.8-2.4 kg)
Minimum	2.64 Lbs. (1.2 kg)
Commutator	
Diameter	
Standard	1.181" (30.00 mm)

Minimum	1.142" (29.00 mm)
Undercut Depth	
Standard	.024" (.60 mm)
Minimum	.008" (.20 mm)
Maximum Runout	.002" (.05 mm)
Tacoma	
Brush Length	
1.4 kW	
Standard	.610" (15.50 mm)
Minimum	.394" (10.00 mm)
2.0 kW	
Standard	.591" (15.00 mm)
Minimum	.354" (9.00 mm)
Brush Spring Load	
1.4 kW	
Standard	3.97-5.29 Lbs. (1.8-2.4 kg)
Minimum	2.64 Lbs. (1.2 kg)
2.0 kW	
Standard	4.85-6.17 Lbs. (2.2-2.8 kg)
Minimum	2.86 Lbs. (1.3 kg)
Commutator	
Diameter	
1.4 kW	
Standard	1.181" (30.00 mm)
Minimum	1.142" (29.00 mm)
2.0 kW	
Standard	1.378" (35.00 mm)
Minimum	1.338" (34.00 mm)
Undercut Depth	
1.4 kW	
Standard	.024" (.60 mm)
Minimum	.008" (.20 mm)
2.0 kW	
Standard	.028" (.70 mm)
Minimum	.008" (.20 mm)
Maximum Runout	.002" (.05 mm)
(1) Information not available from manufacturer.	

STARTER SPECIFICATIONS (V6)

Application	Specification
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Avalon	
Brush Length	
Standard	.610" (15.50 mm)
Minimum	.394" (10.00 mm)
Brush Spring Load	
Standard	3.97-5.29 Lbs. (1.8-2.4 kg)
Minimum	2.6 Lbs. (1.2 kg)
Commutator	
Diameter	
Standard	1.181" (30.00 mm)
Minimum	1.142" (29.00 mm)
Undercut Depth	
Standard	.024" (.60 mm)
Minimum	.008" (.20 mm)
Maximum Runout	.002" (.05 mm)
Camry	
Brush Holder Length	
Standard	.354" (9.00 mm)
Minimum	.157" (4.00 mm)
Commutator	
Runout	
Standard	.0008" (.020 mm)
Maximum	.0020" (.050 mm)
Length	
Standard	.1299" (3.300 mm)
Maximum	.1575" (4.000 mm)
Snap Ring End Gap	.1969" (5.000 mm)
Camry Solara	
Brush Length	
Standard	.610" (15.50 mm)
Minimum	.394" (10.00 mm)
Brush Spring Load	
Standard	3.97-5.29 Lbs. (1.8-2.4 kg)
Minimum	2.64 Lbs. (1.2 kg)
Commutator	
Diameter	
Standard	1.181" (30.00 mm)
Minimum	1.142" (29.00 mm)
Undercut Depth	
Standard	.024" (.60 mm)
Minimum	.008" (.20 mm)

	.002" (.05 mm)
Highlander	
Brush Length	
Standard	.610" (15.50 mm)
Minimum	.335" (8.50 mm)
Brush Spring Load (1)	
Commutator	
Diameter	
Standard	1.181" (30.00 mm)
Minimum	1.142" (29.00 mm)
Undercut Depth	
Standard	.024" (.60 mm)
Minimum	.008" (.20 mm)
Maximum Runout	.002" (.05 mm)
Sienna	
Brush Length	
Standard	.610" (15.50 mm)
Minimum	.394" (10.00 mm)
Brush Spring Load	
Standard	3.97-5.29 Lbs. (1.8-2.4 kg)
Minimum	2.64 Lbs. (1.2 kg)
Commutator	
Diameter	
Standard	1.181" (30.00 mm)
Minimum	1.142" (29.00 mm)
Undercut Depth	
Standard	.024" (.60 mm)
Minimum	.008" (.20 mm)
Maximum Runout	.002" (.05 mm)
Tacoma & 4Runner	
Brush Length	
1.4 kW	
Standard	.610" (15.50 mm)
Minimum	.394" (10.00 mm)
1.8 kW	
Standard	.591" (15.00 mm)
Minimum	.354" (9.00 mm)
Brush Spring Load	
1.4 kW	
Standard	3.97-5.29 Lbs. (1.8-2.4 kg)

Minimum	2.64 Lbs. (1.2 kg)
1.8 kW	
Standard	4.85-6.17 Lbs. (2.2-2.8 kg)
Minimum	2.86 Lbs. (1.3 kg)
Commutator	
Diameter	
1.4 kW	
Standard	1.181" (30.00 mm)
Minimum	1.142" (29.00 mm)
1.8 kW	
Standard	1.378" (35.00 mm)
Minimum	1.338" (34.00 mm)
Undercut Depth	
1.4 kW	
Standard	.024" (.60 mm)
Minimum	.008" (.20 mm)
1.8 kW	
Standard	.028" (.70 mm)
Minimum	.008" (.20 mm)
Maximum Runout	.002" (.05 mm)
Tundra	
Brush Length	
1.2 kW & 1.4 kW	
Standard	.610" (15.50 mm)
Minimum	.394" (10.00 mm)
1.8 kW	
Standard	.591" (15.00 mm)
Minimum	.354" (9.00 mm)
Brush Spring Load	
1.2 kW	
Standard	3.09-4.40 Lbs. (1.4-2.0 kg)
Minimum	2.20 Lbs. (1.0 kg)
1.4 kW	
Standard	3.97-5.29 Lbs. (1.8-2.4 kg)
Minimum	2.64 Lbs. (1.2 kg)
1.8 kW	
Standard	4.85-6.17 Lbs. (2.2-2.8 kg)
Minimum	2.86 Lbs. (1.3 kg)
Commutator	
Diameter	
1.2 kW & 1.4 kW	

	1.181" (30.00 mm)
Minimum	1.142" (29.00 mm)
1.8 kW	
Standard	1.378" (35.00 mm)
Minimum	1.338" (34.00 mm)
Undercut Depth	
1.2 kW & 1.4 kW	
Standard	.024" (.60 mm)
Minimum	.008" (.20 mm)
1.8 kW	
Standard	.028" (.70 mm)
Minimum	.008" (.20 mm)
(1) Information not available from manufacturer.	

STARTER SPECIFICATIONS (V8)

Application	Specification
Land Cruiser	
Brush Length	
Standard	.591" (15.00 mm)
Minimum	.354" (9.00 mm)
Brush Spring Load	
Standard	4.85-6.17 Lbs. (2.2-2.8 kg)
Minimum	2.86 Lbs. (1.3 kg)
Commutator	
Diameter	
Standard	1.378" (35.00 mm)
Minimum	1.338" (34.00 mm)
Undercut Depth	
Standard	.028" (.70 mm)
Minimum	.008" (.20 mm)
Maximum Runout	.002" (.05 mm)
Sequoia	
Brush Length	
1.4 kW	
Standard	.610" (15.50 mm)
Minimum	.334" (8.50 mm)
2.0 kW	
Standard	.591" (15.00 mm)
Minimum	.354" (9.00 mm)
Brush Spring Load	

1.4 kW	
Standard	3.97-4.63 Lbs. (1.8-2.1 kg)
Minimum	2.64 Lbs. (1.2 kg)
2.0 kW	
Standard	4.85-6.17 Lbs. (2.2-2.8 kg)
Minimum	2.86 Lbs. (1.3 kg)
Commutator	
Diameter	
Standard	1.378" (35.00 mm)
Minimum	1.338" (34.00 mm)
Undercut Depth	
Standard	.028" (.70 mm)
Minimum	.008" (.20 mm)
Maximum Runout	.002" (.05 mm)
Tundra	
Brush Length	
1.4 kW	
Standard	.610" (15.50 mm)
Minimum	.394" (10.00 mm)
2.0 kW	
Standard	.591" (15.00 mm)
Minimum	.354" (9.00 mm)
Brush Spring Load	
1.4 kW	
Standard	3.97-5.29 Lbs. (1.8-2.4 kg)
Minimum	2.64 Lbs. (1.2 kg)
2.0 kW	
Standard	4.85-6.17 Lbs. (2.2-2.8 kg)
Minimum	2.86 Lbs. (1.3 kg)
Commutator	
Diameter	
1.4 kW	
Standard	1.181" (30.00 mm)
Minimum	1.142" (29.00 mm)
2.0 kW	
Standard	1.378" (35.00 mm)
Minimum	1.338" (34.00 mm)
Undercut Depth	
1.4 kW	
Standard	.024" (.60 mm)
Minimum	.008" (.20 mm)

Standard	.028" (.70 mm)
Minimum	.008" (.20 mm)
Maximum Runout	.002" (.05 mm)

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Starter Mounting Bolt	
Avalon	29 (39)
Camry	
2.4L 4-Cyl.	29 (39)
3.0L V6	31 (42)
Camry Solara & Celica	27 (37)
Corolla & ECHO	28 (38)
Highlander	
2.4L 4-Cyl.	29 (39)
3.0L V6	31 (42)
Land Cruiser	29 (39)
MR2 & RAV4	28 (38)
Sequoia	29 (39)
Sienna	27 (37)
Tacoma, Tundra & 4Runner	29 (39)
INCH Lbs. (N.m)	
Starter Through Bolt	
Avalon	52 (5.9)
Camry	53 (6.0)
Camry Solara	
2.4L 4-Cyl.	53 (6.0)
3.0L V6	52 (5.9)
Celica, Corolla, ECHO, Highlander, MR2, RAV4 & Sienna	52 (5.9)
Land Cruiser & Sequoia	82 (9.3)
Tacoma	
1.4 kW	52 (5.9)
1.8 kW & 2.0 kW	82 (9.3)
Tundra	
1.2 kW & 1.4 kW	52 (5.9)
1.8 kW & 2.0 kW	82 (9.3)
4Runner	
1.4 kW	52 (5.9)

1.8 kW	82 (9.3)
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WIRING DIAGRAMS

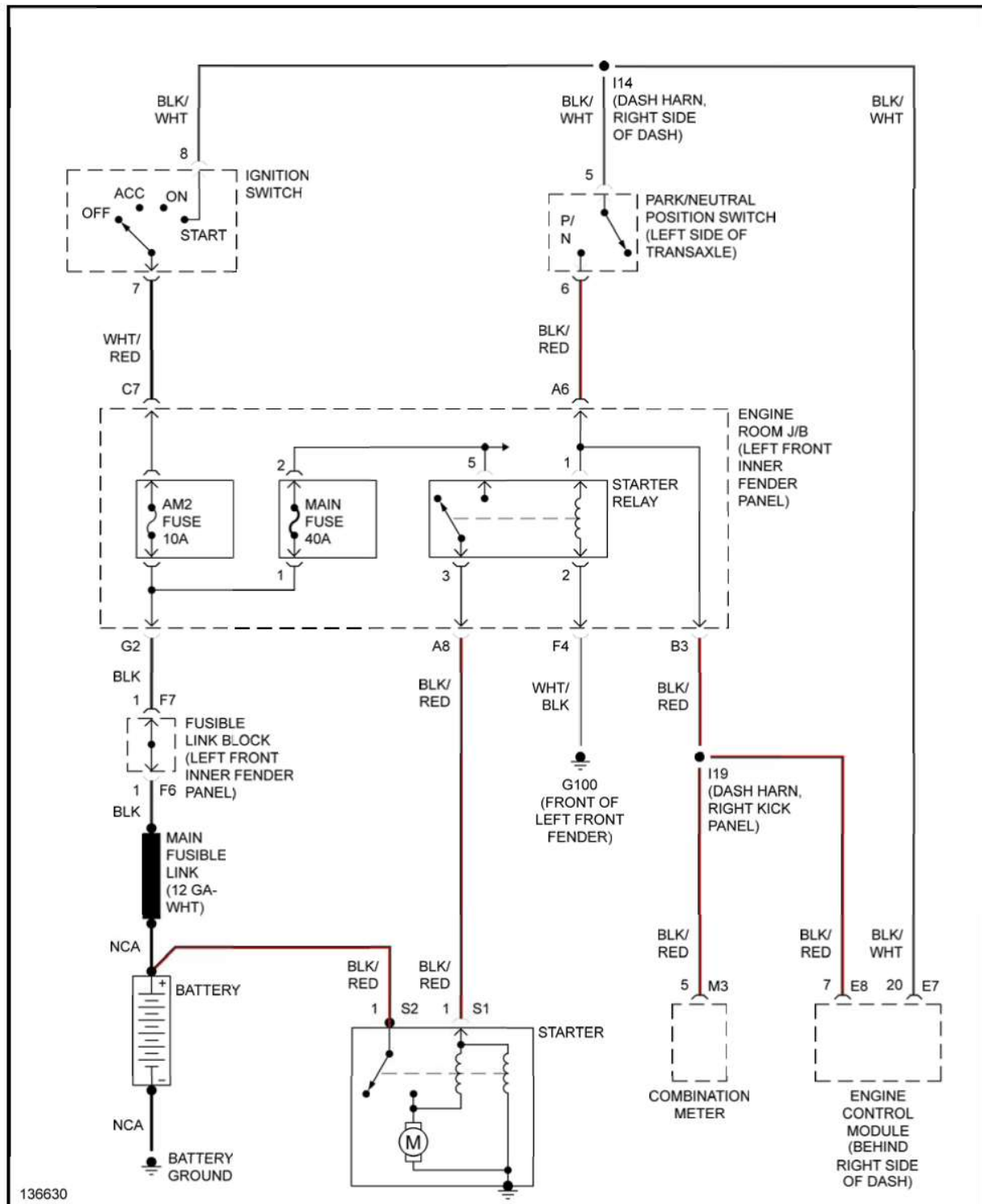
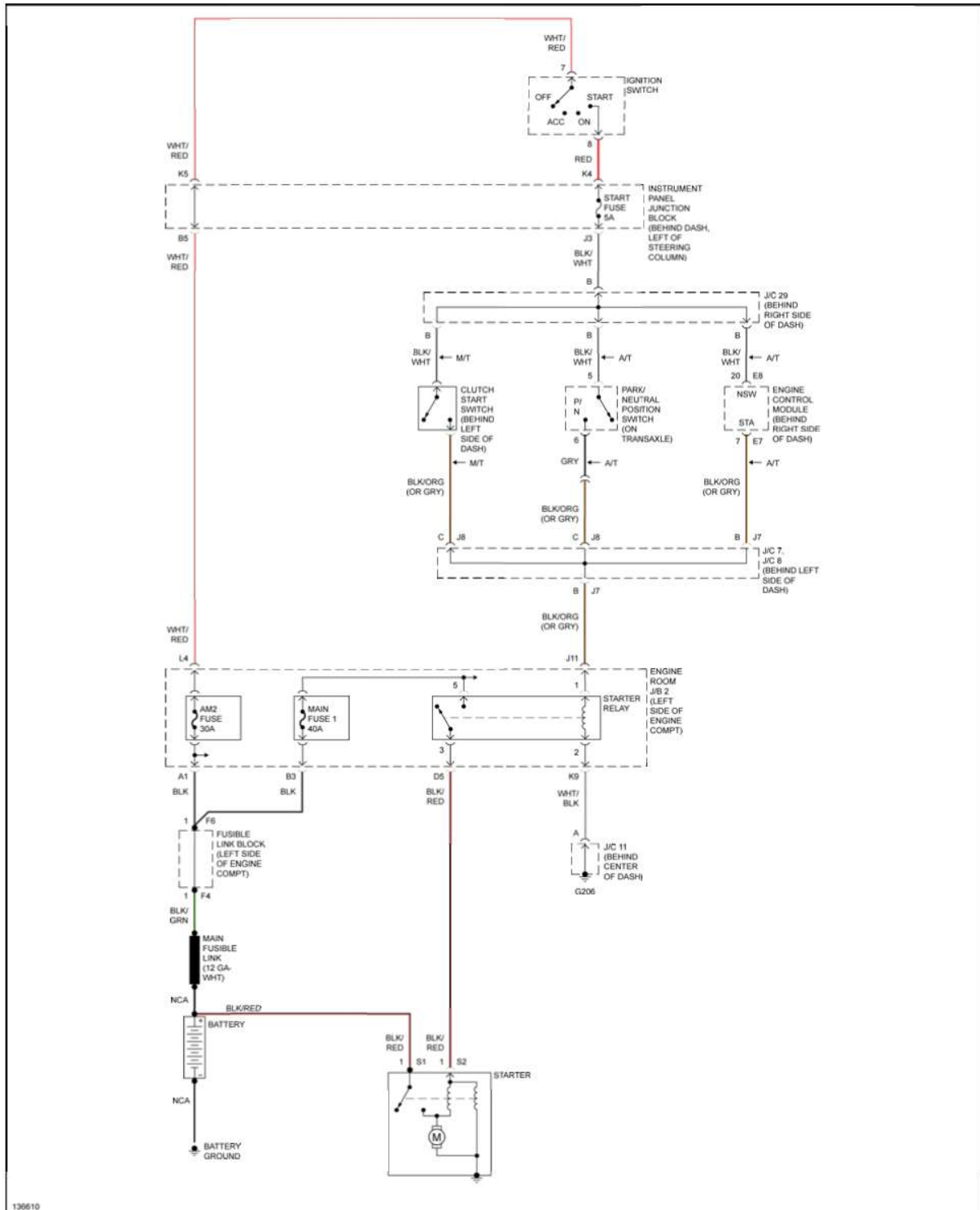


Fig. 19: Starting System Wiring Diagram (Avalon)





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Fig. 20: Starting System Wiring Diagram (Camry - 2.2L & 3.0L)



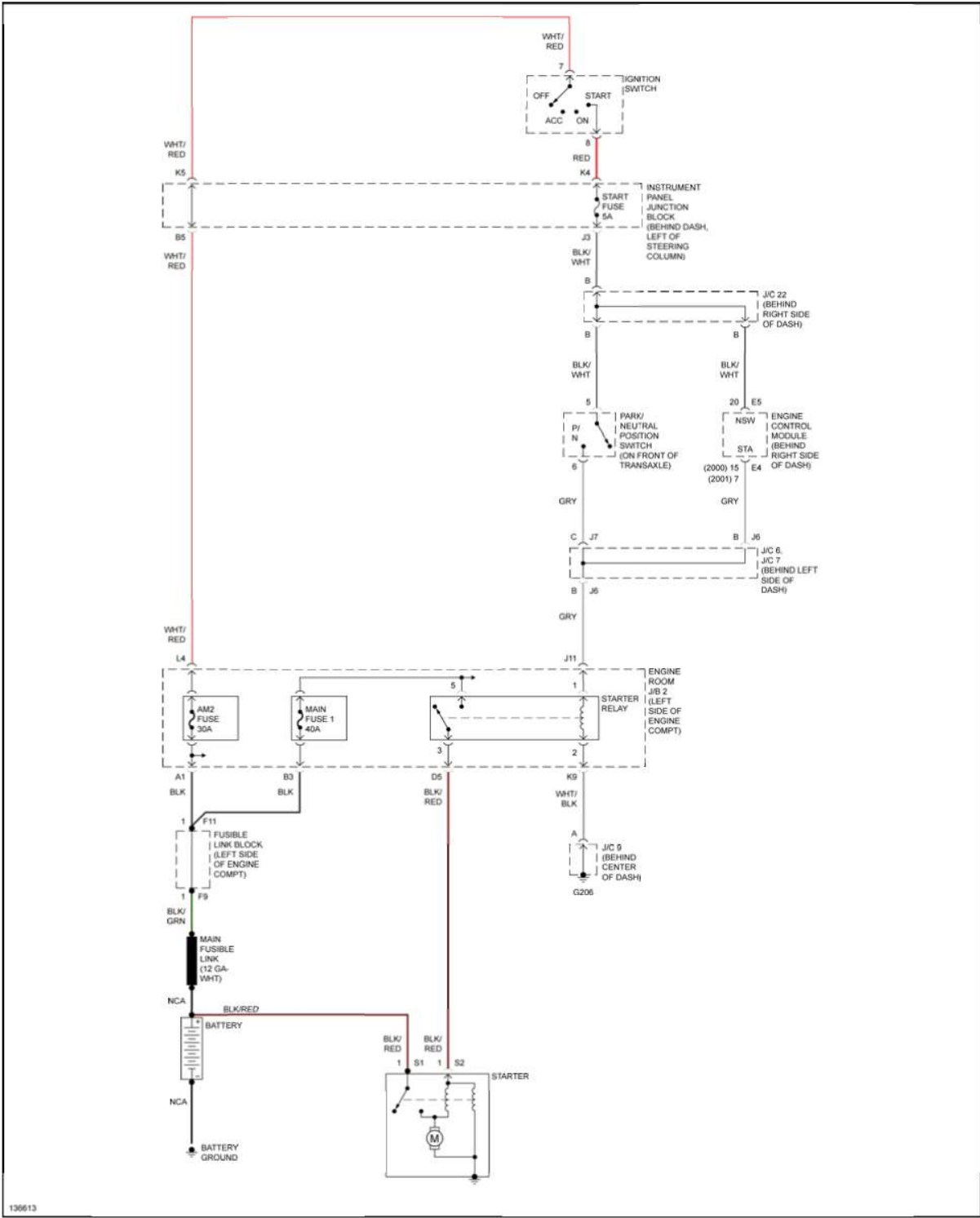


Fig. 21: Starting System Wiring Diagram (Camry - 2.2L CNG)



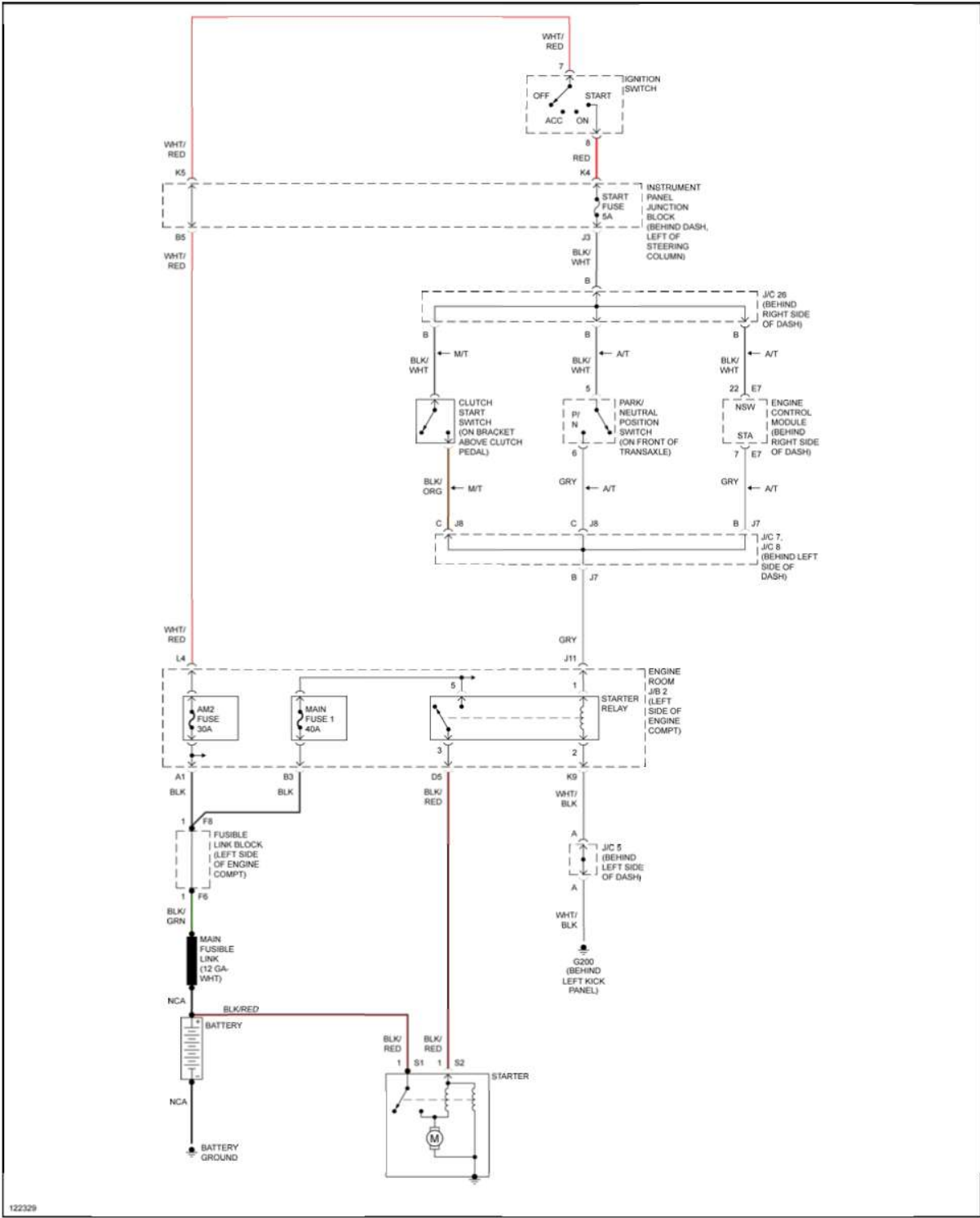


Fig. 22: Starting System Wiring Diagram (Camry Solara)



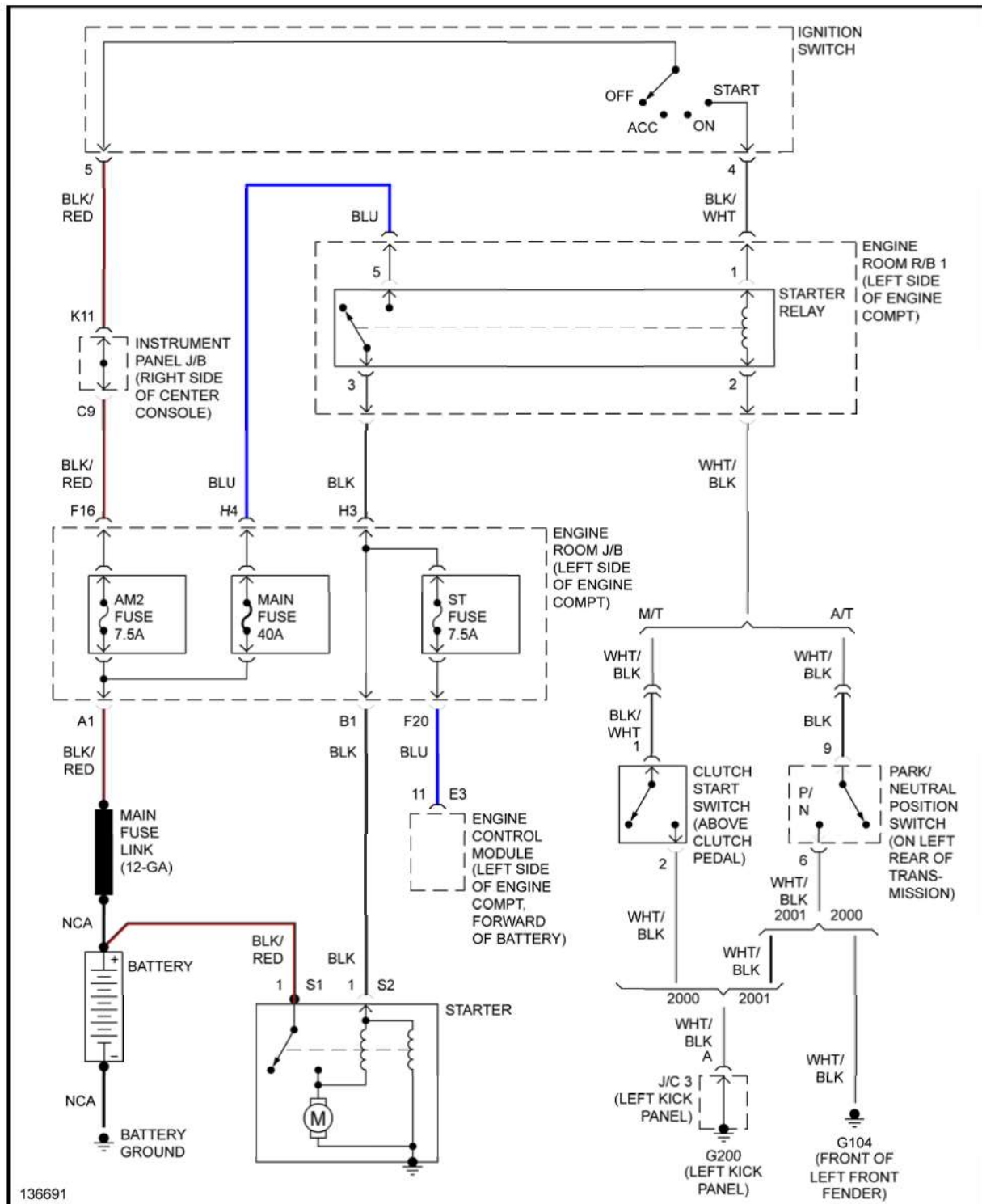


Fig. 23: Starting System Wiring Diagram (Celica)



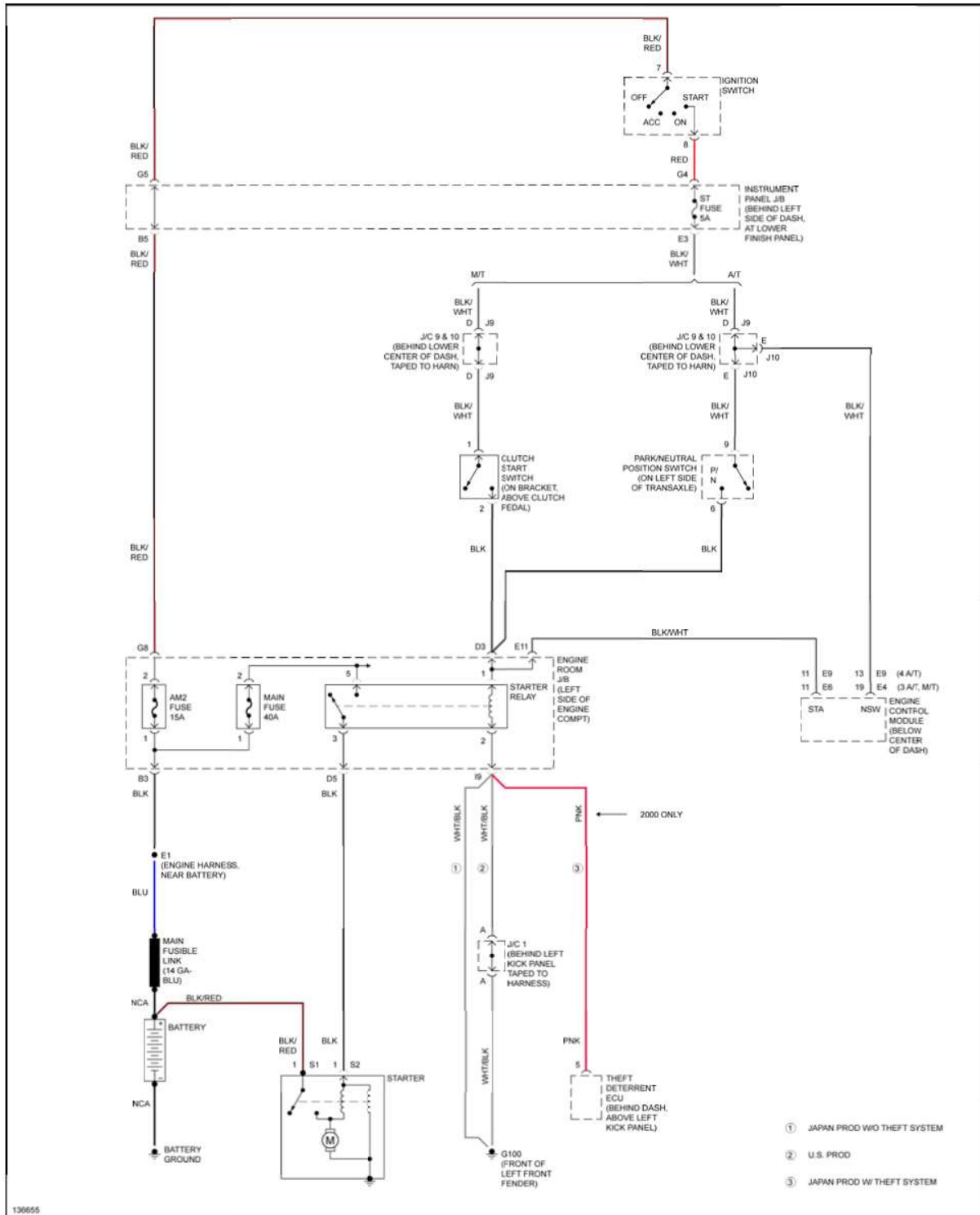


Fig. 24: Starting System Wiring Diagram (Corolla)



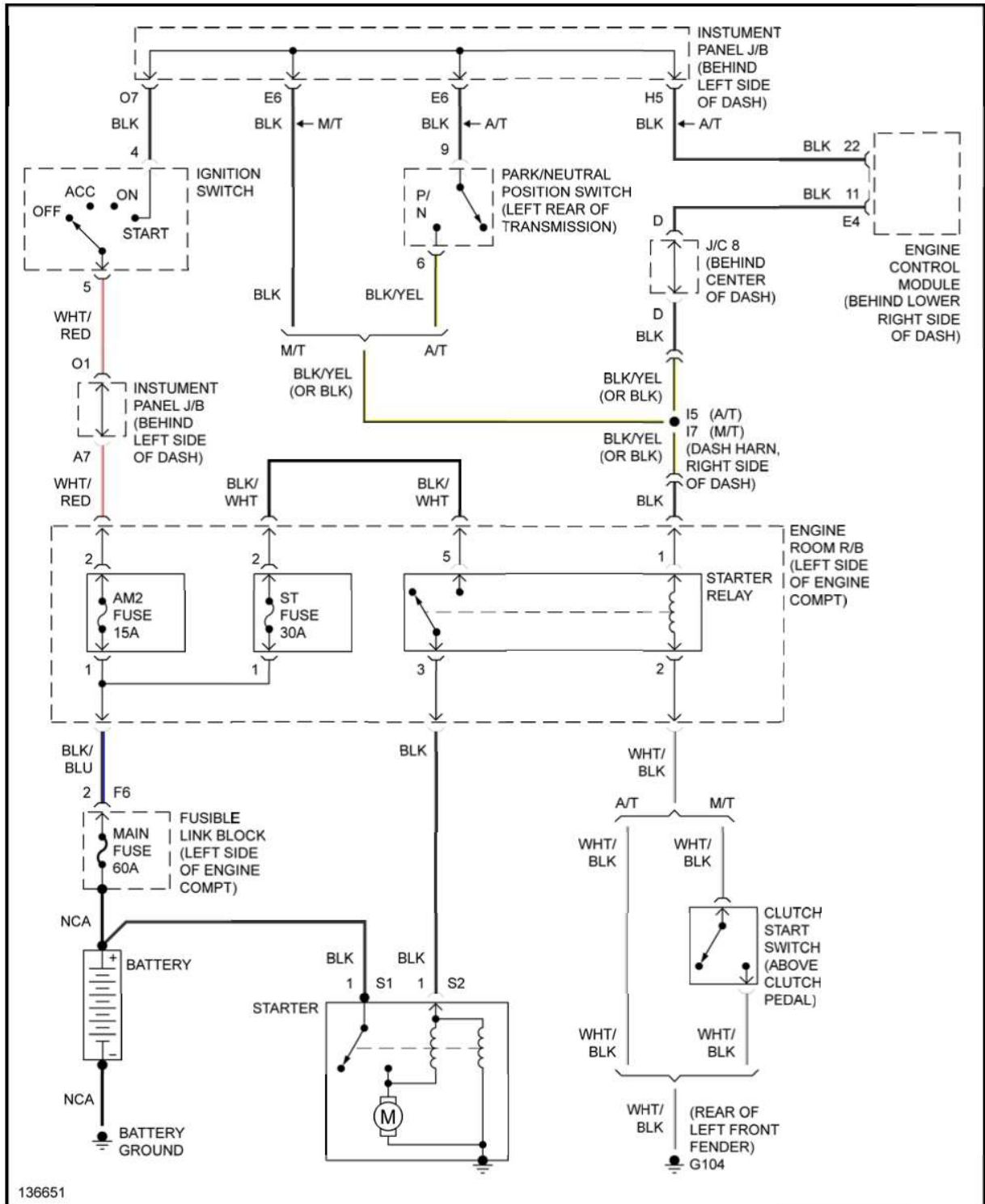


Fig. 25: Starting System Wiring Diagram (ECHO)



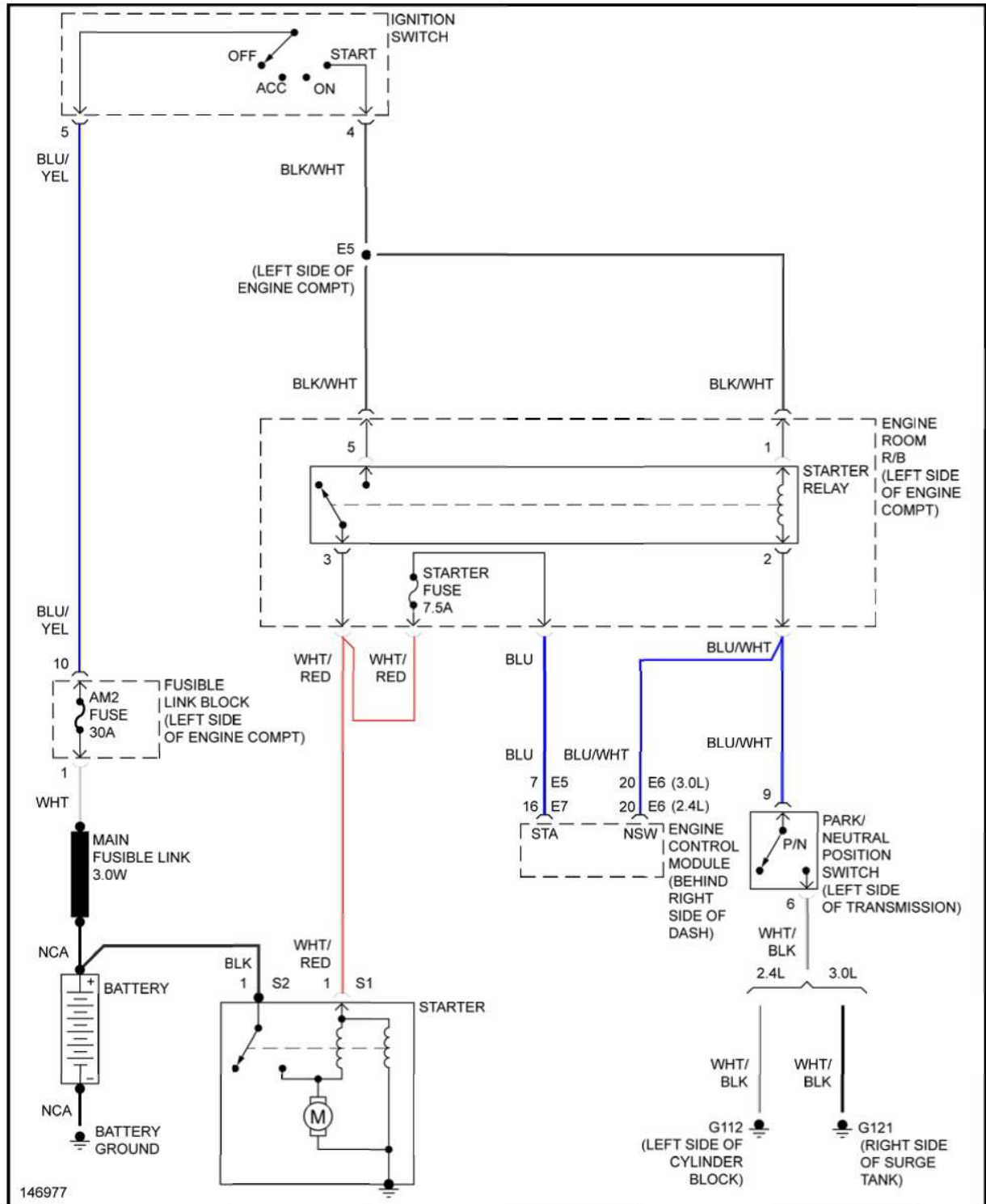


Fig. 26: Starting System Wiring Diagram (Highlander)

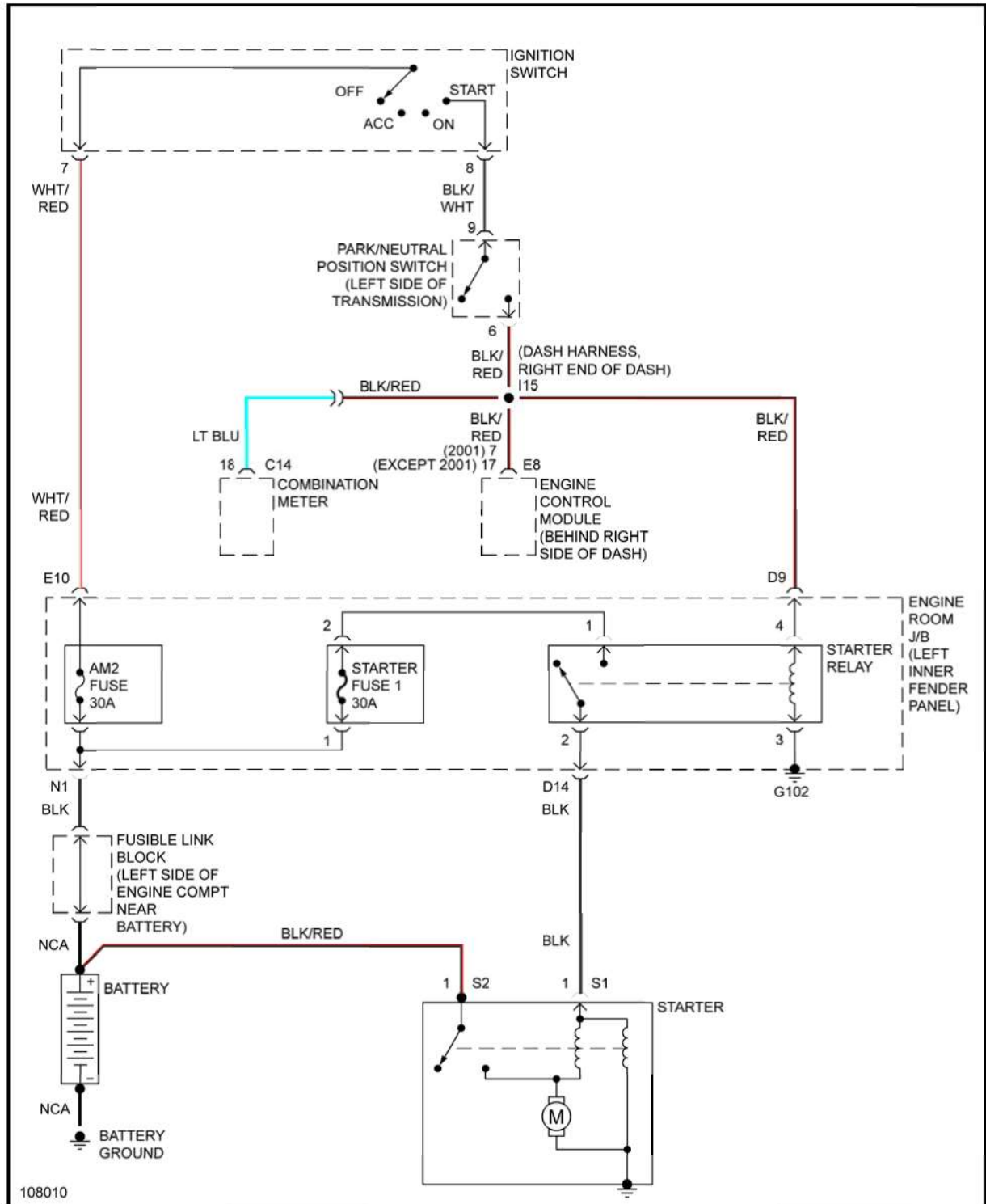


Fig. 27: Starting System Wiring Diagram (Land Cruiser)



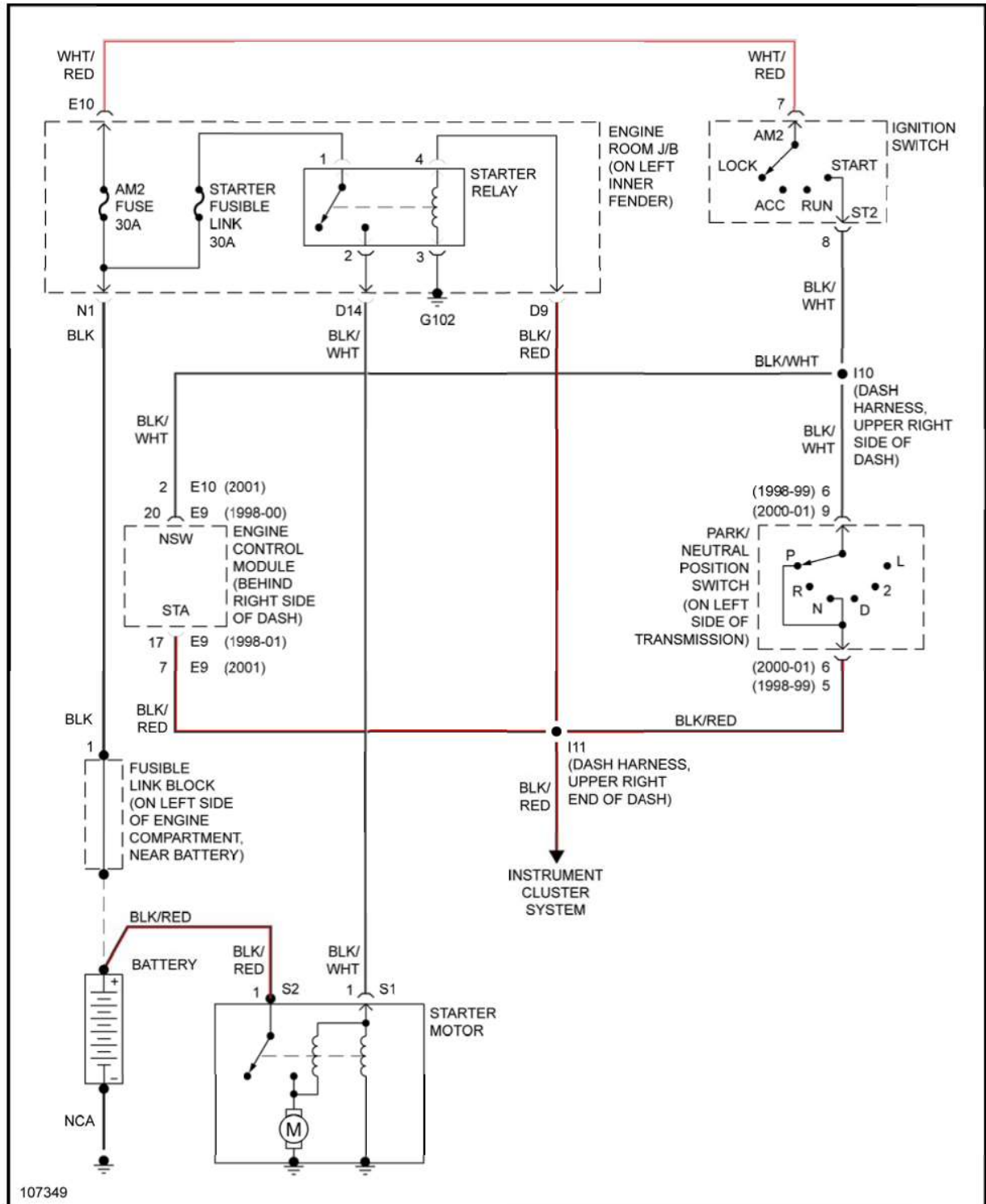


Fig. 28: Starting System Wiring Diagram (Lexus LX470)

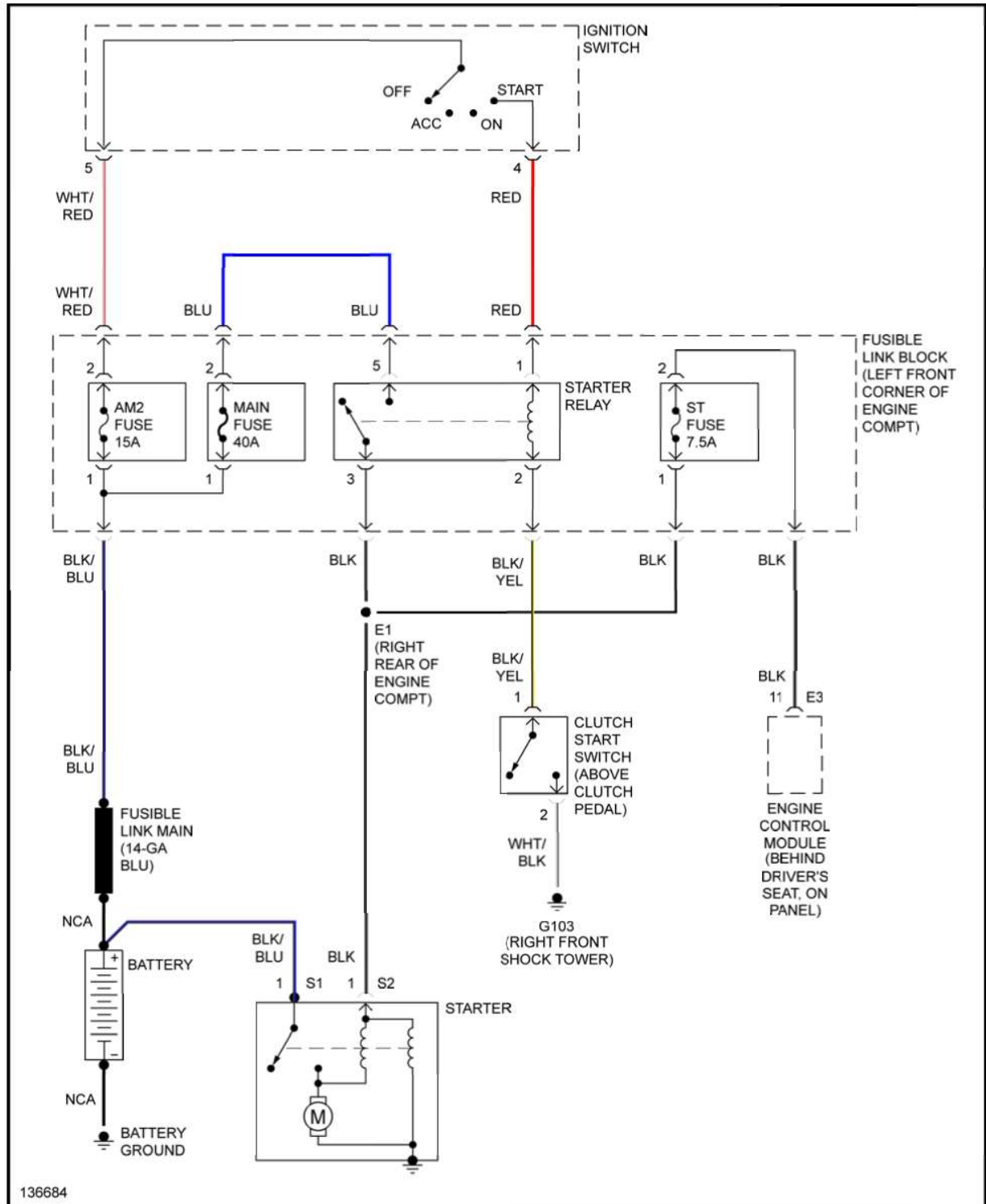


Fig. 29: Starting System Wiring Diagram (MR2)



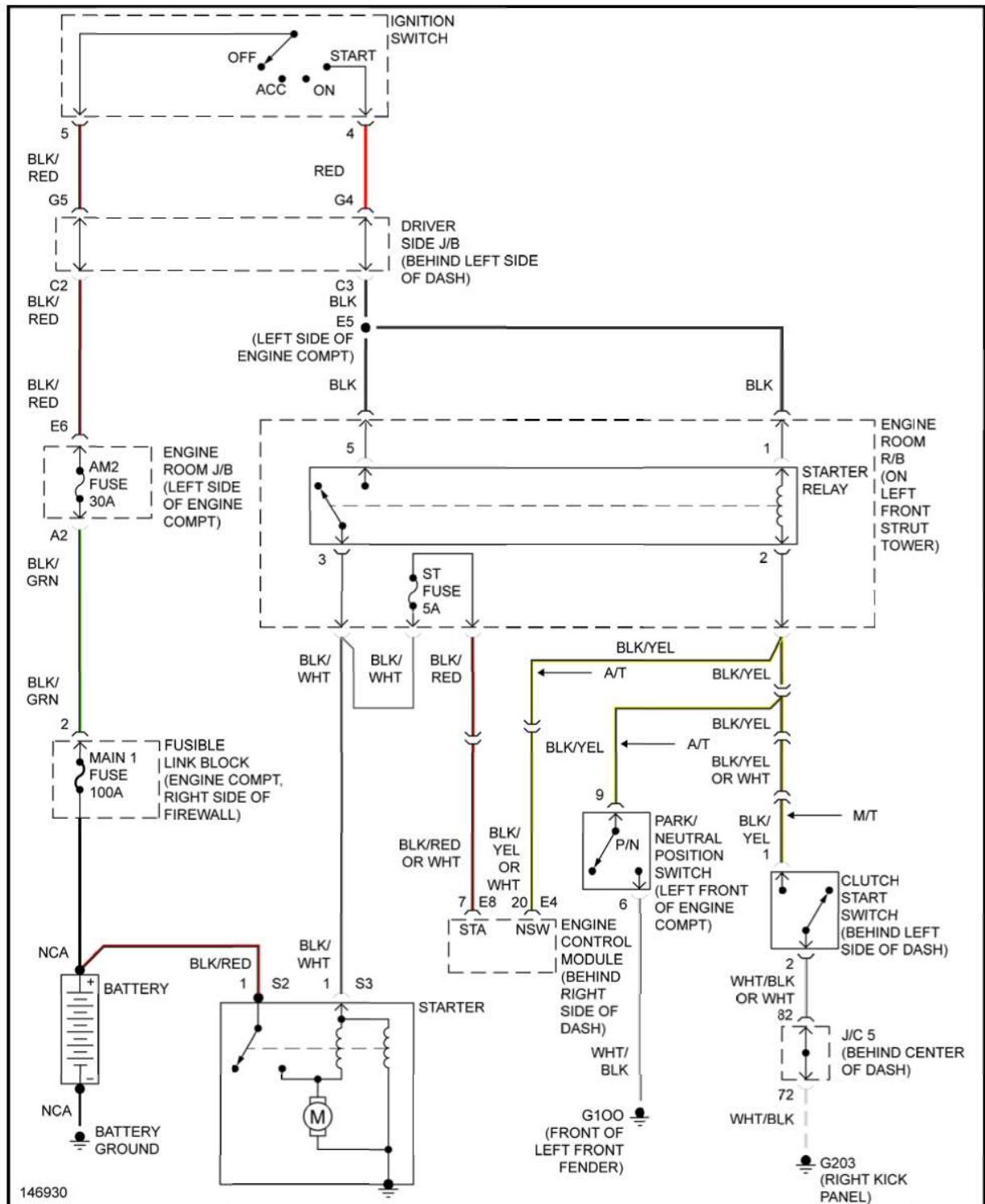


Fig. 30: Starting System Wiring Diagram (RAV4)



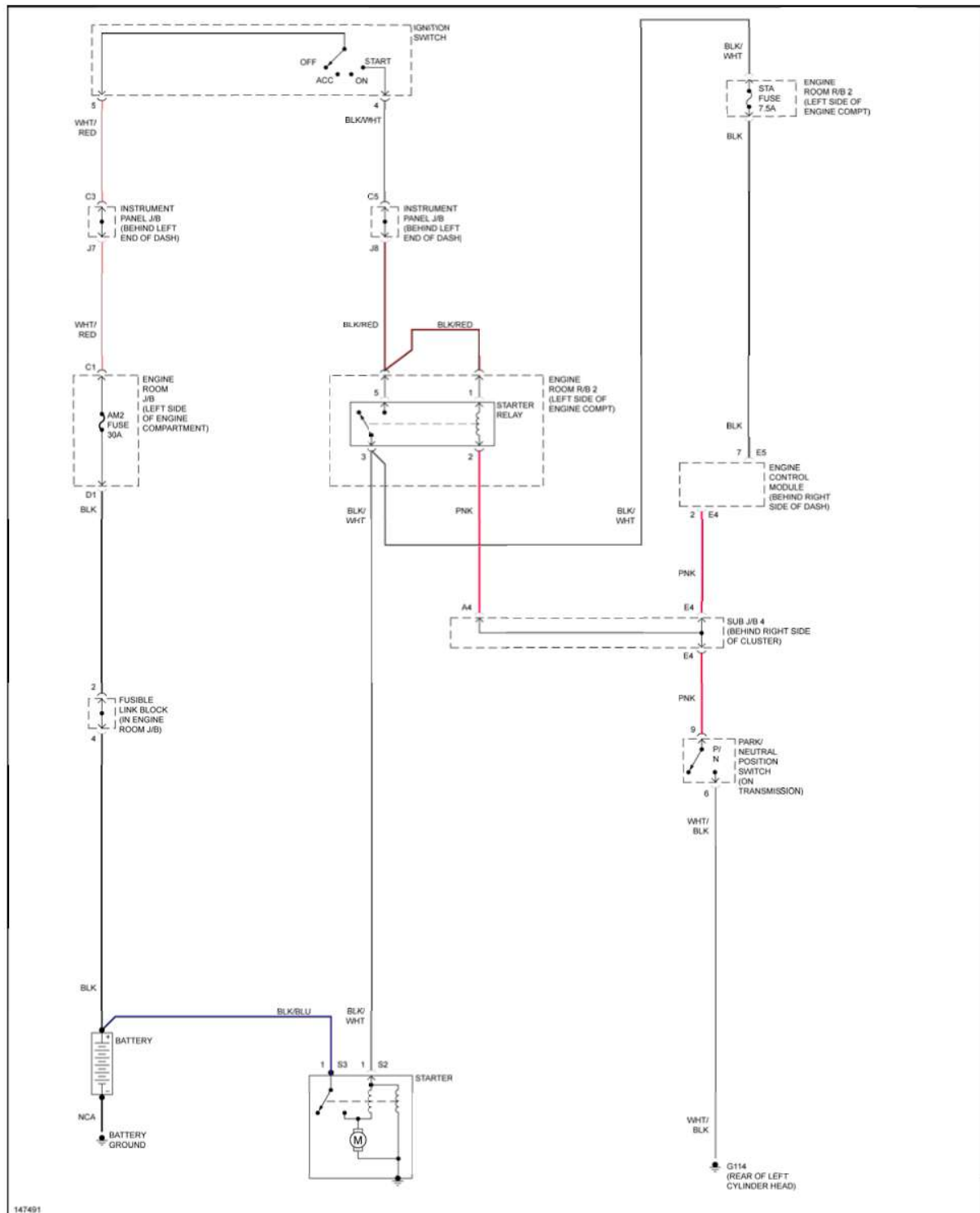


Fig. 31: Starting System Wiring Diagram (Sequoia)

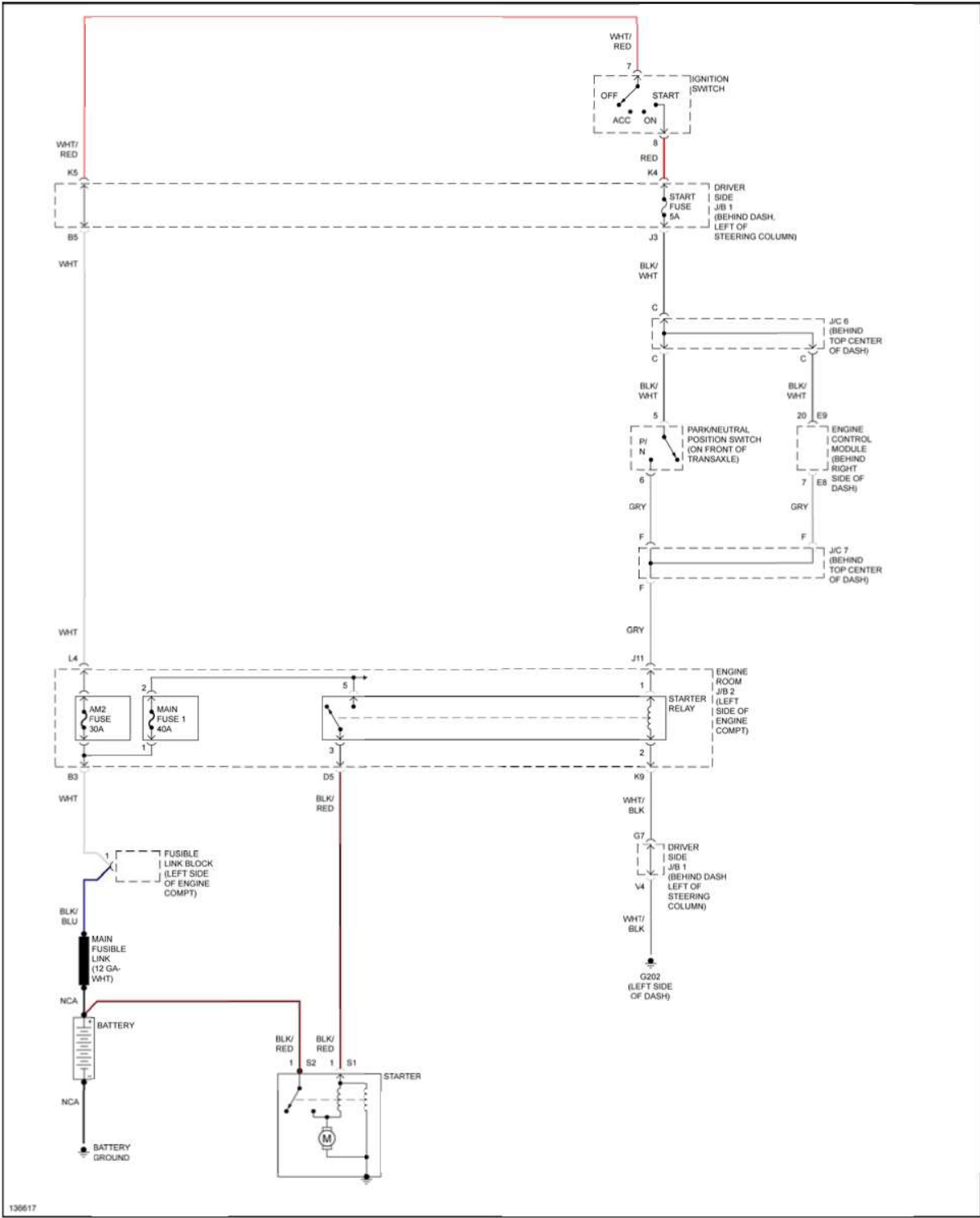


Fig. 32: Starting System Wiring Diagram (Sienna)



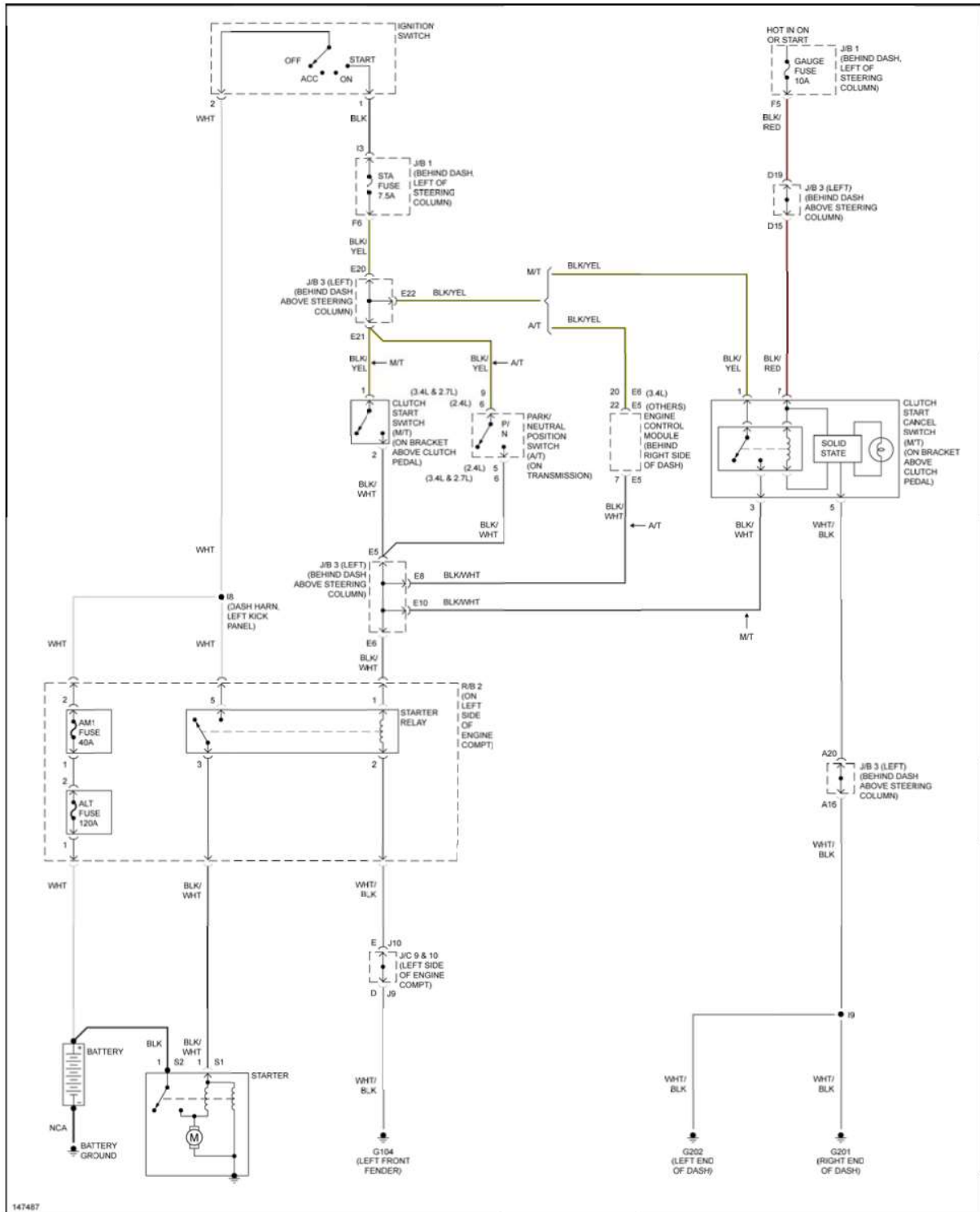


Fig. 33: Starting System Wiring Diagram (Tacoma)



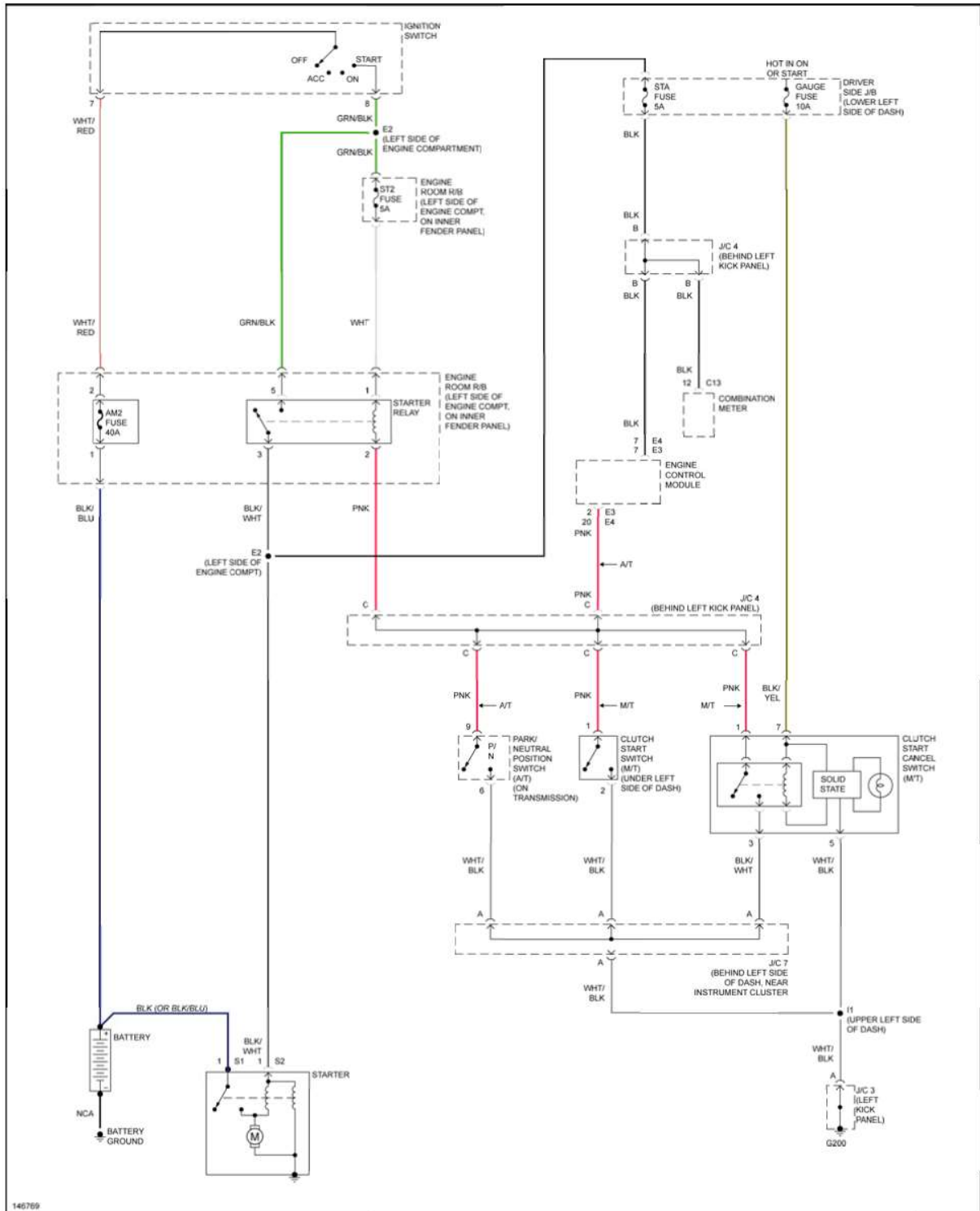


Fig. 34: Starting System Wiring Diagram (Tundra)



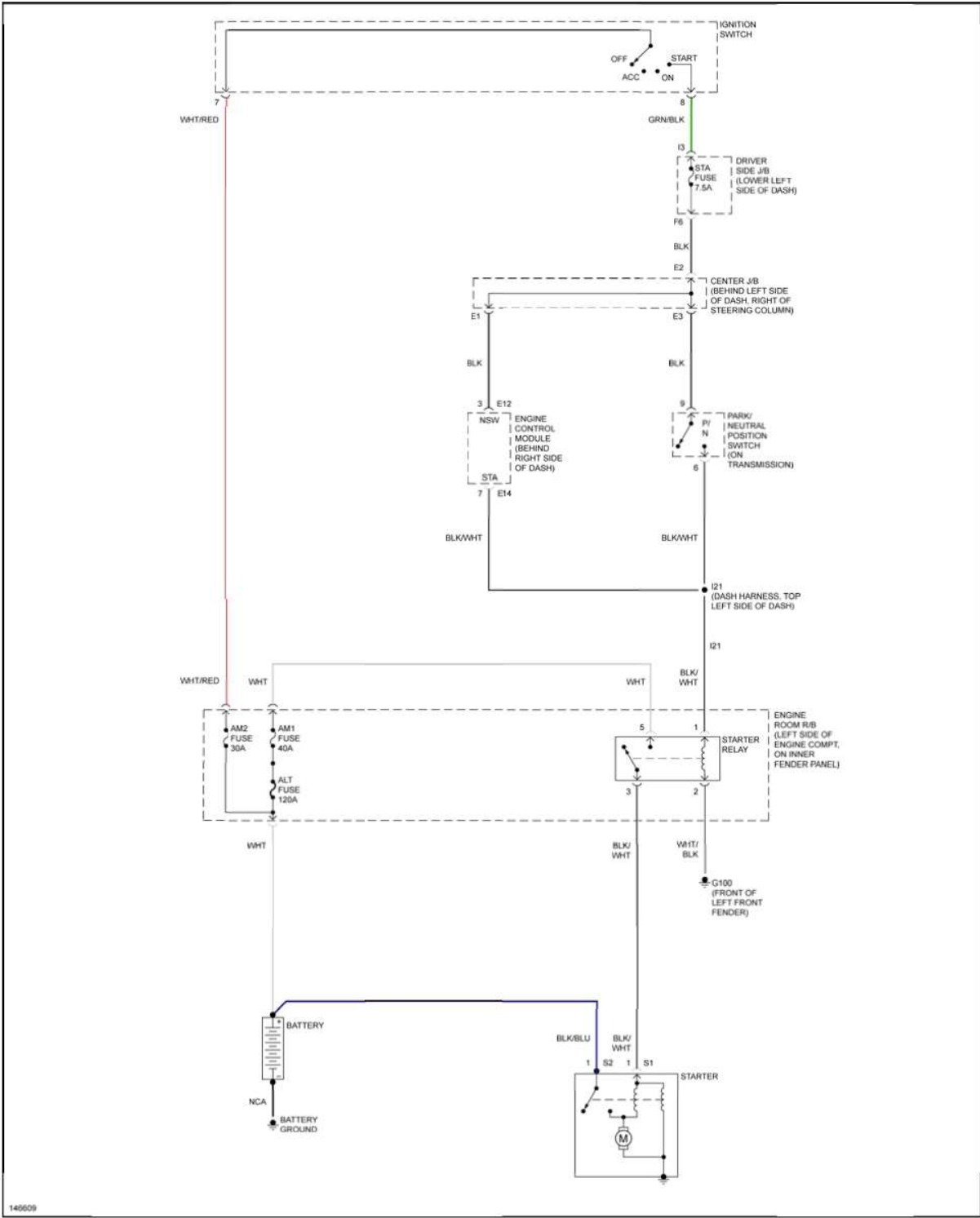


Fig. 35: Starting System Wiring Diagram (4Runner)

