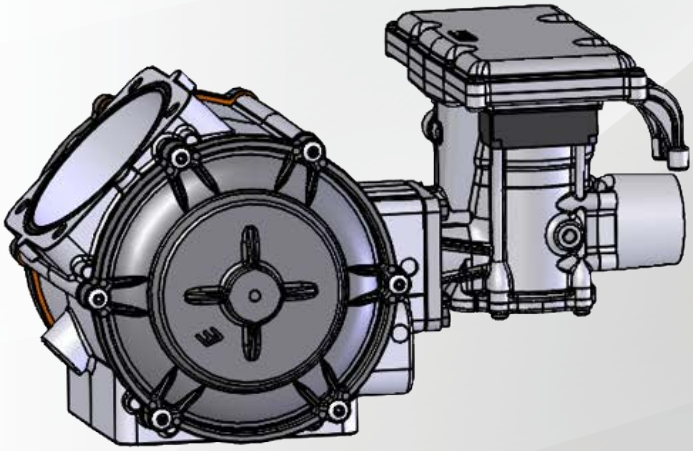
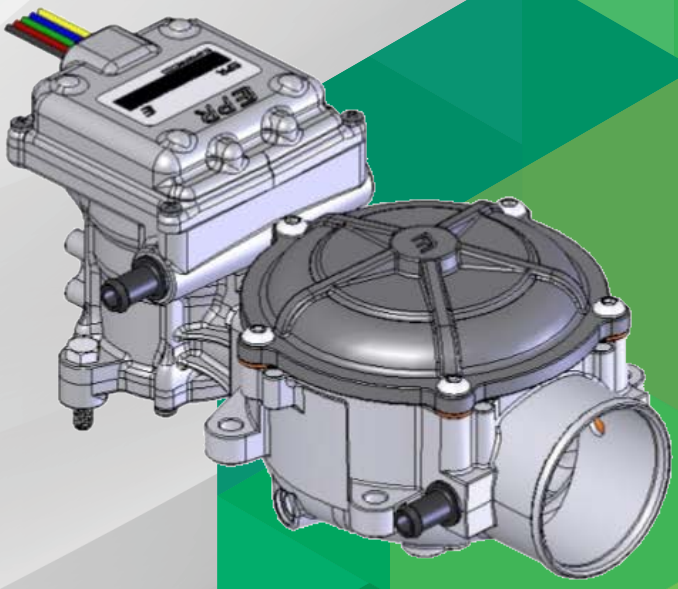
POWER SOLUTIONS INTERNATIONAL

PSI Certified Stationary





Diagnostic Manual

7610023-6 04/20

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REVISION CONTROL INFORMATION

Revision Level	Release Date	Change Description (s)
6	04/08/2020	Add new DTC's for CNP

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DIAGNOSTIC TROUBLE CODE (DTC) CHART

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RS-485 Shutdown Request	1624	0	31
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BPS1 low voltage	1221	27	4
BPS1 higher than BPS2	1224	27	0
BPS1 lower than BPS2	1225	27	1
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FPP1 low voltage	2123	91	4
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EMWT 2 higher than expected level 2	1418	442	0
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Description	DTC	SPN	FMI
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1 Injector Coil Shorted	262	651	6
2 Injector Loop Open or Low-Side Short to Ground	264	652	5
2 Injector Coil Shorted	265	652	6
3 Injector Loop Open or Low-Side Short to Ground	267	653	5
3 Injector Coil Shorted	268	653	6
4 Injector Loop Open or Low-Side Short to Ground	270	654	5
4 Injector Coil Shorted	271	654	6
5 Injector Loop Open or Low-Side Short to Ground	273	655	5
5 Injector Coil Shorted	274	655	6
6 Injector Loop Open or Low-Side Short to Ground	276	656	5
6 Injector Coil Shorted	277	656	6
7 Injector Loop Open or Low-Side Short to Ground	279	657	5
7 Injector Coil Shorted	280	657	6
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9 Injector Loop Open or Low-Side Short to Ground	285	659	5
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PWM1-Gauge1 open / ground short	1631	697	5
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PWM2-Gauge2 open / ground short	1633	698	5
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PWM3-Gauge3 open / ground short	1635	699	5
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AUX Temperature 3 high	1441	703	0
AUX Temperature 3 low	1442	703	1
AUX Pressure 3 high	1454	703	0
AUX Pressure 3 low	1455	703	1
AUX Temperature 4 high	1443	704	0
AUX Temperature 4 low	1444	704	1
AUX Pressure 4 high	1456	704	0
AUX Pressure 4 low	1457	704	1
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AUX analog PUD4 low	1548	713	4
AUX analog PUD6 high	1567	714	3
AUX analog PUD6 low	1568	714	4
AUX analog PUD7 high	1569	715	3
AUX analog PUD7 low	1571	715	4
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Knock 1 sensor open	327	731	4
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Description	DTC	SPN	FMI
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Buzzer control ground short	1641	920	4
Buzzer open	1642	920	5
Buzzer control short to power	1643	920	3
PWM6 open / ground short	1661	925	5
PWM6 short to power	1662	925	3
PWM7 open / ground short	1663	926	5
PWM7 short to power	1664	926	3
Brake output open / ground short	1671	1074	4
Brake output short to power	1672	1074	3
5VE1 high voltage	643	1079	3
5VE1 low voltage	642	1079	4
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5VE2 high voltage	653	1080	3
5VE2 low voltage	652	1080	4
TIP/TOP high voltage	238	1127	3
TIP/TOP low voltage	237	1127	4
APS1 high voltage	1211	1188	3
APS1 low voltage	1212	1188	4
APS1 higher than APS2	1215	1188	0
APS1 lower than APS2	1216	1188	1
Unable to reach higher APS	1217	1188	7
APS2 high voltage	1213	1189	3
APS2 low voltage	1214	1189	4
Unable to reach lower APS	1218	1189	7
WGP high voltage	1131	1192	3
WGP low voltage	1132	1192	4
MIL control ground short	1644	1213	4
MIL open	650	1213	5
MIL control short to power	1645	1213	3
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CAN2 address conflict failure	1650	1231	13
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CAN3 Rx failure	1649	1235	12
CAN3 address conflict failure	1653	1235	13
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1 Spark Plug or Coil Failure	1351	1268	11
1 Primary Loop Open or Low-Side Short to Ground	2300	1268	5
1 Primary Coil Shorted	2301	1268	6
1 External Spark Module Coil Failure	351	1268	31
External Spark Module Failure	350	1268	31
2 Spark Plug or Coil Failure	1352	1269	11
2 Primary Loop Open or Low-Side Short to Ground	2303	1269	5
2 Primary Coil Shorted	2304	1269	6
2 External Spark Module Coil Failure	352	1269	31
3 Spark Plug or Coil Failure	1353	1270	11
3 Primary Loop Open or Low-Side Short to Ground	2306	1270	5
3 Primary Coil Shorted	2307	1270	6
3 External Spark Module Coil Failure	353	1270	31
4 Spark Plug or Coil Failure	1354	1271	11
4 Primary Loop Open or Low-Side Short to Ground	2309	1271	5
4 Primary Coil Shorted	2310	1271	6
4 External Spark Module Coil Failure	354	1271	31
5 Spark Plug or Coil Failure	1355	1272	11
5 Primary Loop Open or Low-Side Short to Ground	2312	1272	5
5 Primary Coil Shorted	2313	1272	6
5 External Spark Module Coil Failure	355	1272	31
6 Spark Plug or Coil Failure	1356	1273	11
6 Primary Loop Open or Low-Side Short to Ground	2315	1273	5
6 Primary Coil Shorted	2316	1273	6
6 External Spark Module Coil Failure	356	1273	31
7 Spark Plug or Coil Failure	1357	1274	11
7 Primary Loop Open or Low-Side Short to Ground	2318	1274	5
7 Primary Coil Shorted	2319	1274	6
7 External Spark Module Coil Failure	357	1274	31
8 Spark Plug or Coil Failure	1358	1275	11
8 Primary Loop Open or Low-Side Short to Ground	2321	1275	5
8 Primary Coil Shorted	2322	1275	6
8 External Spark Module Coil Failure	358	1275	31
9 Spark Plug or Coil Failure	1359	1276	11
9 Primary Loop Open or Low-Side Short to Ground	2324	1276	5
9 Primary Coil Shorted	2325	1276	6
9 External Spark Module Coil Failure	359	1276	31
10 Spark Plug or Coil Failure	1360	1277	11
10 Primary Loop Open or Low-Side Short to Ground	2327	1277	5
10 Primary Coil Shorted	2328	1277	6
10 External Spark Module Coil Failure	360	1277	31

Description	DTC	SPN	FMI
Start relay control ground short	616	1321	4
Start relay coil open	615	1321	5
Start relay coil short to power	617	1321	3
Start command stuck active	1675	1321	31
1 Misfire detected	1311	1323	11
1 Emissions/catalyst damaging misfire	301	1323	31
2 Misfire detected	1312	1324	11
2 Emissions/catalyst damaging misfire	302	1324	31
3 Misfire detected	1313	1325	11
3 Emissions/catalyst damaging misfire	303	1325	31
4 Misfire detected	1314	1326	11
4 Emissions/catalyst damaging misfire	304	1326	31
5 Misfire detected	1315	1327	11
5 Emissions/catalyst damaging misfire	305	1327	31
6 Misfire detected	1316	1328	11
6 Emissions/catalyst damaging misfire	306	1328	31
7 Misfire detected	1317	1329	11
7 Emissions/catalyst damaging misfire	307	1329	31
8 Misfire detected	1318	1330	11
8 Emissions/catalyst damaging misfire	308	1330	31
9 Misfire detected	1319	1331	11
9 Emissions/catalyst damaging misfire	309	1331	31
10 Misfire detected	1320	1332	11
10 Emissions/catalyst damaging misfire	310	1332	31
FPump motor loop open or high-side shorted to ground	2632	1347	5
FPump motor high-side shorted to power	2634	1347	6
FPump relay control ground short	628	1348	4
Fpump relay coil open	627	1348	5
Fpump relay coil short to power	629	1348	3
Service Interval Expired	1604	1350	31
J1939 Shutdown Request	1625	1384	31
AUX Temperature 1 high	1439	1385	0
AUX Temperature 1 low	1440	1385	1
AUX Temperature delta T 1 high	1445	1385	0
AUX Temperature delta T 1 low	1446	1385	1
AUX Temperature 2 high	1438	1386	0
AUX Temperature 2 low	1437	1386	1
AUX Temperature delta T 2 high	1447	1386	0
AUX Temperature delta T 2 low	1448	1386	1
AUX Pressure 1 high	1450	1387	0
AUX Pressure 1 low	1451	1387	1
AUX Pressure delta P 1 high	1458	1387	0
AUX Pressure delta P 1 low	1459	1387	1
AUX Pressure 2 high	1452	1388	0
AUX Pressure 2 low	1453	1388	1
AUX Pressure delta P 2 high	1460	1388	0
AUX Pressure delta P 2 low	1461	1388	1
Secondary FP high voltage	2296	1390	3
Secondary FP low voltage	2295	1390	4
Secondary fuel pressure high	1088	1390	0
Secondary fuel pressure low	1087	1390	1
Power relay control ground short	686	1485	4
Power relay coil open	685	1485	5
Power relay coil short to power	687	1485	3
Relay off high voltage	1602	1485	0
Relay on low voltage	1603	1485	1
Hardware ID Failure	1674	1634	2
Calibration Configuration Error	1673	1634	13
TIP/TOP active	236	1692	2
Control over boost	234	1692	0
Control under boost	299	1692	1
PWM8 open / ground short	1665	2646	5
PWM8 short to power	1666	2646	3
PWM9 open / ground short	1669	2647	5
PWM9 short to power	1670	2647	3
PWM10 open / ground short	1676	2648	5
PWM10 short to power	1677	2648	3
PWM11 open / ground short	1678	2649	5
PWM11 short to power	1679	2649	3
PWM12 open / ground short	1680	2650	5
PWM12 short to power	1681	2650	3
1 CR Injector High-Side Short to Ground	2261	2651	5
1 CR Injector Low-Side Short to Power	2262	2651	3
PWM13 open / ground short	1682	2651	5
PWM13 short to power	1683	2651	3
2 CR Injector High-Side Short to Ground	2264	2652	5
2 CR Injector Low-Side Short to Power	2265	2652	3
PWM14 open / ground short	1684	2652	5

Description	DTC	SPN	FMI
PWM14 short to power	1685	2652	3
3 CR Injector High-Side Short to Ground	2267	2653	5
3 CR Injector Low-Side Short to Power	2268	2653	3
PWM15 open / ground short	1686	2653	5
PWM15 short to power	1687	2653	3
4 CR Injector High-Side Short to Ground	2270	2654	5
4 CR Injector Low-Side Short to Power	2271	2654	3
PWM16 open / ground short	1688	2654	5
PWM16 short to power	1689	2654	3
5 CR Injector High-Side Short to Ground	2273	2655	5
5 CR Injector Low-Side Short to Power	2274	2655	3
PWM17 open / ground short	1690	2655	5
PWM17 short to power	1691	2655	3
6 CR Injector High-Side Short to Ground	2276	2656	5
6 CR Injector Low-Side Short to Power	2277	2656	3
PWM18 open / ground short	1692	2656	5
PWM18 short to power	1693	2656	3
7 CR Injector High-Side Short to Ground	2279	2657	5
7 CR Injector Low-Side Short to Power	2280	2657	3
PWM19 open / ground short	1694	2657	5
PWM19 short to power	1695	2657	3
8 CR Injector High-Side Short to Ground	2282	2658	5
8 CR Injector Low-Side Short to Power	2283	2658	3
PWM20 open / ground short	1696	2658	5
PWM20 short to power	1697	2658	3
PWM21 open / ground short	1698	2659	5
PWM21 short to power	1699	2659	3
PWM22 open / ground short	1700	2660	5
PWM22 short to power	1701	2660	3
PWM23 open / ground short	1702	2661	5
PWM23 short to power	1703	2661	3
1 Glow Plug Open/Power Short	3001	2899	3
2 Glow Plug Open/Power Short	3002	2899	3
3 Glow Plug Open/Power Short	3003	2899	3
4 Glow Plug Open/Power Short	3004	2899	3
5 Glow Plug Open/Power Short	3005	2899	3
6 Glow Plug Open/Power Short	3006	2899	3
7 Glow Plug Open/Power Short	3007	2899	3
8 Glow Plug Open/Power Short	3008	2899	3
9 Glow Plug Open/Power Short	3009	2899	3
10 Glow Plug Open/Power Short	3010	2899	3
1 Glow Plug Short to Ground	671	2899	4
2 Glow Plug Short to Ground	672	2899	4
3 Glow Plug Short to Ground	673	2899	4
4 Glow Plug Short to Ground	674	2899	4
5 Glow Plug Short to Ground	675	2899	4
6 Glow Plug Short to Ground	676	2899	4
7 Glow Plug Short to Ground	677	2899	4
8 Glow Plug Short to Ground	678	2899	4
9 Glow Plug Short to Ground	679	2899	4
10 Glow Plug Short to Ground	680	2899	4
UEGO1 return voltage shorted high	8906	3056	3
UEGO1 return voltage shorted low	8907	3056	4
UEGO2 return voltage shorted high	3040	3057	3
UEGO2 return voltage shorted low	3041	3057	4
CR Injection Bank Boost Voltage Low, Bank 1	3100	3100	4
CR Injection Bank Boost Voltage Low, Bank 2	3101	3101	4
CR Injection Bank Internal Fault, Bank 1	3102	3102	31
CR Injection Bank Internal Fault, Bank 2	3103	3103	31
IMV Loop Open or Short to Ground	3104	3104	5
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UEGO1 sense cell voltage high	8910	3217	3
UEGO1 sense cell voltage low	8911	3217	4
UEGO1 pump voltage shorted high	8908	3218	3
UEGO1 pump voltage shorted low	8909	3218	4
UEGO1 internal processor fault	8901	3221	31
UEGO1 internal supply voltage low	8920	3221	0
UEGO1 drift is out-of-tolerance	8921	3221	15
UEGO1 drift is out-of-tolerance - level 2	3030	3221	16
UEGO1 cal resistor voltage high	8904	3221	3
UEGO1 cal resistor voltage low	8905	3221	4
EGOH1 open / ground short	31	3222	4
EGOH1 short to power	32	3222	3
UEGO1 heater supply high voltage	8902	3222	3
UEGO1 heater supply low voltage	8903	3222	4
UEGO1 sense cell slow to warm up	8914	3222	10
UEGO1 sense cell impedance high	8916	3222	0
UEGO1 heater open / ground short	3031	3222	4

Description	DTC	SPN	FMI
UEGO1 heater short to power	3032	3222	3
UEGO1 pump voltage at high drive limit	8912	3225	3
UEGO1 pump voltage at low drive limit	8913	3225	4
UEGO1 pump cell slow to warm up	8915	3225	10
UEGO1 pump cell impedance high	8917	3225	0
UEGO1 pump cell impedance low	8918	3225	1
EGOH2 open / ground short	51	3232	4
EGOH2 short to power	52	3232	3
UEGO2 sense cell voltage high	3044	3256	3
UEGO2 sense cell voltage low	3045	3256	4
UEGO2 pump voltage shorted high	3042	3257	3
UEGO2 pump voltage shorted low	3043	3257	4
UEGO2 internal processor fault	3033	3260	31
UEGO2 internal supply voltage low	3055	3260	1
UEGO2 drift is out-of-tolerance	3034	3260	15
UEGO2 drift is out-of-tolerance - level 2	3035	3260	16
UEGO2 cal resistor voltage high	3038	3260	3
UEGO2 cal resistor voltage low	3039	3260	4
EGOH3 open / ground short	37	3261	4
EGOH3 short to power	38	3261	3
UEGO2 heater supply high voltage	3036	3261	3
UEGO2 heater supply low voltage	3037	3261	4
UEGO2 sense cell slow to warm up	3048	3261	10
UEGO2 sense cell impedance high	3050	3261	0
UEGO2 heater open / ground short	3053	3261	4
UEGO2 heater short to power	3054	3261	3
UEGO2 pump voltage at high drive limit	3046	3264	3
UEGO2 pump voltage at low drive limit	3047	3264	4
UEGO2 pump cell slow to warm up	3049	3264	10
UEGO2 pump cell impedance high	3051	3264	0
UEGO2 pump cell impedance low	3052	3264	1
EGOH4 open / ground short	57	3271	4
EGOH4 short to power	58	3271	3
APS1/2 simultaneous voltages out of range	1219	3464	31
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5VE3 low voltage	698	3511	4
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CFV RLV test failed	2665	3601	7
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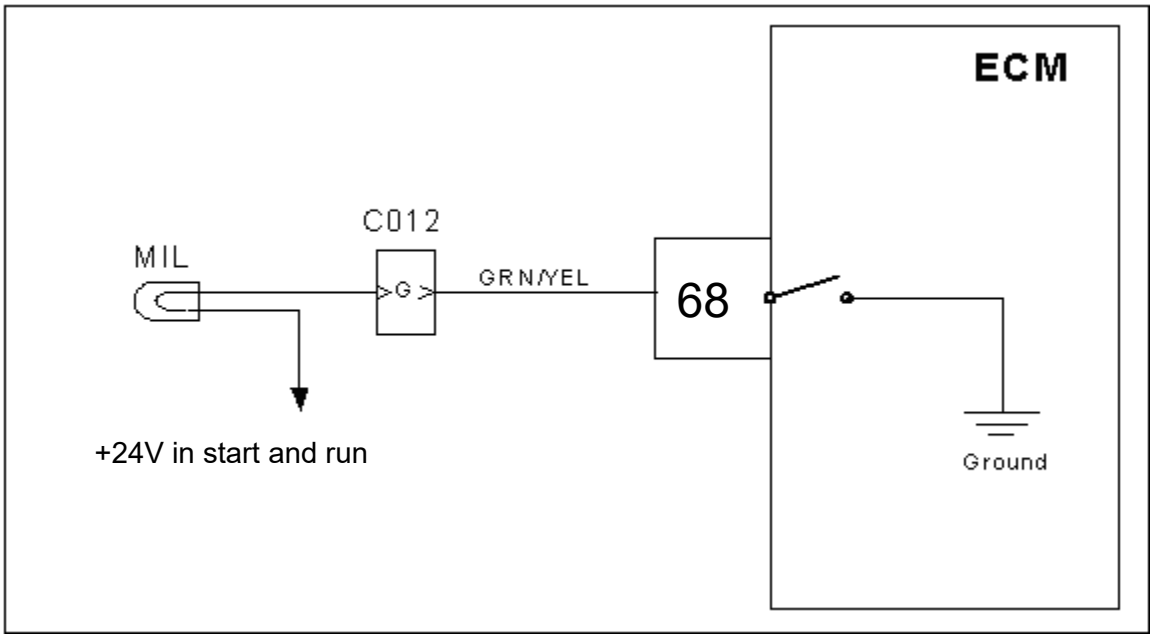
BPS2 high voltage	1222	3822	3
BPS2 low voltage	1223	3822	4
Unable to reach lower BPS	1227	3822	7
Envirotech receipt lost	1601	4490	18
Catalyst monitor - exhaust P low	2170	4755	1
Catalyst monitor - exhaust P high	2171	4755	0
HBB drive current high	1230	5264	6
HBA drive current high	1229	5386	6
AL high gasoline bank1	171	520200	0
AL low gasoline bank1	172	520200	1
AL high gasoline bank2	174	520201	0
AL low gasoline bank2	175	520201	1
AUX DIG5 high	1574	520202	3
AUX DIG5 low	1575	520202	4
AL high LPG	1161	520202	0
AL low LPG	1162	520202	1
AUX DIG6 high	1576	520203	3
AUX DIG6 low	1577	520203	4
AL high NG	1163	520203	0
AL low NG	1164	520203	1
AUX DIG7 high	1578	520204	3
AUX DIG7 low	1579	520204	4
CL high gasoline bank1	1155	520204	0
CL low gasoline bank1	1156	520204	1
AUX DIG8 high	1581	520205	3
AUX DIG8 low	1582	520205	4
CL high gasoline bank2	1157	520205	0
CL low gasoline bank2	1158	520205	1
AUX DIG9 high	1583	520206	3
AUX DIG9 low	1584	520206	4
CL high LPG	1151	520206	0
CL low LPG	1152	520206	1
AUX DIG10 high	1585	520207	3
AUX DIG10 low	1586	520207	4
CL high NG	1153	520207	0
CL low NG	1154	520207	1
EGO open / lazy pre-cat 2/post-cat 1	154	520208	10

Description	DTC	SPN	FMI
AUX DIG11 high	1589	520209	3
AUX DIG11 low	1591	520209	4
EGO open / lazy post-cat 1	140	520209	10
AUX DIG12 high	1592	520210	3
AUX DIG12 low	1593	520210	4
EGO open / lazy post-cat 2	160	520210	10
Gasoline cat monitor bank 1	420	520211	10
Gasoline cat monitor bank 2	430	520212	10
LPG cat monitor	1165	520213	10
NG cat monitor	1166	520214	10
AUX analog PD1 high	1515	520215	3
AUX analog PD1 low	1516	520215	4
AUX analog PU1 high	1511	520216	3
AUX analog PU1 low	1512	520216	4
AUX analog PU2 high	1513	520217	3
AUX analog PU2 low	1514	520217	4
AUX analog PU3 high	1517	520218	3
AUX analog PU3 low	1518	520218	4
AUX analog PUD1 high	1541	520219	3
AUX analog PUD1 low	1542	520219	4
AUX analog PUD2 high	1543	520220	3
AUX analog PUD2 low	1544	520220	4
AUX analog PUD3 high	1545	520221	3
AUX analog PUD3 low	1546	520221	4
AUX DIG1 high	1551	520222	3
AUX DIG1 low	1552	520222	4
AUX DIG2 high	1553	520223	3
AUX DIG2 low	1554	520223	4
Water Intrusion Detection	1558	520224	3
AUX DIG3 high	1555	520224	3
AUX DIG3 low	1556	520224	4
Shift actuator feedback out-of-range	916	520226	3
Shift unable to reach desired gear	919	520226	7
Shift actuator or drive circuit failure	920	520226	31
PWM5 open / ground short	1639	520230	5
PWM5 short to power	1640	520230	6
FT gaseous fuel high	188	520240	3
FT gaseous fuel low	187	520240	4
Knock 2 sensor open	332	520241	4
Knock 2 excessive signal	331	520241	2
FPP1 invalid voltage and FPP2 disagrees with IVS (redundancy lost)	2120	520250	31
FPP2 invalid voltage and FPP1 disagrees with IVS (redundancy lost)	2125	520250	31
FPP1/2 do not match each other or the IVS (redundancy lost)	1122	520250	31
TPS2 high voltage	223	520251	3
TPS2 low voltage	222	520251	4
IAC ground short	508	520252	6
IAC coil open/short	509	520252	5
EPR / CFV regulation pressure higher than expected	1171	520260	0
EPR / CFV regulation pressure lower than expected	1172	520260	1
EPR / CFV comm lost	1173	520260	31
EPR / CFV voltage supply high	1174	520260	3
EPR / CFV voltage supply low	1175	520260	4
EPR / CFV internal actuator fault detection	1176	520260	7
EPR / CFV internal circuitry fault detection	1177	520260	12
EPR / CFV internal comm fault detection	1178	520260	12
CFV flow higher than commanded	1179	520260	15
CFV flow lower than commanded	1180	520260	17
IVS/Brake/Trans-Park interlock failure	1531	520270	31
AUX analog PD2 high	1561	520271	3
AUX analog PD2 low	1562	520271	4
AUX analog PD3 high	1563	520272	3
AUX analog PD3 low	1564	520272	4
AUX analog PUD5 high	1565	520273	3
AUX analog PUD5 low	1566	520273	4
AUX analog PUD8 high	1705	520274	3
AUX analog PUD8 low	1706	520274	4
AUX analog PUD9 high	1707	520275	3
AUX analog PUD9 low	1708	520275	4
AUX analog PUD10 high	1709	520276	3
AUX analog PUD10 low	1710	520276	4
AUX analog PUD11 high	1711	520277	3
AUX analog PUD11 low	1712	520277	4
AUX analog PUD12 high	1713	520278	3
AUX analog PUD12 low	1714	520278	4
AUX analog PUD13 high	1715	520279	3
AUX analog PUD13 low	1716	520279	4
AUX analog PUD14 high	1717	520280	3
AUX analog PUD14 low	1718	520280	4

Description	DTC	SPN	FMI
AUX analog PUD15 high	1719	520281	3
AUX analog PUD15 low	1720	520281	4
AUX analog PUD16 high	1721	520282	3
AUX analog PUD16 low	1722	520282	4
AUX analog PUD17 high	1723	520283	3
AUX analog PUD17 low	1724	520283	4
AUX analog PUD18 high	1725	520284	3
AUX analog PUD18 low	1726	520284	4
AUX analog PUD19 high	1727	520285	3
AUX analog PUD19 low	1728	520285	4
AUX analog PUD20 high	1729	520286	3
AUX analog PUD20 low	1730	520286	4
AUX analog PUD21 high	1731	520287	3
AUX analog PUD21 low	1732	520287	4
AUX analog PUD22 high	1733	520288	3
AUX analog PUD22 low	1734	520288	4
AUX analog PUD23 high	1735	520289	3
AUX analog PUD23 low	1736	520289	4
AUX analog PUD24 high	1737	520290	3
AUX analog PUD24 low	1738	520290	4
AUX analog PUD25 high	1739	520291	3
AUX analog PUD25 low	1740	520291	4
AUX DIG13 high	1741	520292	3
AUX DIG13 low	1742	520292	4
AUX DIG14 high	1743	520293	3
AUX DIG14 low	1744	520293	4
AUX DIG15 high	1745	520294	3
AUX DIG15 low	1746	520294	4
AUX DIG16 high	1747	520295	3
AUX DIG16 low	1748	520295	4
AUX DIG17 high	1749	520296	3
AUX DIG17 low	1750	520296	4
AUX DIG18 high	1751	520297	3
AUX DIG18 low	1752	520297	4
AUX DIG19 high	1753	520298	3
AUX DIG19 low	1754	520298	4
AUX DIG20 high	1755	520299	3
AUX DIG20 low	1756	520299	4
AUX DIG21 high	1757	520300	3
AUX DIG21 low	1758	520300	4
AUX DIG22 high	1759	520301	3
AUX DIG22 low	1760	520301	4
AUX DIG23 high	1761	520302	3
AUX DIG23 low	1762	520302	4
AUX DIG24 high	1763	520303	3
AUX DIG24 low	1764	520303	4
AUX DIG25 high	1765	520304	3
AUX DIG25 low	1766	520304	4
Fuel impurity level high	1182	520401	0
Intake cam / distributor position	11	520800	7
Exhaust cam position	24	520801	7
EPR autozero / lockoff failed	1183	520803	31

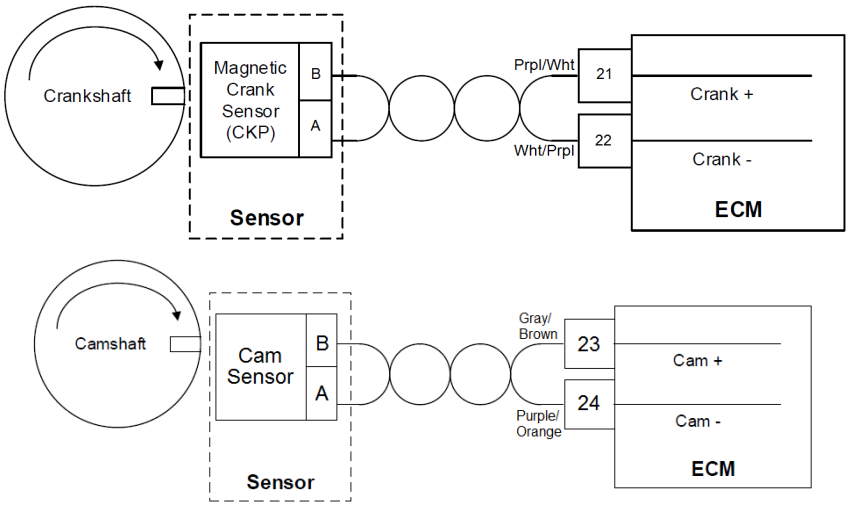
OBD System Check/MIL (Malfunction Indicator Lamp)



Circuit Description

The fuel system is equipped with OBD (On-Board Diagnostics). The MIL serves as notification of an engine or fuel system related problem. The MIL also has the ability to flash DTC codes in what is referred to as the blink code mode. It will display DTCs that have been stored due to a possible system malfunction. The follow-ing DTC charts in this manual will instruct the technician to perform the OBD system check. This simply means to verify the operation of the MIL. The lamp should illuminate when the key is in the ON position, and the engine is not running. This feature verifies that the lamp is in proper working order. If the lamp does not illuminate with the vehicle key ON and engine OFF, repair it as soon as possible. Once the engine is in start or run mode, the lamp should go off. If the lamp stays on while the engine is in the start or run mode, a current diagnostic trouble code may be set or a problem may exist with the MIL electrical wiring. The electrical schematic above shows the MIL power source supplied to the lamp. The ECM completes the circuit to ground to turn the lamp ON.

DTC 16 – Never Crank Synced At Start



Conditions for Setting the DTC

- Check Condition: Key-On, Engine Cranking or Running
- Fault Condition: Engine speed > 90 RPM, no sync for 4 revs
- MIL: ON during active fault

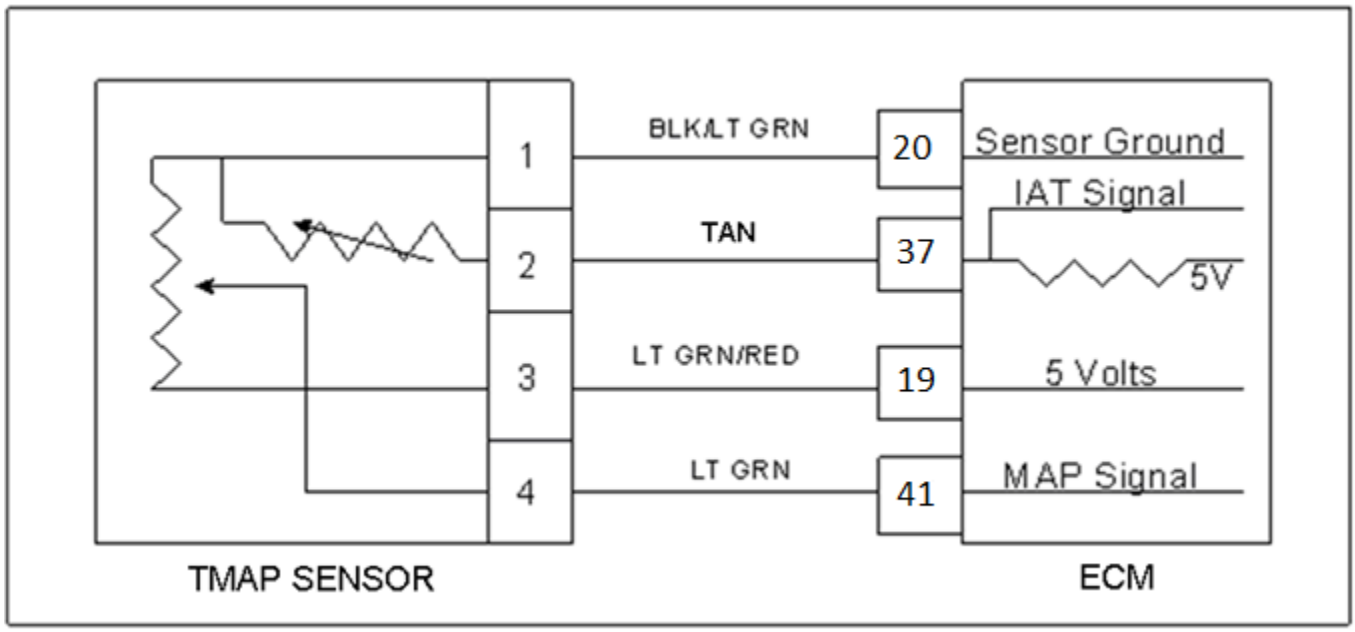
Fault Description

The crankshaft and camshaft position sensors are magnetic sensors installed in the block adjacent to "coded" trigger wheels that are used to determine crankshaft and camshaft position (with respect to TDC cylinder #1 compression) and the rotational engine speed. The ECM must see a valid crankshaft position and camshaft position signal properly aligned during cranking before it can synchronize the ignition system to initiate starting. If engine speed is greater than 90 RPM and the crank and/or cam cannot synchronize within 4 cranking revs this fault will set. Typically, conditions triggering this fault will result in an engine that will not start or run.

Diagnostic Aids

- Check that the crankshaft and/or camshaft position sensors are securely connected to harness
- Check that the crankshaft and/or camshaft position sensors are securely installed on the engine, and all brackets are tight
- Check crankshaft and/or camshaft position sensor circuits wiring for open circuits

DTC 107-MAP Low Voltage



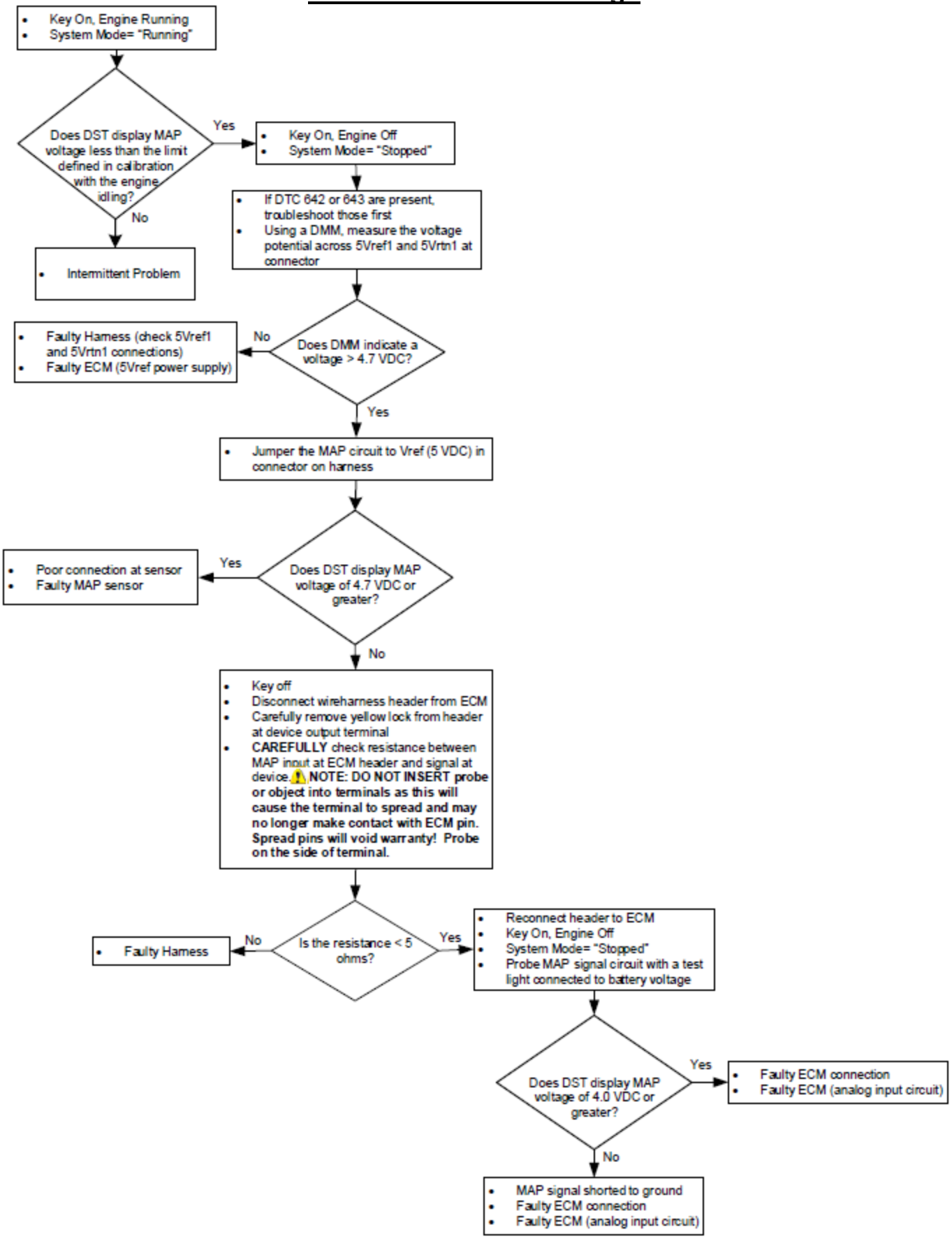
Conditions for Setting the DTC

- Check Condition: Engine cranking or running
- Fault Condition: MAP voltage less than 0.050 with throttle position greater than 2.0% and engine RPM less than 7000.
- MIL: ON
- Engine Shutdown

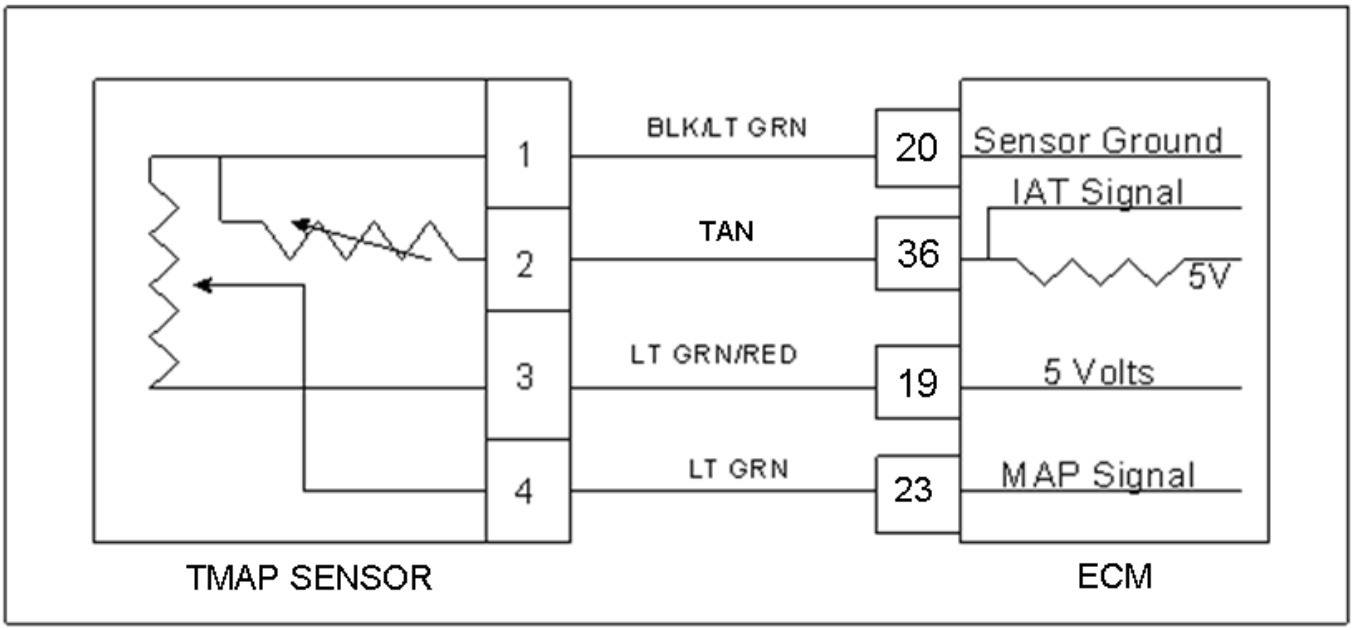
Circuit Description

The Manifold Absolute Pressure sensor is a pressure transducer connected to the intake manifold. It is used to measure the pressure of air in the manifold prior to induction. The pressure reading is used in conjunction with other inputs to estimate the airflow rate to the engine, which determines the fuel flow rate. This fault will set if the MAP voltage is less than 0.050 with TPS greater than 2% and engine RPM is less than 7000. The fault will cause an engine shutdown.

DTC 107-MAP Low Voltage



DTC 108-MAP High Pressure



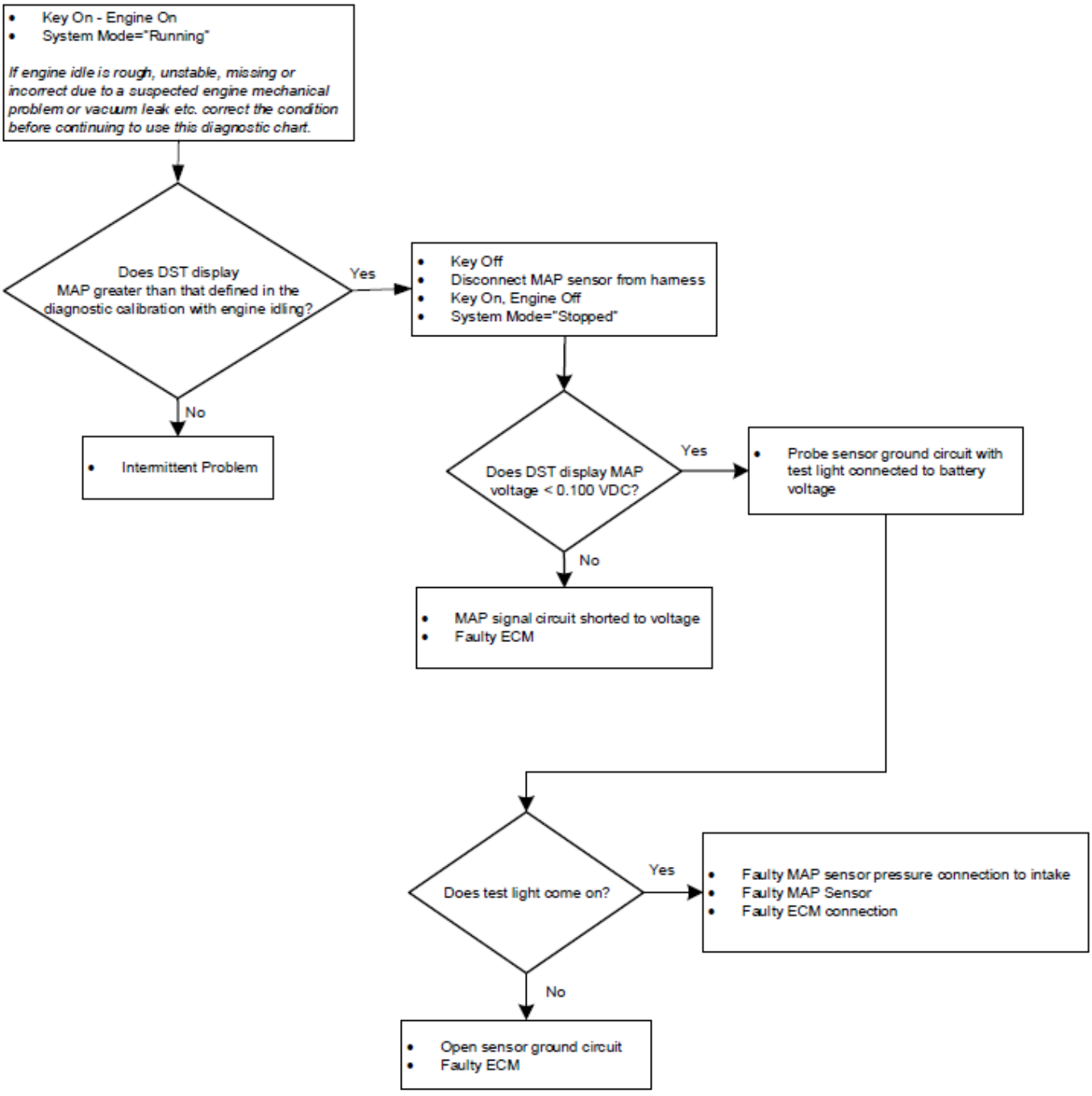
Conditions for Setting the DTC

- Check condition: engine running
- Fault Condition: MAP greater than 35 psia with TPS less than 10% and engine rpm greater than 1400.
- MIL: ON
- Engine Shutdown

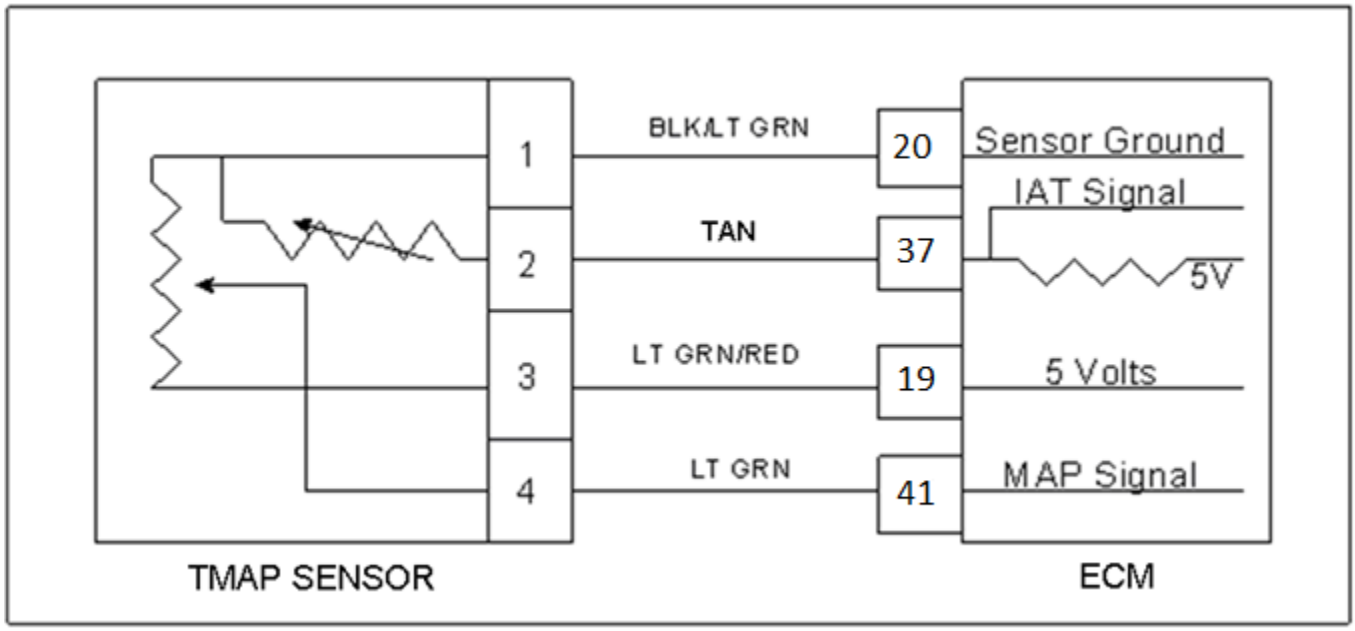
Circuit Description

The MAP (Manifold Absolute Pressure) is measured by the MAP sensor. The MAP pressure value is used for fuel, airflow and spark calculations. This fault will set in the event the MAP value is greater than 35 psia when the TPS is less than 10% with engine rpm greater than 1400.

DTC 108-MAP High Pressure



DTC 111-IAT Higher Than Expected Stage 1



Conditions for Setting the DTC

- Check Condition: Engine Running
- Fault Condition: Intake Air Temperature greater than 140 degrees F
- Condition must be present for a minimum of 30 seconds
- MIL: ON
- Adaptive: Disabled during active fault

Circuit Description

The TMAP is a combined IAT (Intake Air Temperature) and MAP (Manifold Absolute Pressure) sensor. A temperature sensitive resistor is used in the TMAP located in the air intake manifold of the engine. It is used to monitor incoming air temperature, and the output in conjunction with other sensors is used to determine the airflow to the engine. The ECM provides a voltage divider circuit so that when the air is cool, the signal reads higher voltage, and lower when warm. This fault will set if the Intake Air Temperature is greater than 140 degrees F.

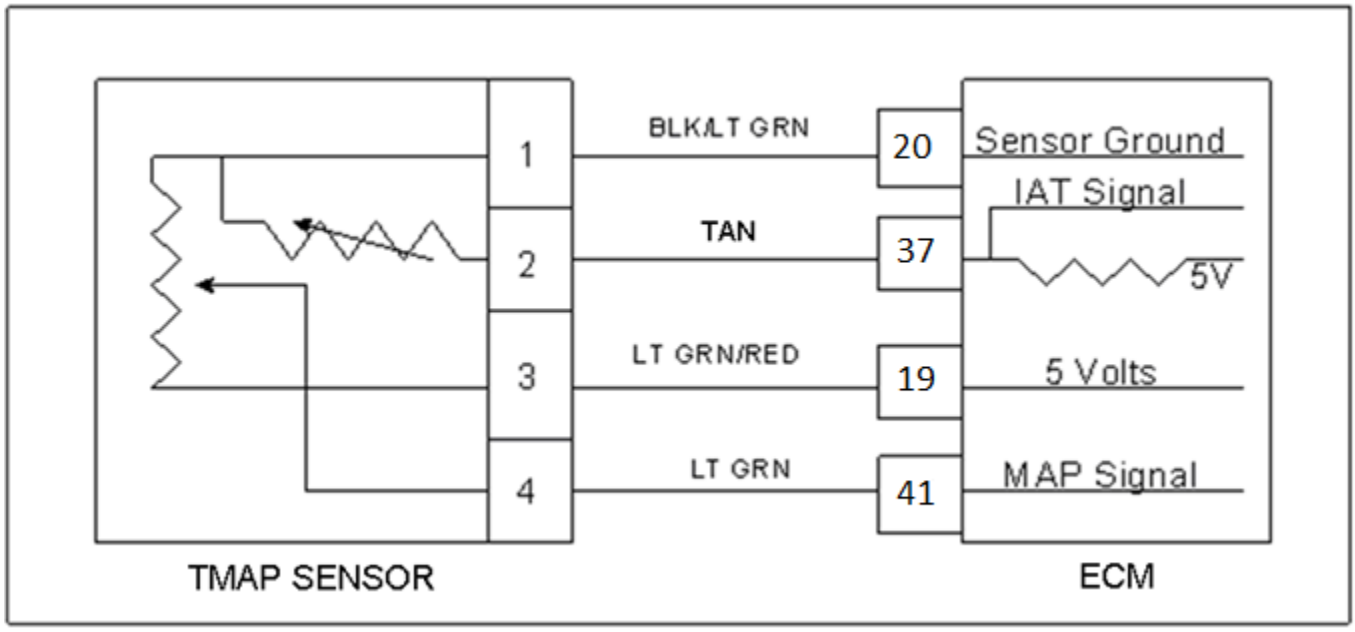
DTC 111-IAT Higher Than Expected 1

Diagnostic Aid

This fault will set when inlet air is much hotter than normal. The most common cause of high inlet air temperature is a problem with the air inlet system.

- Ensure that the air inlet is not obstructed, modified or damaged.
- Ensure the intake air is being sourced from a cool location. Engine heat recirculating into the intake can cause elevated intake air temperatures.
- Inspect the air inlet system for cracks or breaks that may allow unwanted hot air in to the air inlet system
- If none of the above can be found, follow the diagnostic steps for DTC 112-IAT Low Voltage.

DTC 112-IAT Low Voltage



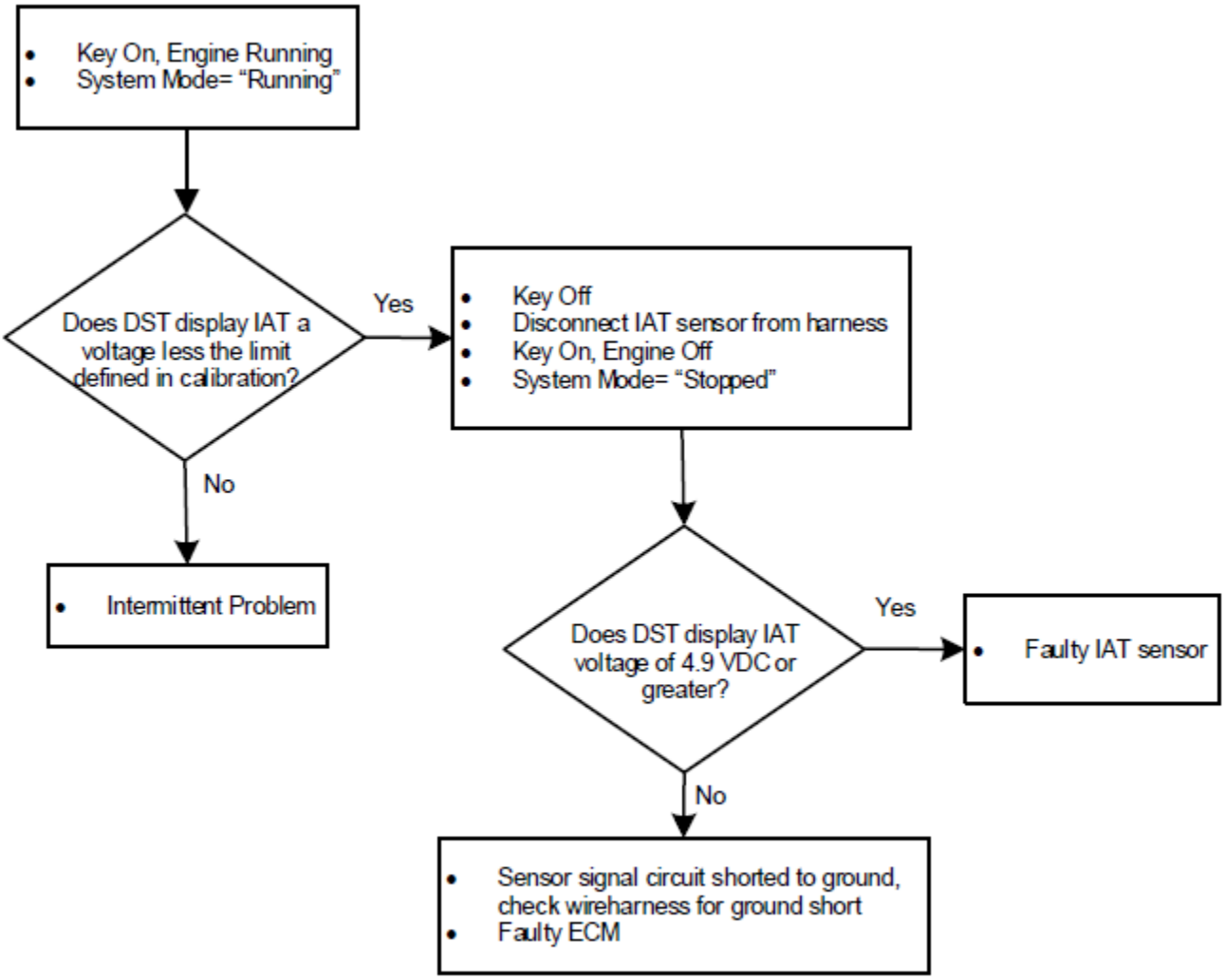
Conditions for Setting the DTC

- Check Condition: Engine Cranking or Running
- Fault Condition: IAT Sensor Voltage less than 0.050
- MIL: ON during active fault
- Engine Shutdown

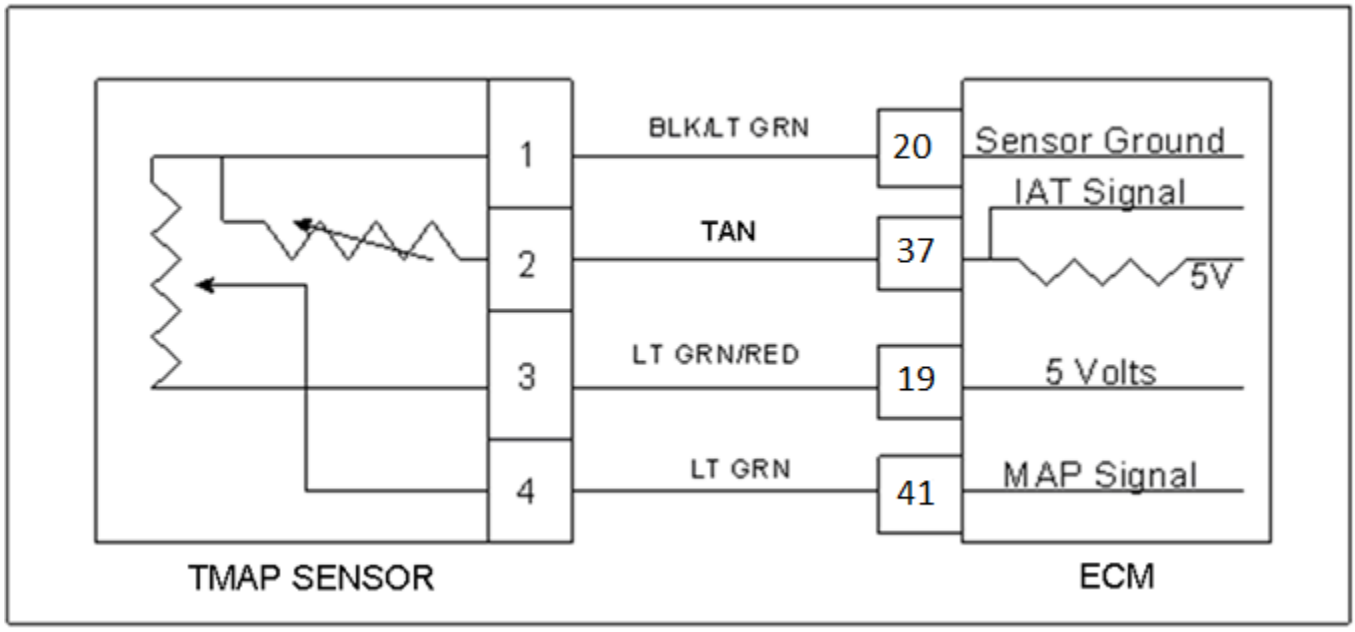
Circuit Description

The TMAP is a combined IAT (Intake Air Temperature) and MAP (Manifold Absolute Pressure) sensor. A temperature sensitive resistor is used in the TMAP is located in the engine's air intake or intake manifold. It is used to monitor incoming air temperature, and the output in conjunction with other sensors is used to determine the airflow to the engine. The ECM provides a voltage divider circuit so that when the air is cool the signal reads higher voltage, and lower when warm. This fault will set if the signal voltage is less than 0.050 volts for 1 second anytime the engine is cranking or running. The engine will not start if this fault is active, and this fault will cause a shutdown if it becomes active during engine operation.

DTC 112-IAT Voltage Low



DTC 113-IAT High Voltage



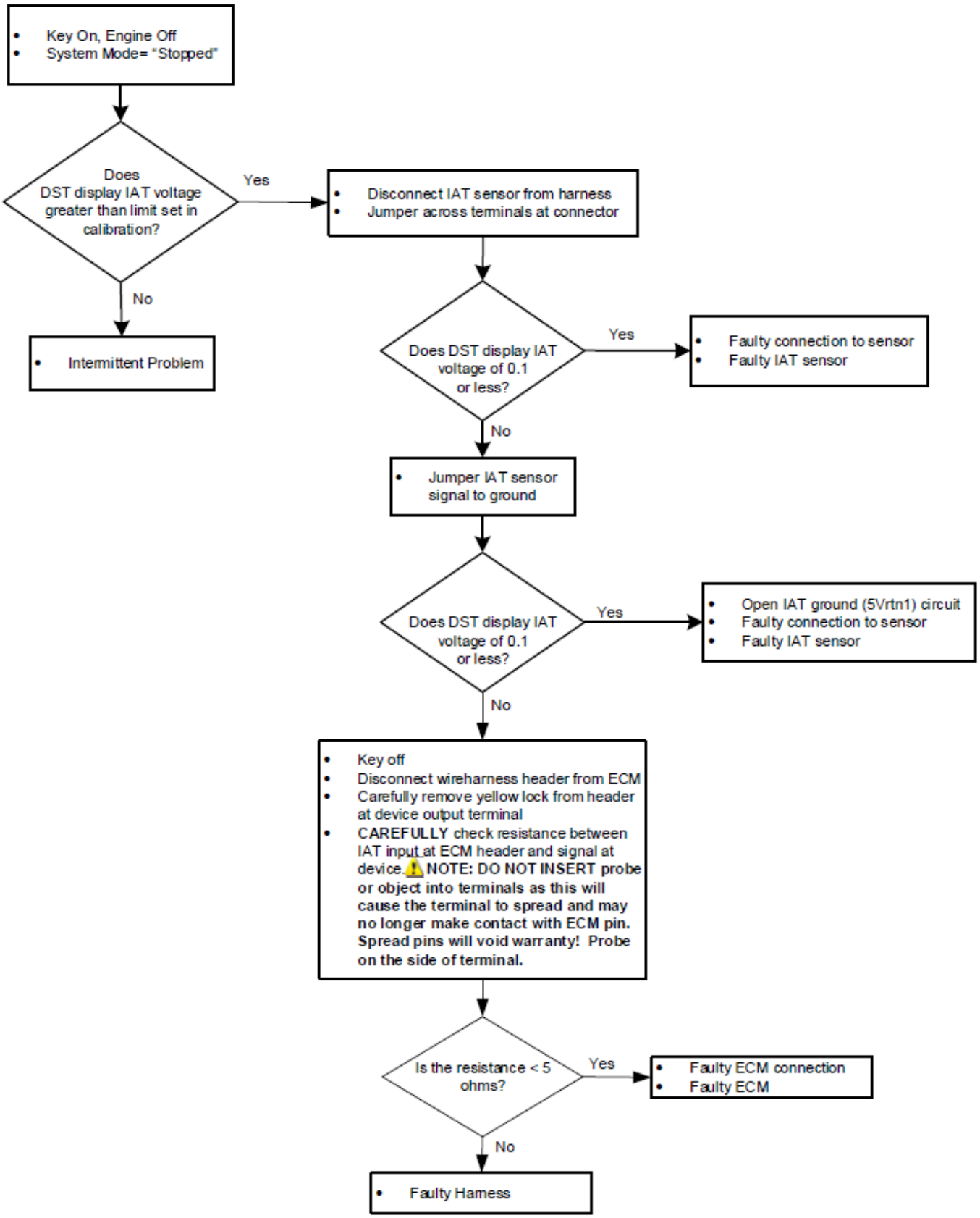
Conditions for Setting the DTC

- Check Condition: Engine Running
- Fault Condition: IAT Sensor Voltage greater than 4.950 volts
- MIL: ON during active fault
- Engine Shutdown

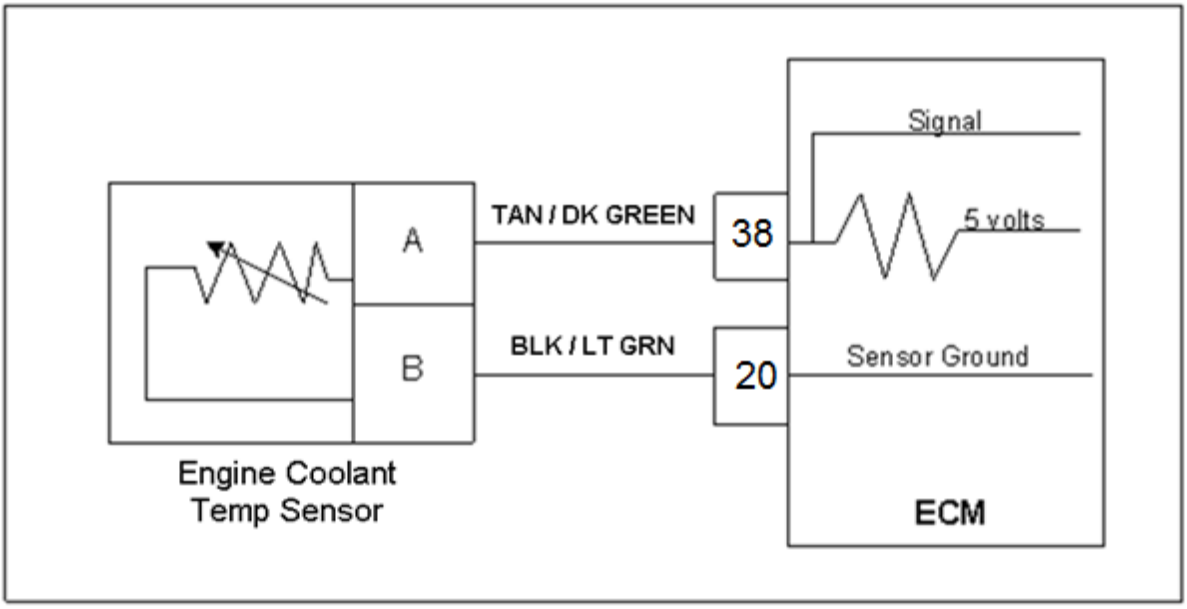
Circuit Description

The TMAP is a combined IAT (Intake Air Temperature) and MAP (Manifold Absolute Pressure) sensor. A temperature sensitive resistor is used in the TMAP is located in the engine's air intake or intake manifold. It is used to monitor incoming air temperature, and the output in conjunction with other sensors is used to determine the airflow to the engine. The ECM provides a voltage divider circuit so that when the air is cool, the signal reads higher voltage, and lower when warm. This fault will set if the signal voltage is greater than 4.950 volts for 1 second or longer. The ECM will use a default value for the IAT sensor in the event of this fault.

DTC 113-IAT High Voltage



DTC 116-ECT Higher Than Expected 1



Conditions for Setting the DTC

- Check Condition: Engine Running
- Fault Condition: Engine Coolant Temperature reading greater than 220 degrees F. for 15 seconds
- MIL: On
- Adaptive: Disabled during active fault

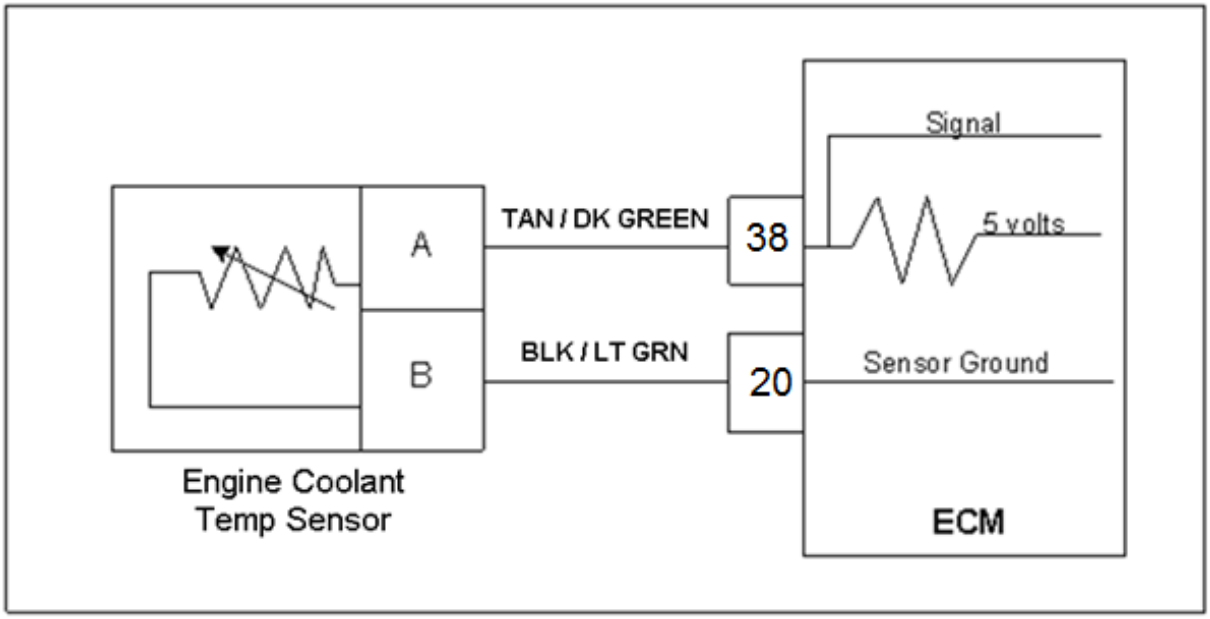
Circuit Description

The ECT (Engine Coolant Temperature) sensor is a temperature sensitive resistor located in the engine coolant sensor that is located in the coolant passage. The ECT is used for engine airflow calculation, fuel enrichment, and ignition timing control and to enable certain other temperature dependent operations. This code set is designed to help prevent engine damage from overheating. The ECM provides a voltage divider circuit so when the sensor reading is cool the sensor reads higher voltage, and lower when warm. This fault will set when the coolant exceeds 220 degrees F for more than 15 seconds.

DTC 116-ECT Higher Than Expected 1

STEP	Action	Value(s)	Yes
1	Did you perform the On-Board (OBD) System Check?	_	Go to Step (2)
2	• Key ON • DST (Diagnostic Scan Tool) connected in system data mode Warm engine to normal operating temperature, then run the engine above 1200 rpm for at least 60 seconds Does the DST display ECT temperture of 220 degrees F or greater?		Go to Step (3)
3	Verify with a temperature gauge that the engine coolant is over 220 degrees F. Does the temperature gauge indicated 220 degrees F. or greater?		Repair cooling system.
4	Verify ECT Circuit function. Follow diagnostic test procedure for DTC 217 (ECT Higher than expected 2)		-

DTC 117-ECT/CHT Low Voltage



Conditions for Setting the DTC

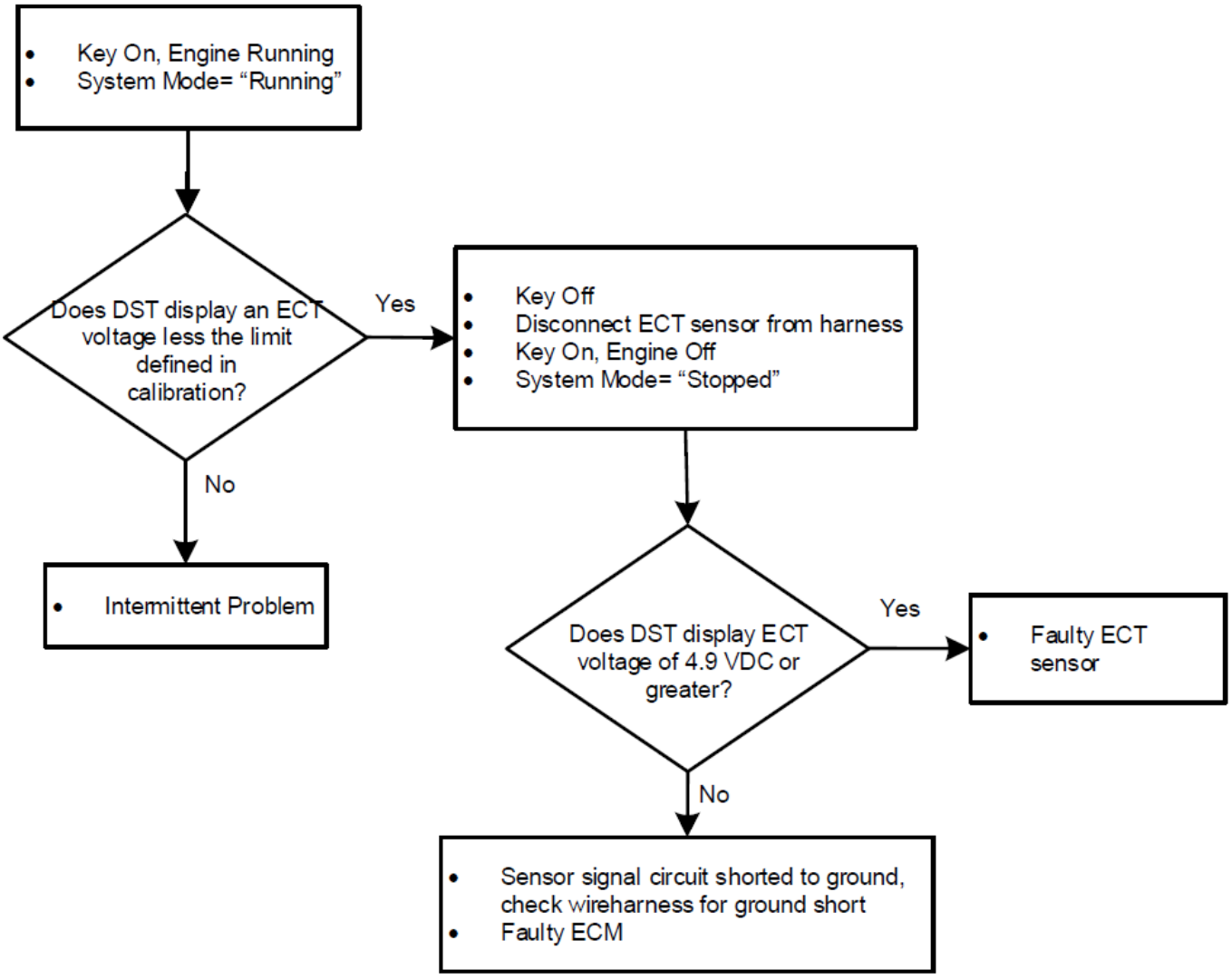
- Check Condition: Engine Running
- Fault Condition: ECT sensor voltage less than 0.050
- MIL: ON during active fault
- Adaptive: Disabled during active fault

Circuit Description

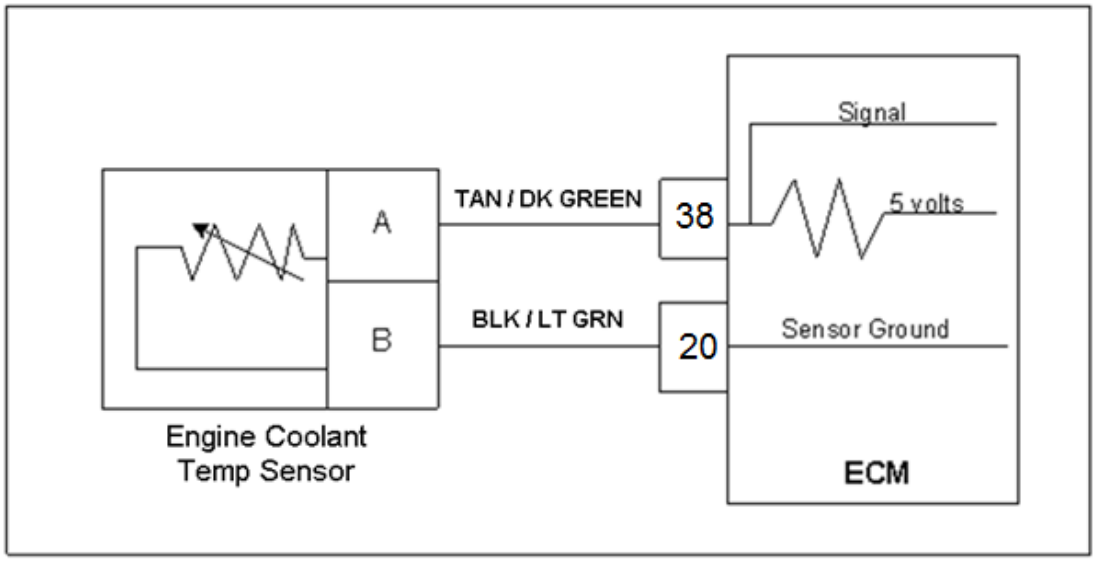
The ECT (Engine Coolant Temperature) sensor is a temperature sensitive resistor located in the engine coolant passage. It is used for the engine airflow calculation, cold fuel enrichment and to enable other temperature dependent features. The ECM provides a voltage divider circuit so that when the coolant is cool, the signal reads higher voltage, and lower when warm (see table). This fault will set if the signal voltage is less than 0.050 volts for any period longer than 1 second. The ECM will use a default value for the ECT sensor in the event of this fault.

Temp (deg F)	Ohms +/-10%
242.4	101
231.9	121
211.6	175
201.4	209
181.9	302
163.1	434
144.9	625
127.4	901
102.4	1,556
78.9	2,689
49.9	5,576
23.5	11,562
-5.7	28,770
-21.2	49,715
-30.8	71,589
-40.0	99,301

DTC 117-ECT/CHT Voltage Low



DTC 118-ECT/CHT High Voltage



Conditions for Setting the DTC

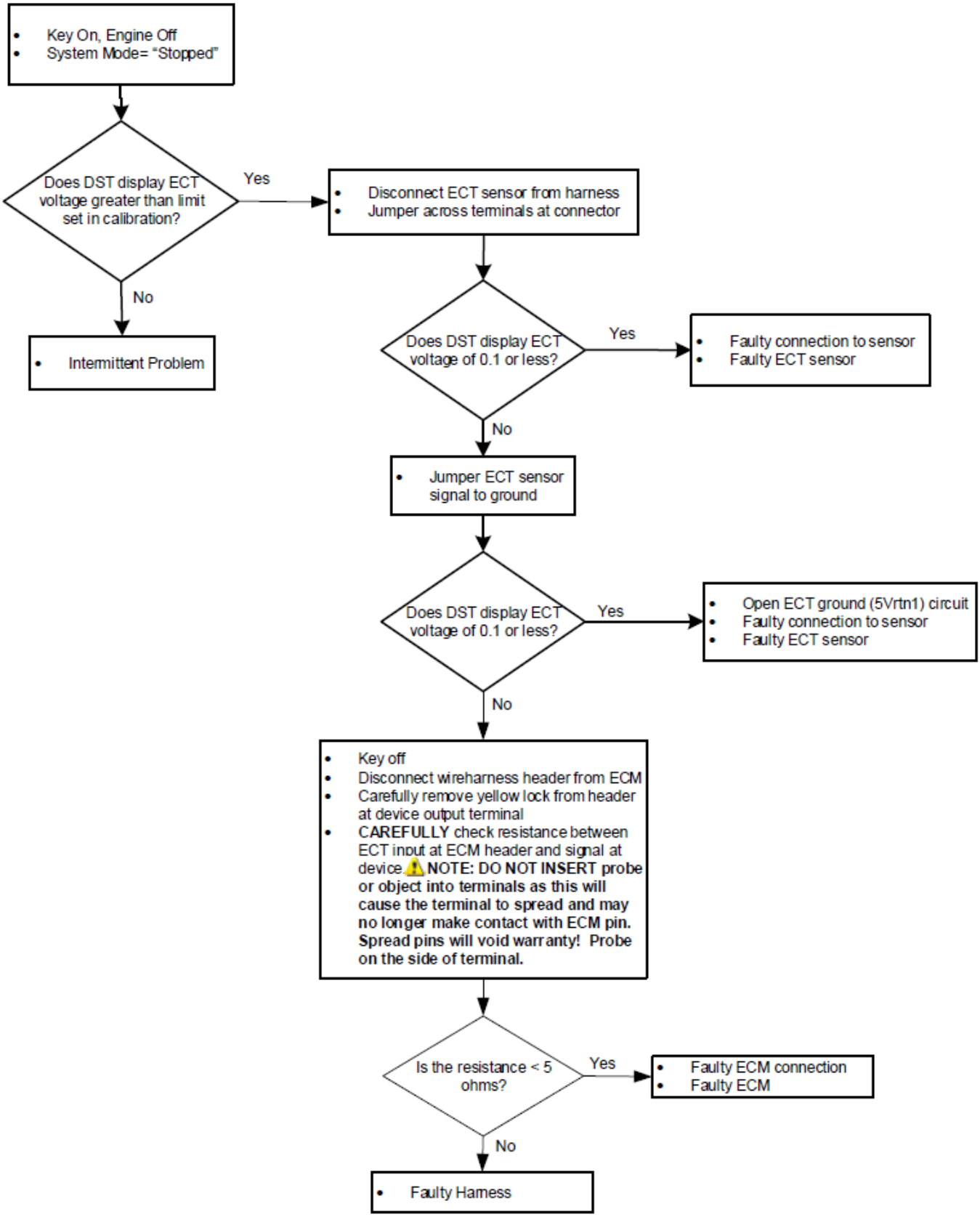
- Check Condition: Engine Running
- Fault Condition: ECT sensor voltage exceeds 4.950 volts
- MIL: ON during active fault
- Adaptive: Disabled

Circuit Description

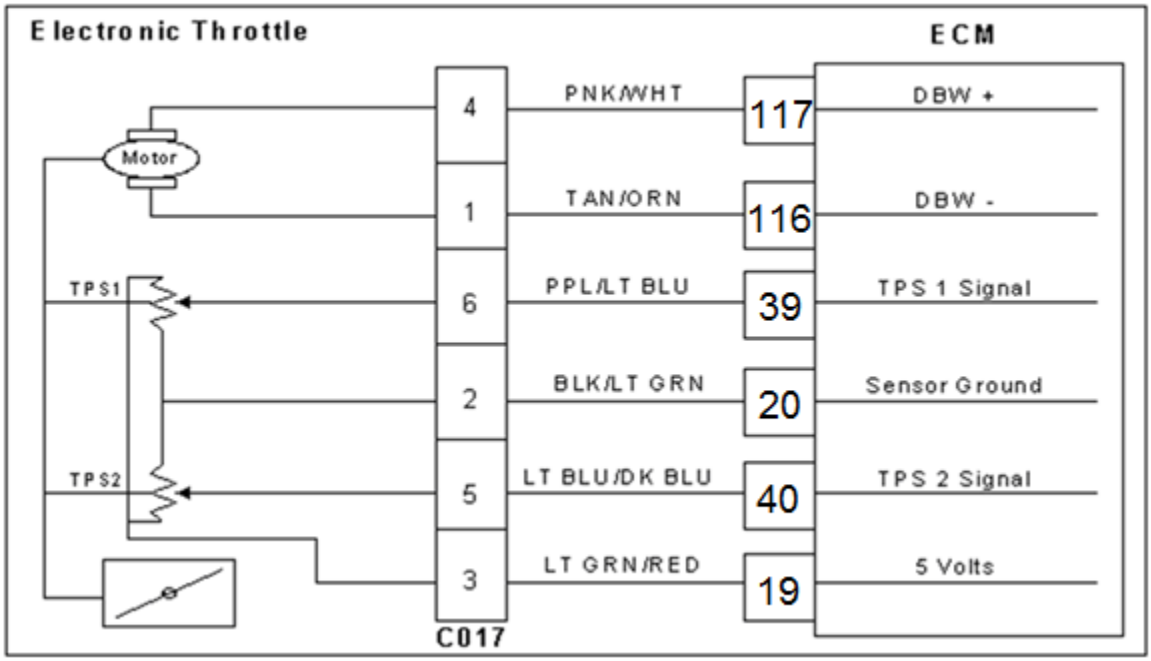
The ECT (Engine Coolant Temperature) sensor is a temperature sensitive resistor located in the engine coolant passage. It is used for the engine airflow calculation, cold fuel enrichment and to enable other temperature dependent features. The ECM provides a voltage divider circuit so that when the coolant is cool, the signal reads higher voltage, and lower when warm (see table). This fault will set if the signal voltage is greater than 4.950 volts anytime the engine is running. The ECM will use a default value for the ECT sensor in the event of this fault.

Temp (deg F)	Ohms +/-10%
242.4	101
231.9	121
211.6	175
201.4	209
181.9	302
163.1	434
144.9	625
127.4	901
102.4	1,556
78.9	2,689
49.9	5,576
23.5	11,562
-5.7	28,770
-21.2	49,715
-30.8	71,589
-40.0	99,301

DTC 118-ECT/CHT Voltage High



DTC 121-TPS 1 Lower Than TPS 2



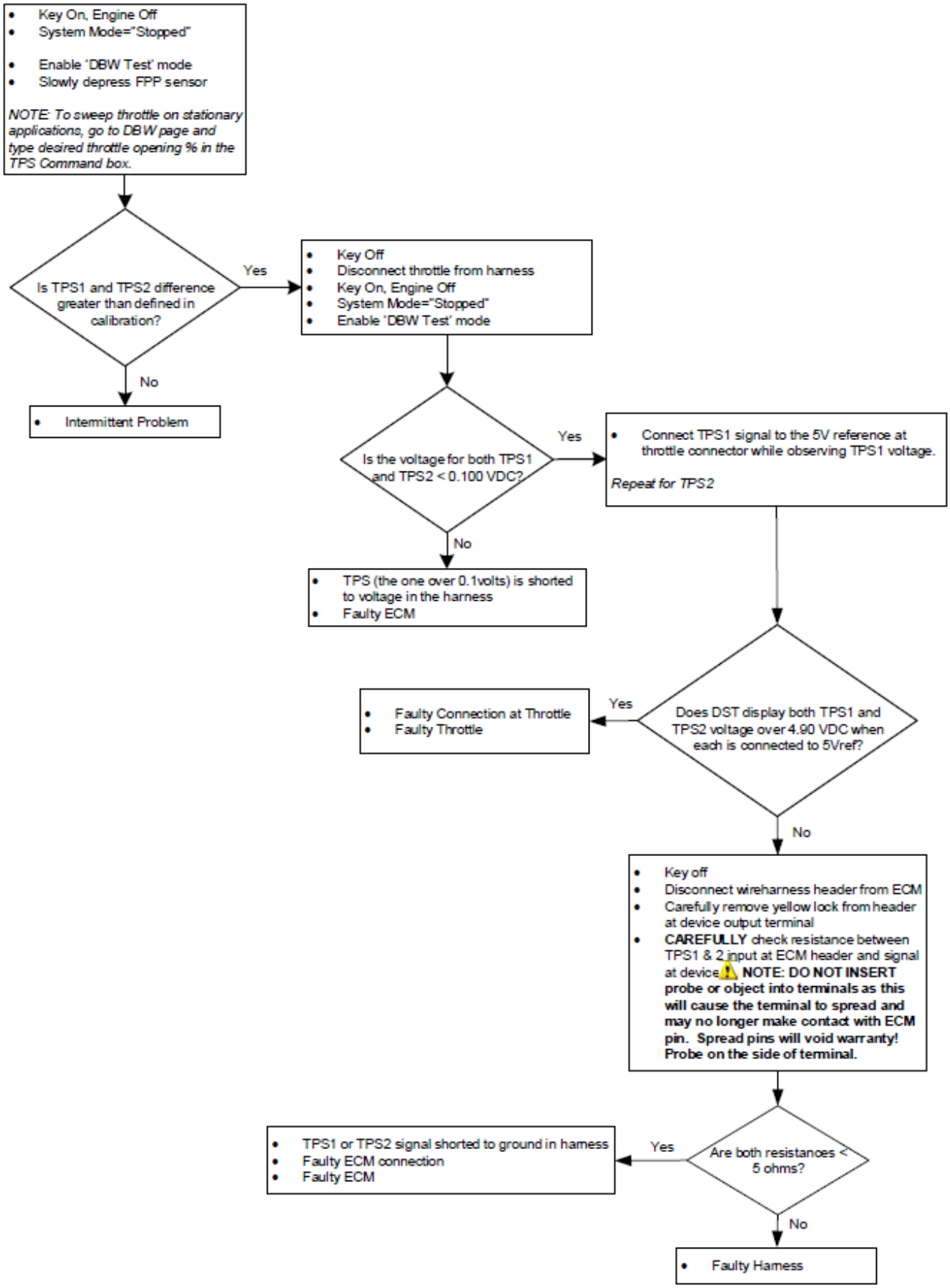
Conditions for Setting the DTC

- Check Condition: Key ON
- Fault Condition: TPS 1 20% lower than TPS 2
- MIL: ON for remainder of key on cycle
- Engine shutdown

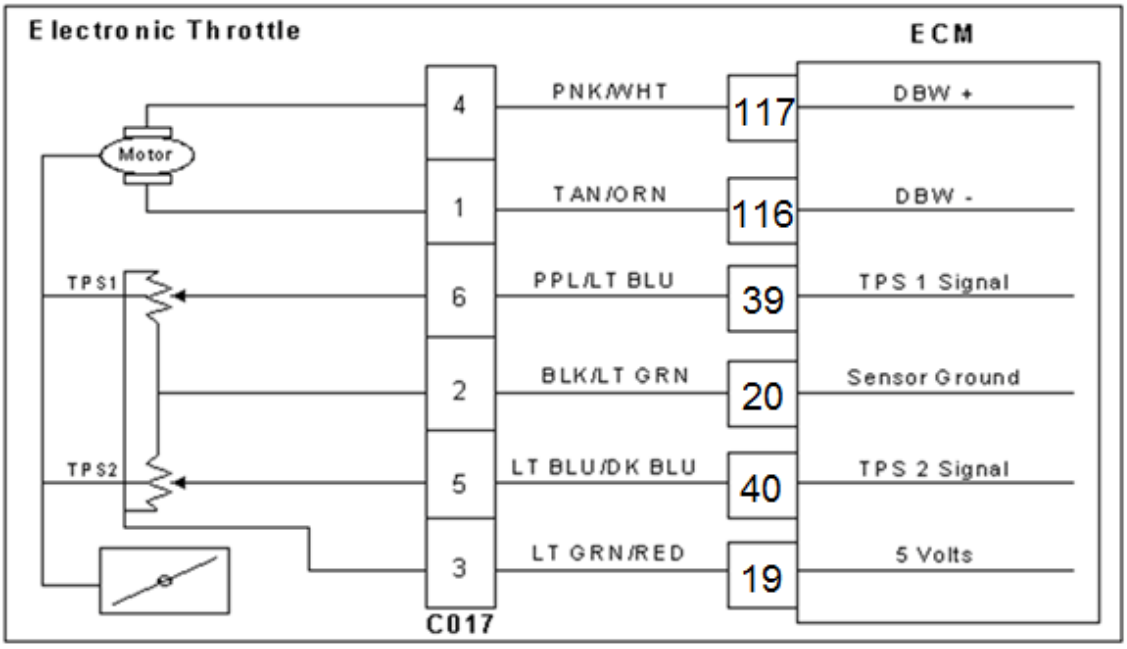
Circuit description

Dual throttle position sensors are used within the throttle that use variable resistors to determine signal voltage based on throttle plate position. TPS 1 will read low voltage when closed and TPS 2 will read high voltage when closed. The TPS 1 and TPS 2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded. This fault will set if TPS 1 is 20% (or more) lower than TPS 2. At this point the throttle is considered to be out of specification, or there is a problem with the TPS signal circuit. The MIL command is on and the engine will shut down.

DTC 121 TPS 1 Lower Than TPS 2



DTC 122-TPS 1 Low Voltage



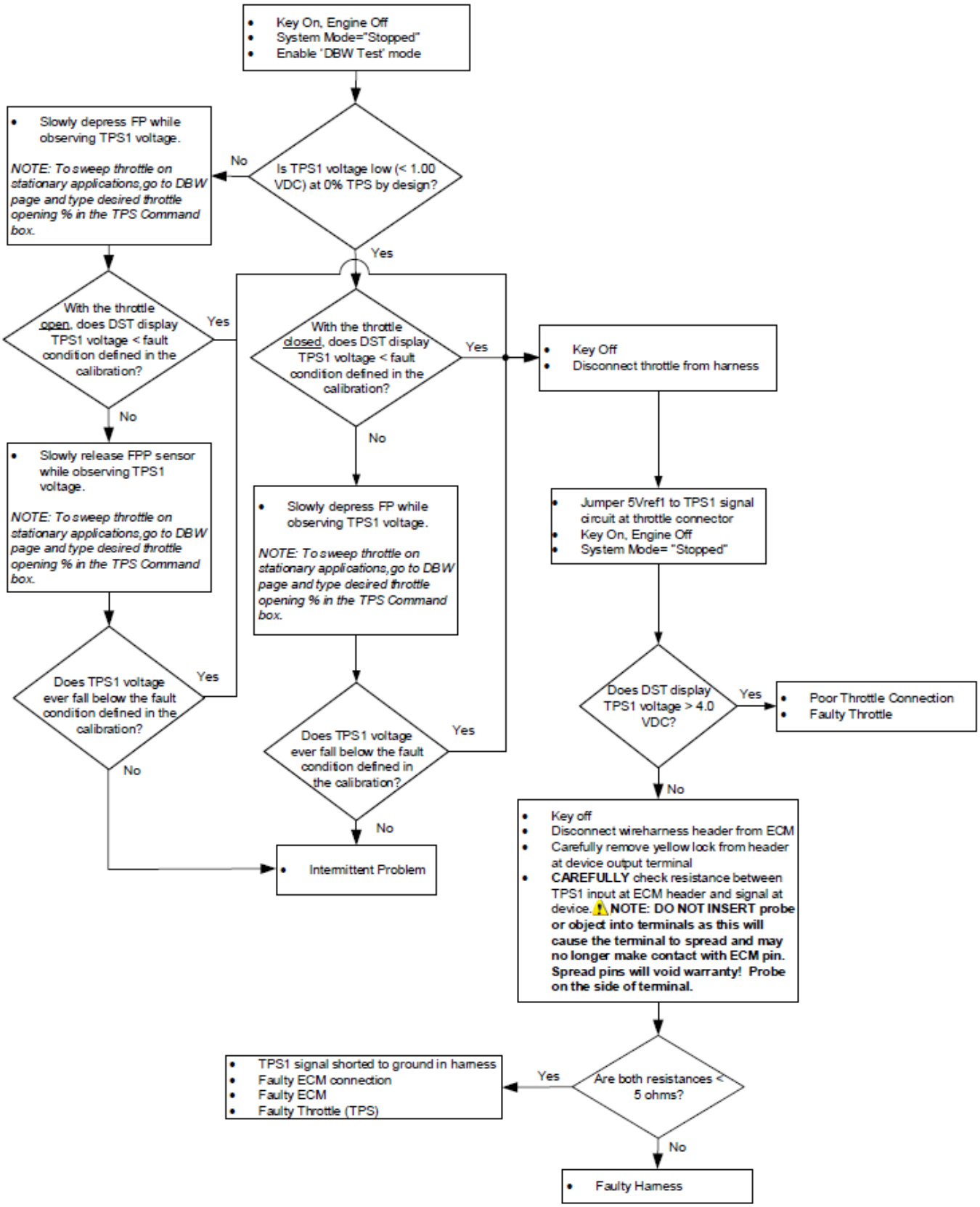
Conditions for Setting the DTC

- Check Condition: Cranking or Running
- Fault Condition: TPS sensor less than 0.200 volts
- MIL: ON during active fault
- Engine shutdown

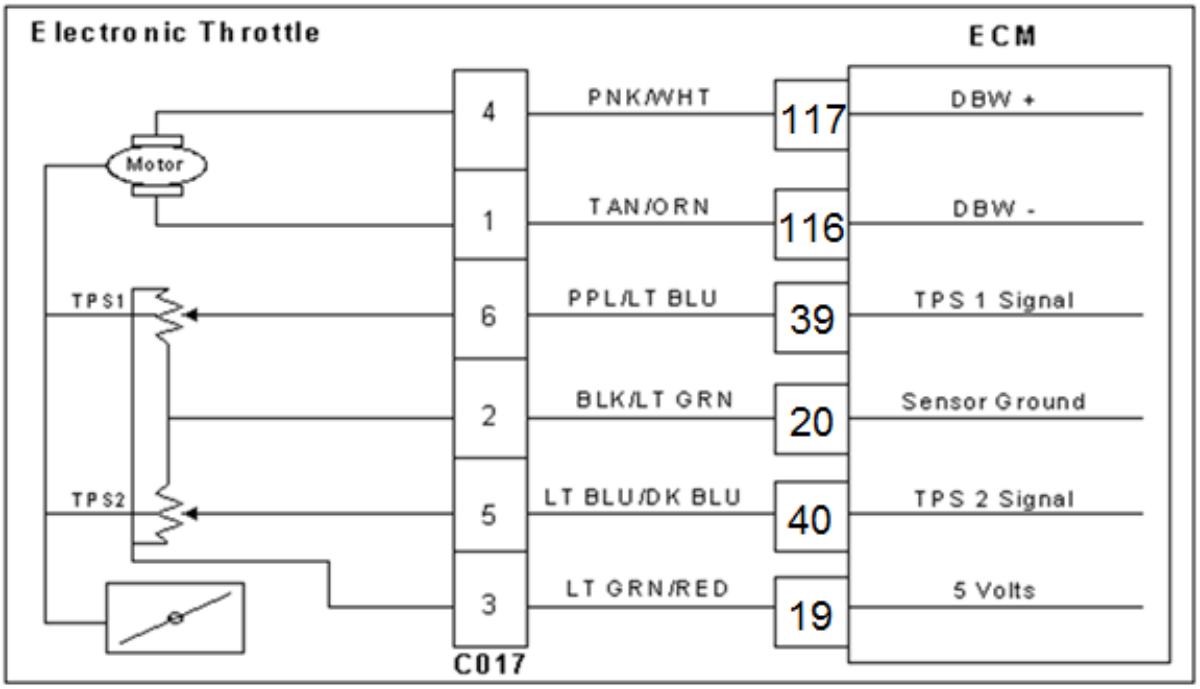
Circuit Description

Dual throttle position sensors are used within the throttle that use variable resistors to determine signal voltage based on throttle plate position. TPS1 will read lower voltage when closed and TPS2 will read higher voltage when closed. The TPS1 and TPS2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded. The TPS is not serviceable and in the event of a failure the electronic throttle assembly must be replaced. This fault will set if the TPS 1 voltage is less than 0.200 volts. The MIL command is ON and the engine will shut down.

DTC 122 TPS 1 Signal Voltage Low



DTC 123-TPS 1 High Voltage



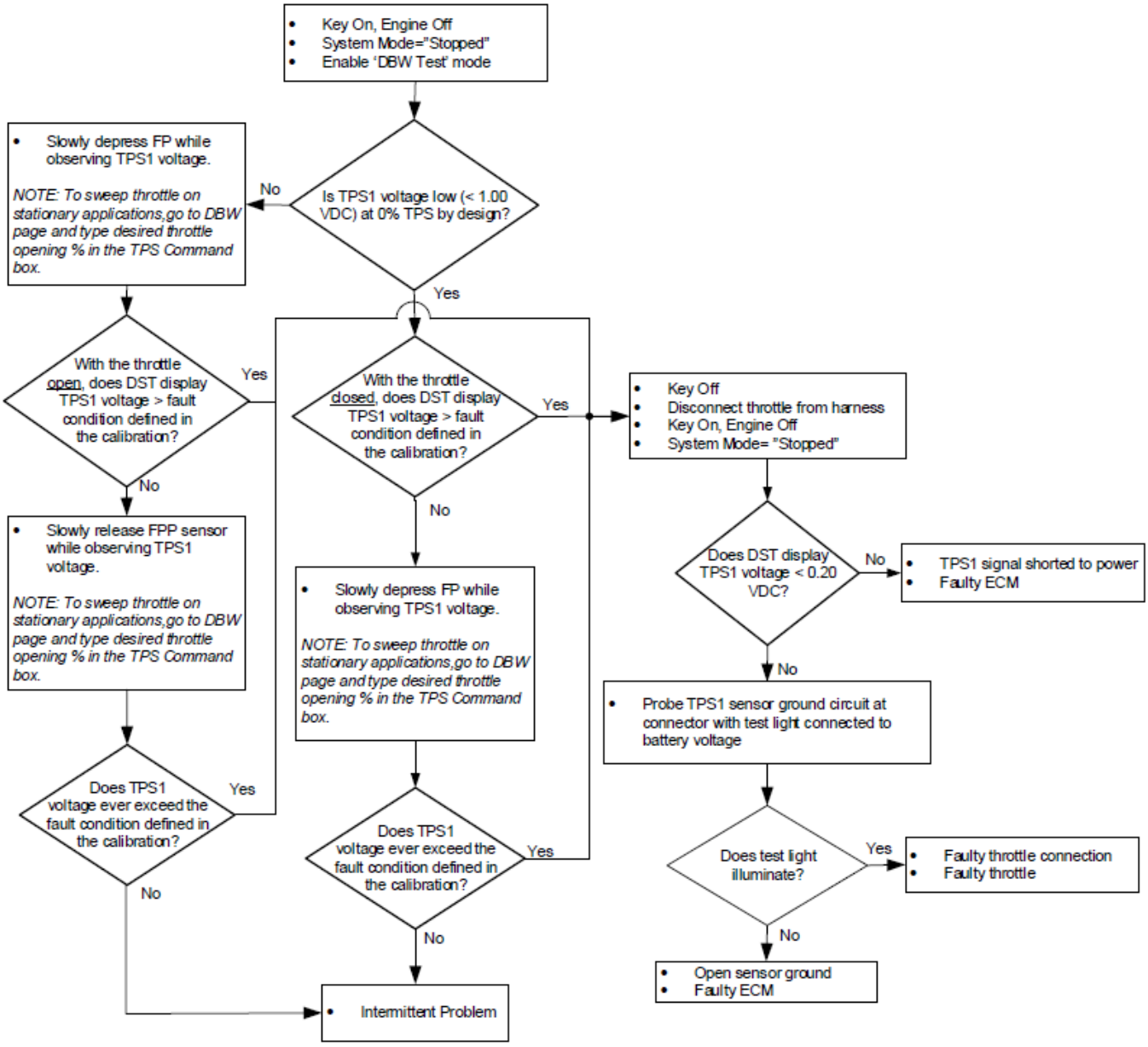
Conditions for Setting the DTC

- Check Condition: Cranking or Running
- Fault Condition: TPS sensor voltage exceeds 4.800 volts
- MIL: ON during active fault
- Engine shutdown

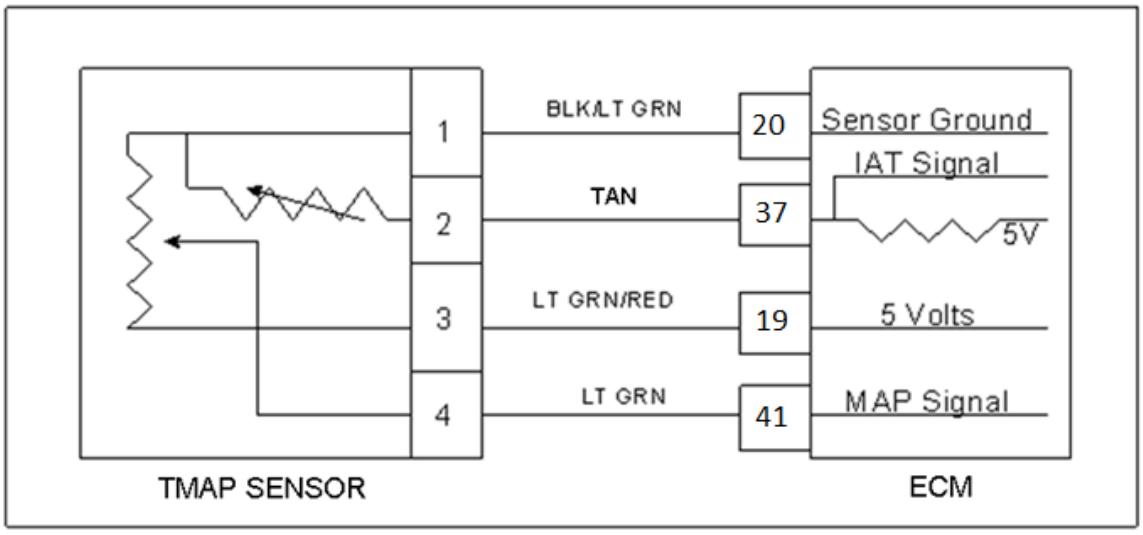
Circuit Description

Dual throttle position sensors are used within the throttle that use variable resistors to determine signal voltage based on throttle plate position. TPS1 will read lower voltage when closed and TPS2 will read higher voltage when closed. The TPS1 and TPS2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded. The TPS is not serviceable and in the event of a failure the electronic throttle assembly must be replaced. This fault will set if the TPS 1 voltage exceeds 4.800 volts. The MIL command is ON and the engine will shut down.

DTC 123 TPS 1 Signal Voltage High



DTC 127-IAT Higher Than Expected 2



Conditions for Setting the DTC

- Check Condition: Engine Running
- Fault Condition: Intake Air Temperature greater than 155 degrees F. with engine speed greater than 600 rpm
- Fault condition must be active for longer than 5 seconds
- MIL: ON for active fault
- Engine Shut Down

Circuit Description

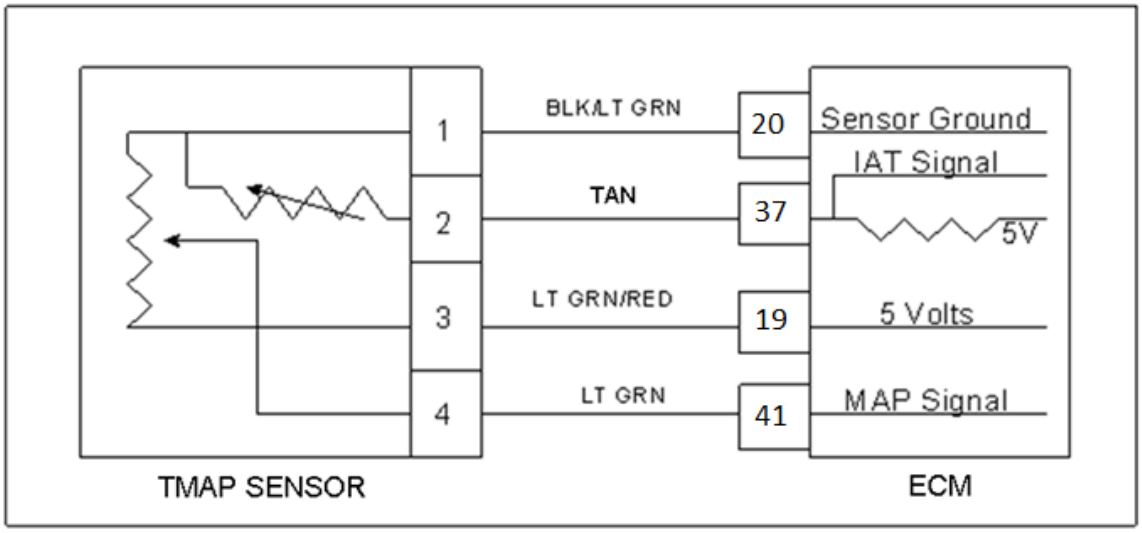
The TMAP is a combined IAT (Intake Air Temperature) and MAP (Manifold Absolute Pressure) sensor. A temperature sensitive resistor is used in the TMAP located in the intake manifold of the engine. It is used to monitor incoming air temperature, and the output in conjunction with other sensors is used to determine the airflow to the engine. The ECM provides a voltage divider circuit so that when the air is cool, the signal reads a higher voltage, and lower when warm. This fault will set if the intake air temperature is greater than 155 degrees F. with engine speed greater than 600 rpm. The MIL light command is on during this active fault and the engine will shut down.

DTC 127-IAT Higher Than Expected 2

Diagnostic Aid

- This fault will set when inlet air is much hotter than normal. The most common cause of high inlet air temperature is a problem with the air inlet system. Ensure that the air inlet is not obstructed, modified or damaged, and that hot air from the engine, exhaust, or radiator is not recirculating into the air inlets.
- Inspect the air inlet system for cracks or breaks that may allow heated air into the air inlet system.
- If none of the above can be found, follow the diagnostic steps for DTC 112-IAT Low Voltage.

DTC 129-BP Low Pressure



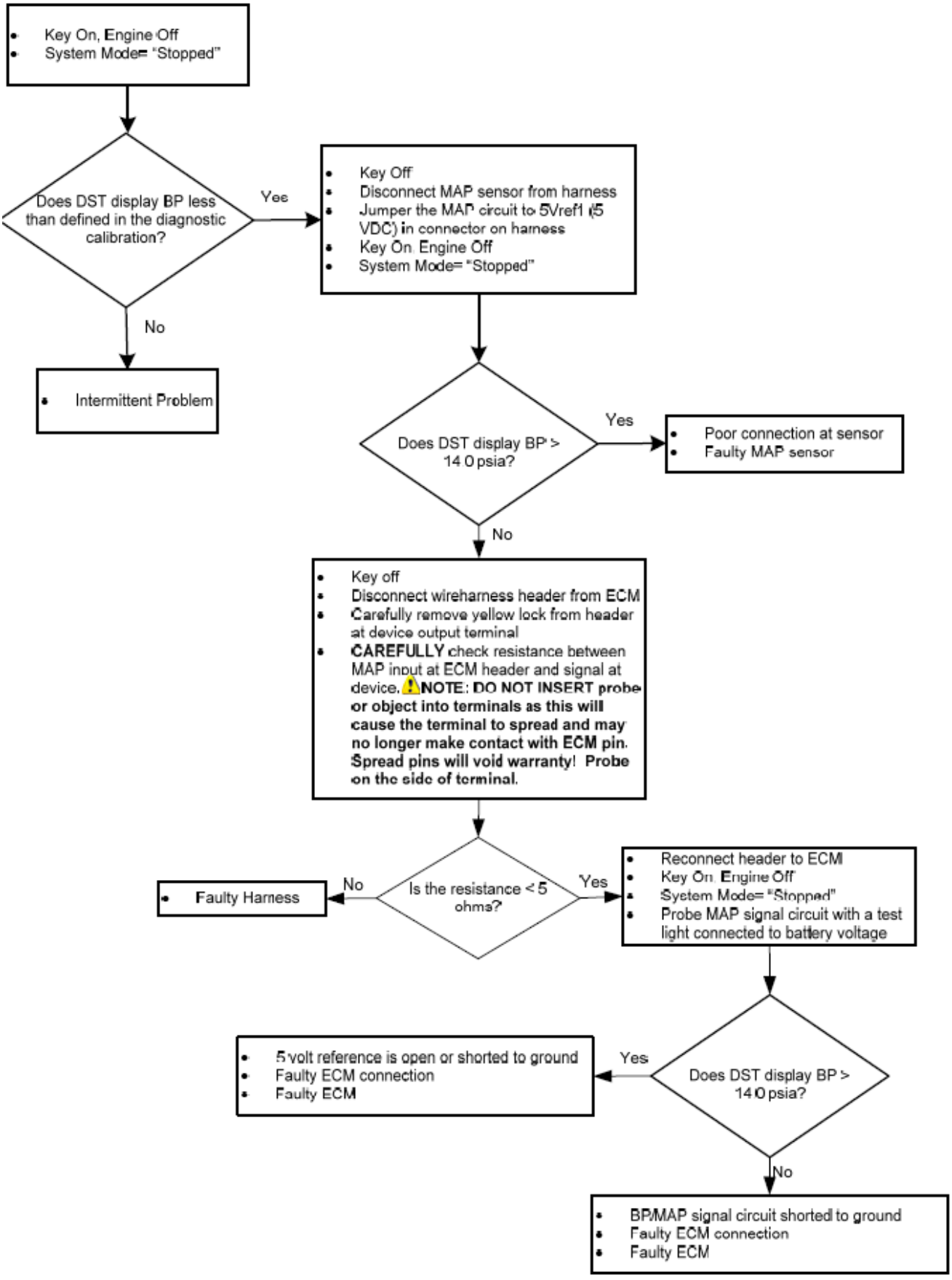
Conditions for Setting the DTC

- Check Condition: Key ON
- Fault Condition: BP less than 8.30 psia
- MIL: ON for active fault
- Adaptive: Disabled

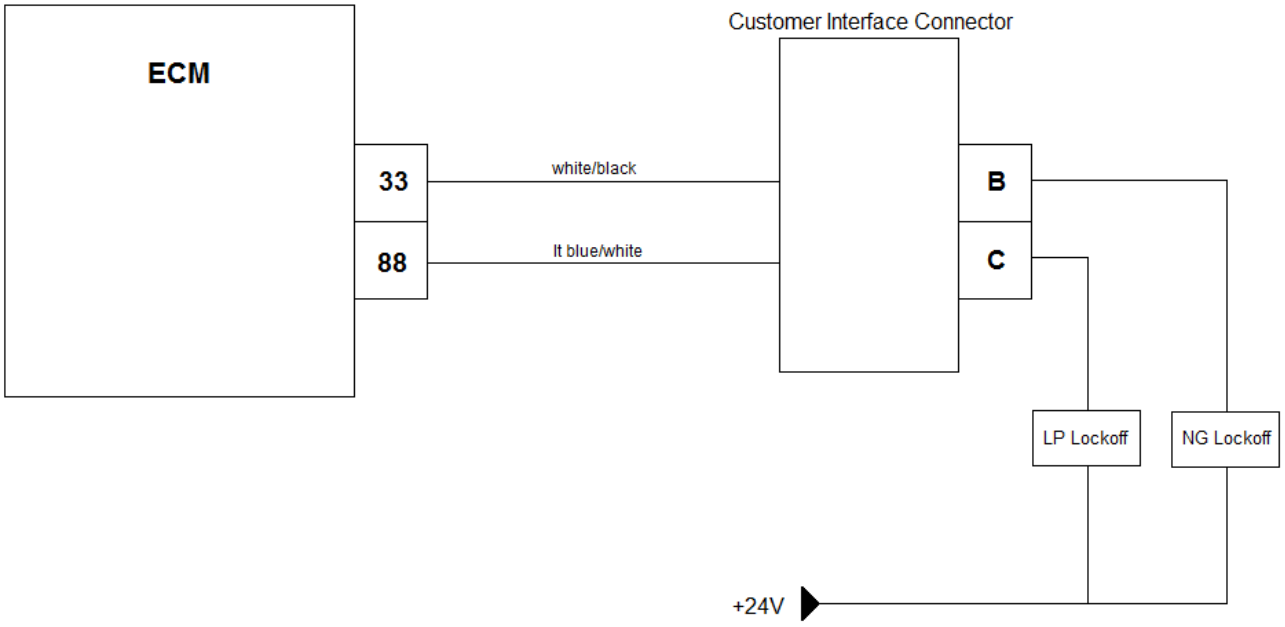
Circuit Description

The BP (Barometric Pressure) is estimated from the TMAP sensor. The barometric pressure value is used for fuel and airflow calculations. This fault sets in the event the BP value is out of the normal range.

DTC 129-BP Low Pressure



DTC-148 Fuel Run-out Longer Than Expected



Conditions for Setting the DTC

- Check Condition: Key OFF
- Fault Condition: Engine run down time greater than 10 seconds
- MIL-ON

Circuit Description

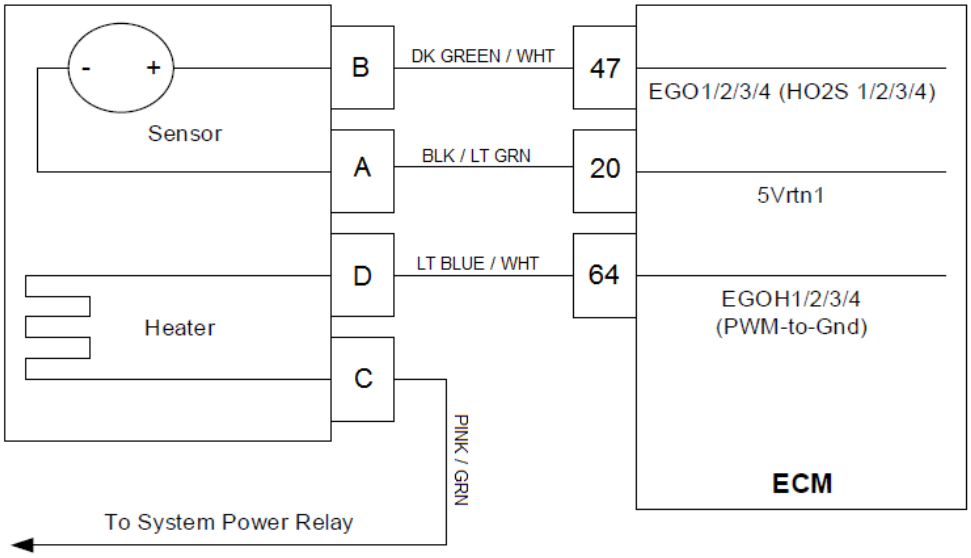
The fuel shut off valves are supplied system battery power from the VSW fused source. The ECM then provides a path to ground to turn the valve on. This fault will set in the event the engine continues to run for more than 10 seconds after the key is turned off. This fault indicates a possible problem with the electric fuel shut-off valve, or a wiring issue.

DTC-148 Fuel Run-out Longer Than Expected

Step	Action	Value(s)	Yes		No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)		
2	Disconnect the natural gas lockoff solenoid connector. Using a DVOM check for power across terminals A and B while cranking the engine, then turn the key to the OFF position Did the voltage immediately turn OFF with the key cycle?	System Voltage	Go to Step (3)		Go to Step (5)
3	Turn off the natural gas manual valve. Start the engine and let it idle until the engine stops. (THIS MAY TAKE SEVERAL MINUTES) Did the engine ever stop?		Intermittent problem. See intermittent problems in the electrical section of this manual.		Go to Step (4)
4	Replace the natural gas lockoff solenoid. Is the replacement complete?		Go to Step (8)		–
5	Key OFF Disconnect the ECM wire harness header connector Using a DVOM check for continuity between header connector pin 33 and engine ground Do you have continuity?		**Repair the natural gas solenoid control short to ground**		Go to Step (6)
6	Inspect the ECM wire harness and connector for damage corrosion or contamination Did you find a problem?		**Correct the problem as required. See wire harness repair.**		Go to Step (7)
7	Replace the ECM Is the replacement complete?		Go to Step (8)		–

Step	Action	Value(s)	Yes		No
8	**Remove all test equipment except the DST.** Connect any disconnected components, fuses, etc. Using the DST clear DTC information from the ECM. Turn the ignition OFF and wait 30 seconds. Start the engine and operate the vehicle to full operating temperature Observe the MIL Observe engine performance and drivability After operating the engine within the test parameters of DTC-359 check for any stored codes. **Does the engine operate normally with no stored codes?**		**System OK**		**Go to OBD System Check**

DTC 154 – EGO2 Open/Lazy



Conditions for Setting the DTC

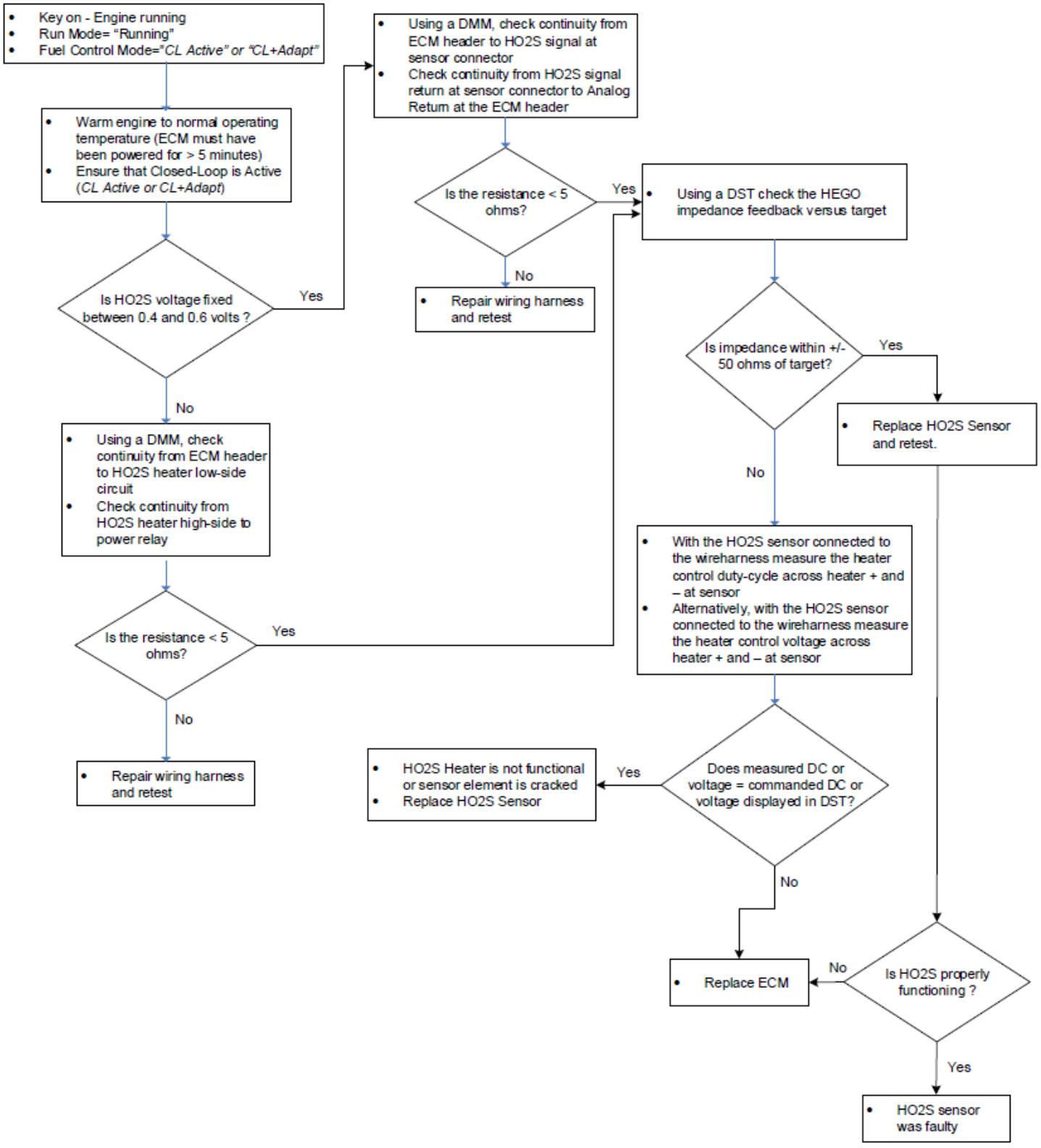
- Check Condition: Key-On, Engine Running
- Fault Condition: EGO cold persistently for greater than 120 seconds
- MIL: ON during active fault

Fault Description

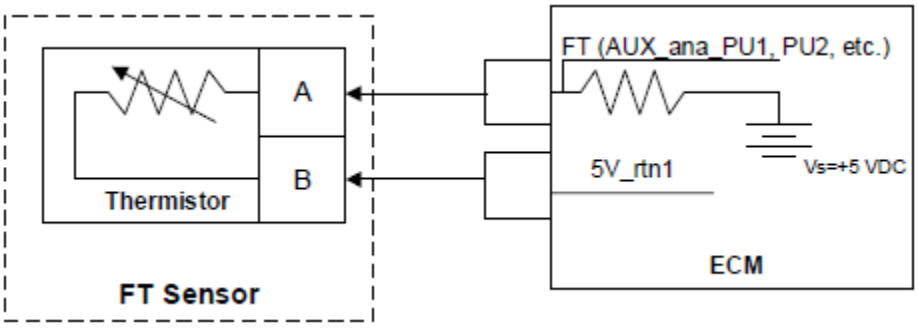
In a post-catalyst configuration, the HEGO/H2OS sensor is a switching-type sensor around stoichiometry that measures the oxygen content downstream of the catalyst for two main functions: 1) to compare it to the oxygen content upstream of the catalyst to determine how efficiently the catalyst is using oxygen to determine its effectiveness and 2) trim the commanded equivalence ratio target to maximize the catalyst conversion efficiency.

This fault will set if the sensor element is cold, non-responsive, or inactive for 120 seconds. Cold, non-responsive, or inactive are determined based on two criteria: 1) a measurement of the feedback sense element (zirconia) to determine its temperature or 2) a lack of change in sensor feedback.

DTC 154 – EGO2 Open/Lazy



DTC 187 – Fuel Temperature Gaseous Low



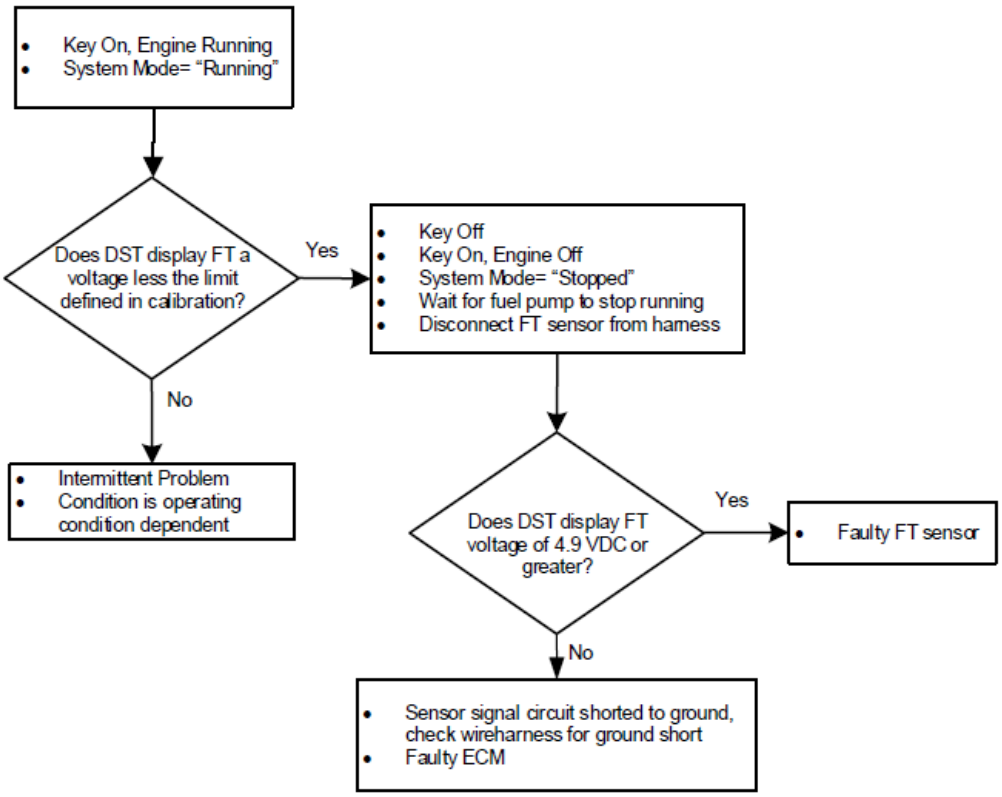
Conditions for setting DTC

- Key on, Engine on
- Fault Conditions: FT voltage less than normal operating voltage or fuel temperature less than normal operating temperature.

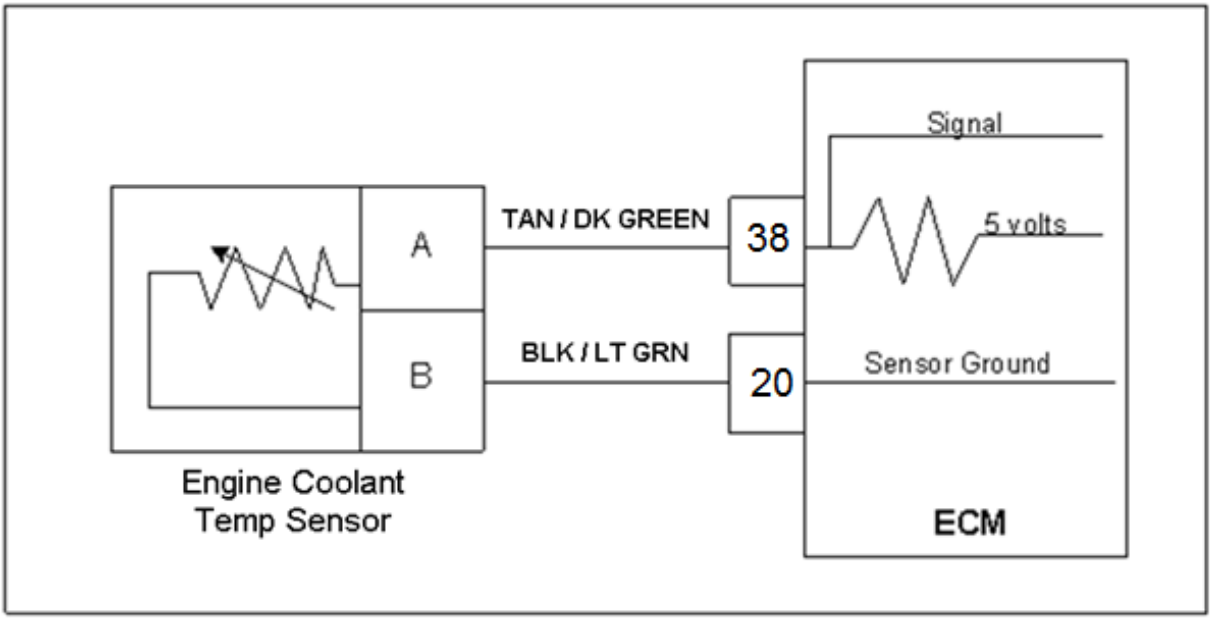
Fault Description

The Fuel Temperature sensor is a thermistor (temperature sensitive resistor) integrated into the EPR fuel outlet. It is used to monitor the gaseous fuel temperature exiting the EPR to be used as an input in a fuel temperature estimation of the temperature entering the gaseous mixer. This information is used to calculate a real-time fuel pressure correction in order to reduce fueling errors. The ECM provides a voltage divider circuit so that when the fuel is cool, the signal reads higher voltage, and lower when warm.

DTC 187 – Diagnostic Troubleshooting Tree



DTC 217- ECT Higher Than Expected 2



Conditions for Setting the DTC

- Check Condition: Engine Running
- Fault Condition: Engine Coolant Temperature reading or estimate greater than 230 degrees F. for greater than 10 seconds
- MIL: On
- Engine shutdown will occur

Circuit Description

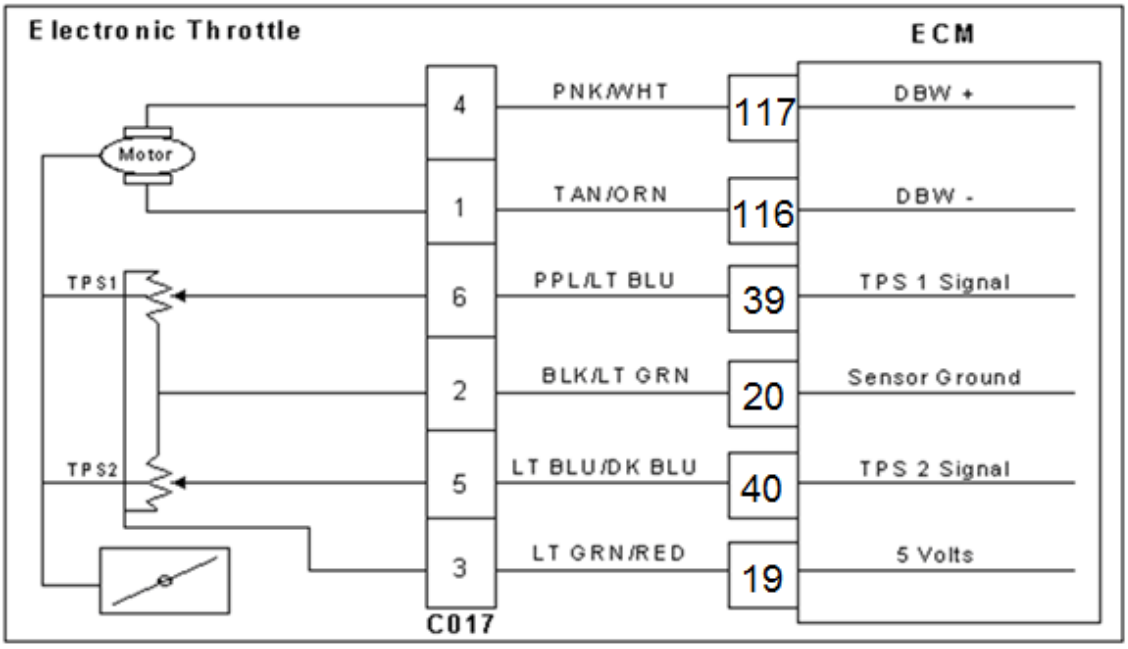
The ECT (Engine Coolant Temperature) sensor is a temperature sensitive resistor located in the engine coolant sensor that is located in the coolant passage. The ECT is used for engine airflow calculation, fuel enrichment, and ignition timing control and to enable certain other temperature dependent operations. This code set is designed to help prevent engine damage from overheating. The ECM provides a voltage divider circuit so when the sensor reading is cool the sensor reads higher voltage, and lower when warm. This fault will set when the coolant exceeds 230 degrees F. for more than 10 seconds. Engine shutdown will occur if this code occurs.

DTC 217-ECT Higher Than Expected 2

This is not an electronic fault; the engine is running too hot. The cooling system should be thoroughly inspected to find the root cause of the overheating.

- Is the cooling system full?
- Is the coolant in the cooling system the proper type, and is it the proper 50/50 mix of coolant and water?
- Are the fan belts intact and tight?
- Is the radiator clean? Debris on the radiator core and impede airflow through the radiator and cause the engine to overheat. Bear in mind that most engines are equipped with pusher fans, so the side of the radiator core closest to the engine will be the one to get coated with debris. Fan guards may need to be removed in order to inspect and properly clean the radiator core.
- Is hot air recirculating around the radiator, or is hot exhaust being drawn into the airflow through the radiator?

DTC 221-TPS 1 Higher Than TPS 2



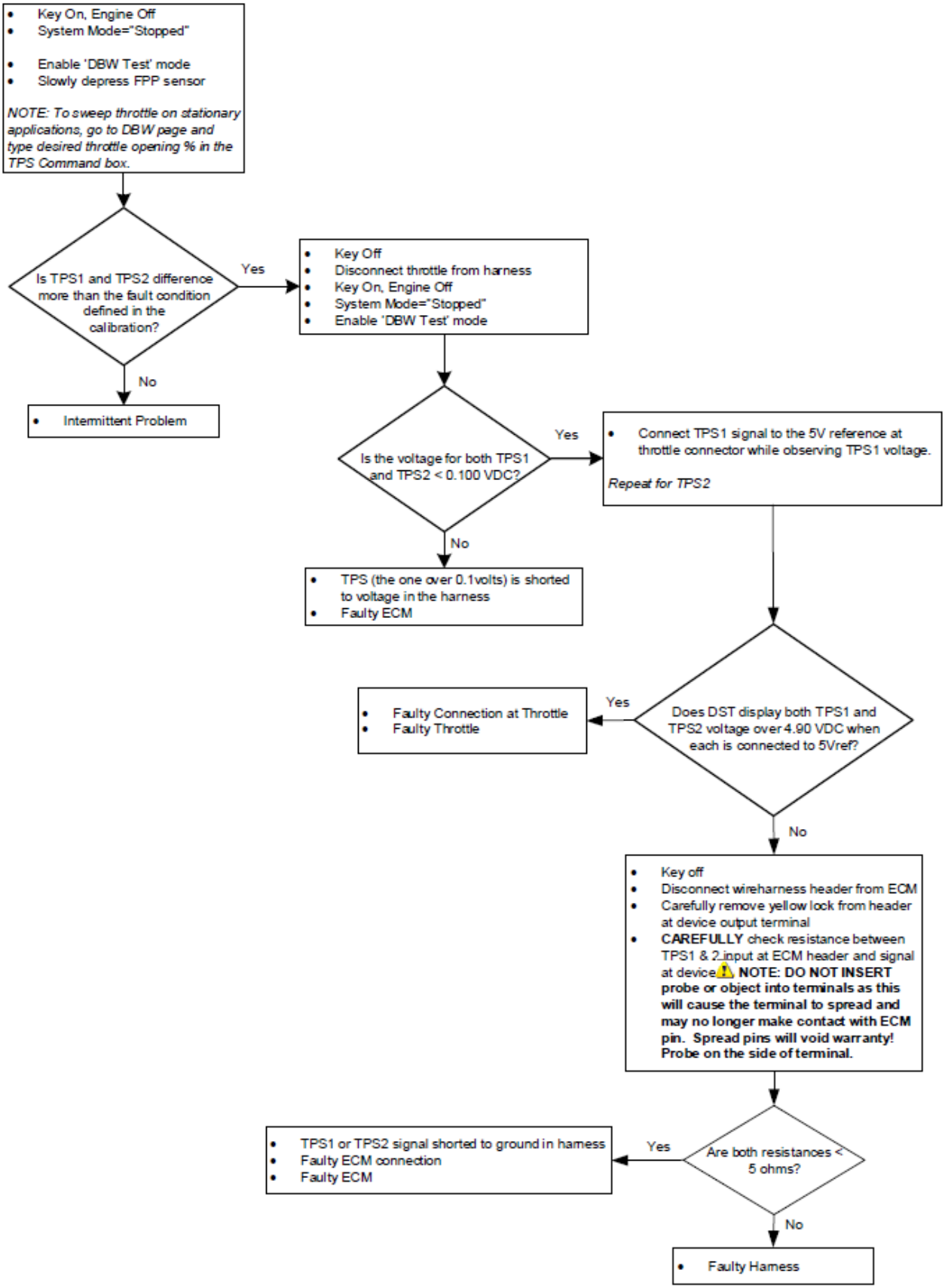
Conditions for Setting the DTC

- Check Condition: Key ON
- Fault Condition: TPS 1 20% higher than TPS2
- MIL: ON for remainder of key on cycle
- Engine shutdown

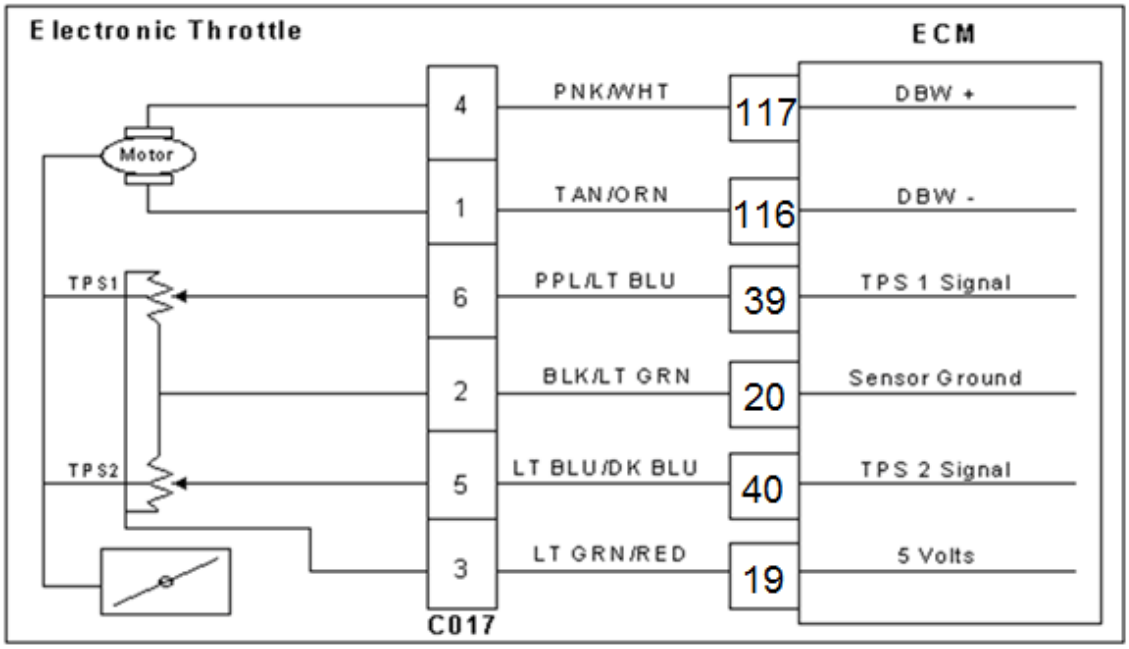
Circuit Description

Dual throttle position sensors are used within the throttle that use variable resistors to determine signal voltage based on throttle plate position. TPS 1 will read lower voltage when closed and TPS 2 will read higher voltage when closed. The TPS 1 and TPS 2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded. The TPS is not serviceable and in the event of a failure the electronic throttle assembly must be replaced. This fault will set if TPS 1 is 20% (or more) higher than TPS 2. At this point the throttle is considered to be out of specification, or there is a problem with the TPS signal circuit. The MIL command is ON and the engine will shut down.

DTC 221 TPS 1 Higher Than TPS 2



DTC 222-TPS 2 Signal Voltage Low



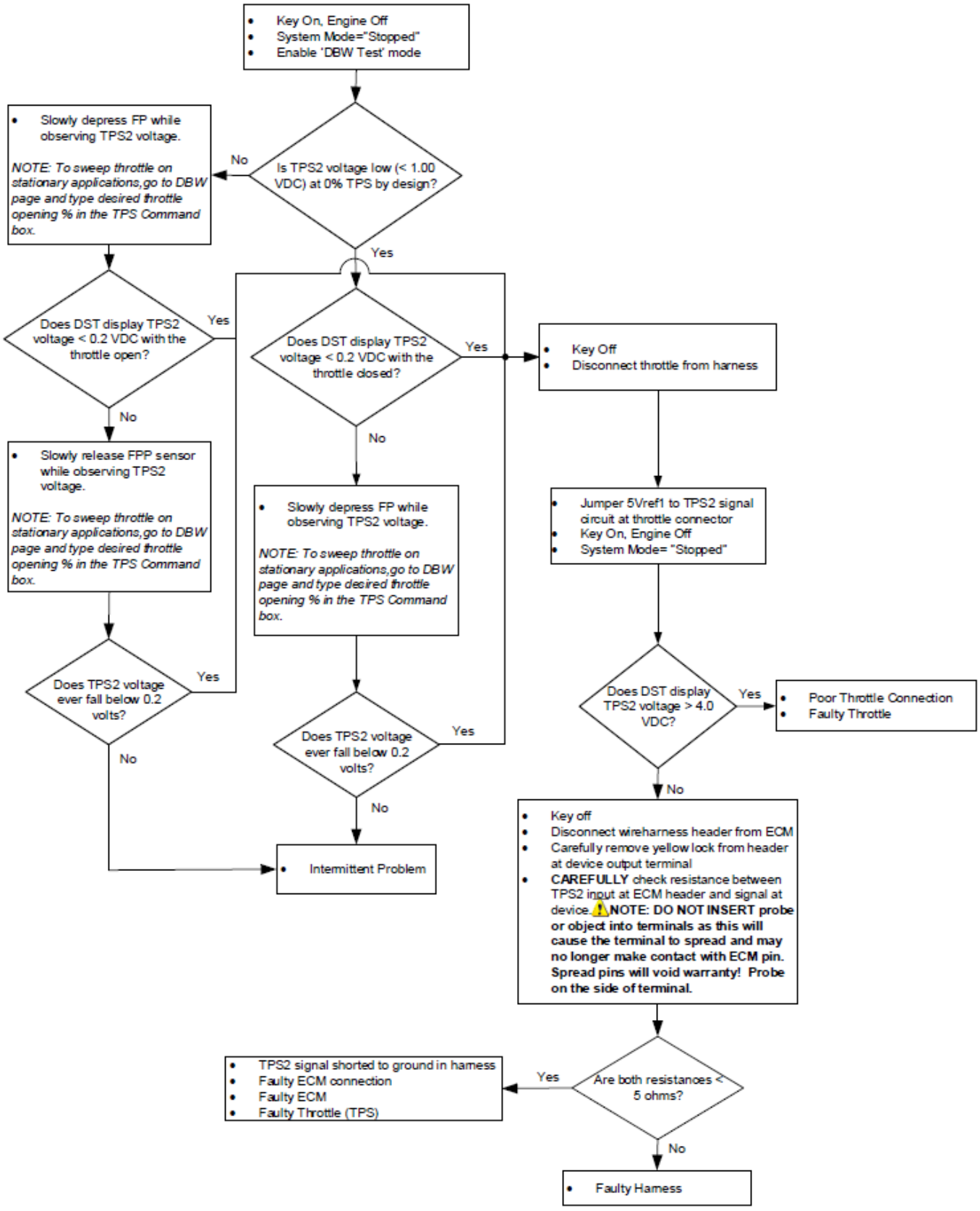
Conditions for Setting the DTC

- Check Condition: Cranking or Running
- Fault Condition: TPS 2 sensor voltage less than 0.200 volts
- MIL: ON during active fault

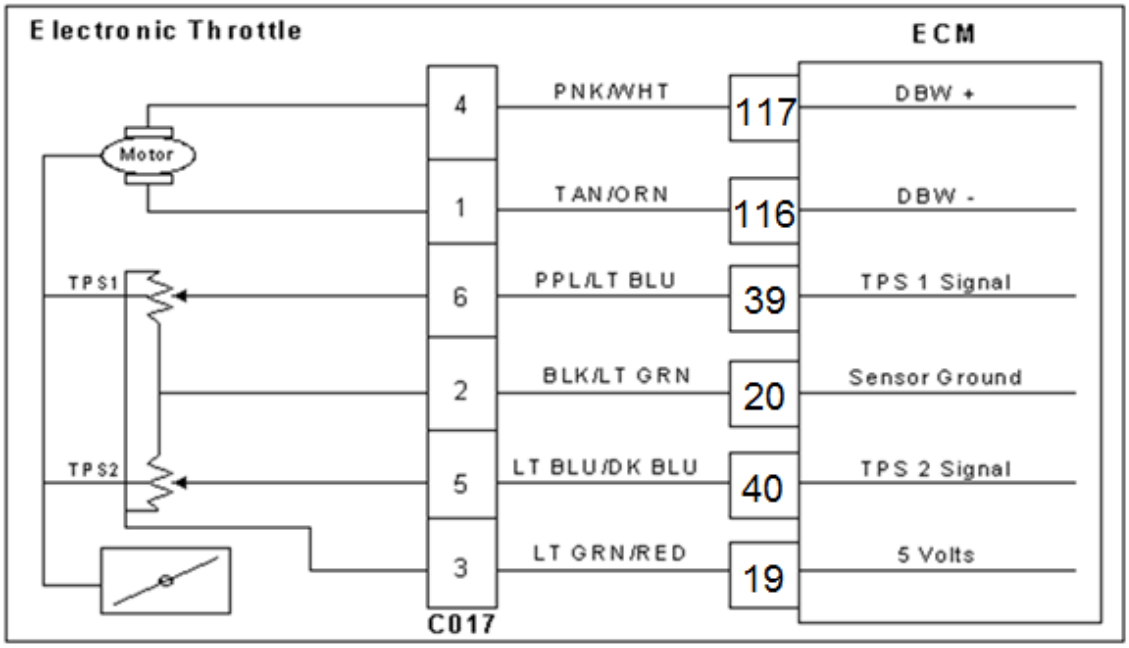
Circuit Description

Dual throttle position sensors are used within the throttle that use variable resistors to determine signal voltage based on throttle plate position. TPS1 will read lower voltage when closed and TPS2 will read higher voltage when closed. The TPS1 and TPS2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded. The TPS is not serviceable and in the event of a failure the electronic throttle assembly must be replaced. This fault will set if the TPS 2 voltage is less than 0.200 volts. The MIL command is ON.

DTC 222 TPS 2 Signal Voltage Low



DTC 223-TPS 2 Signal Voltage High



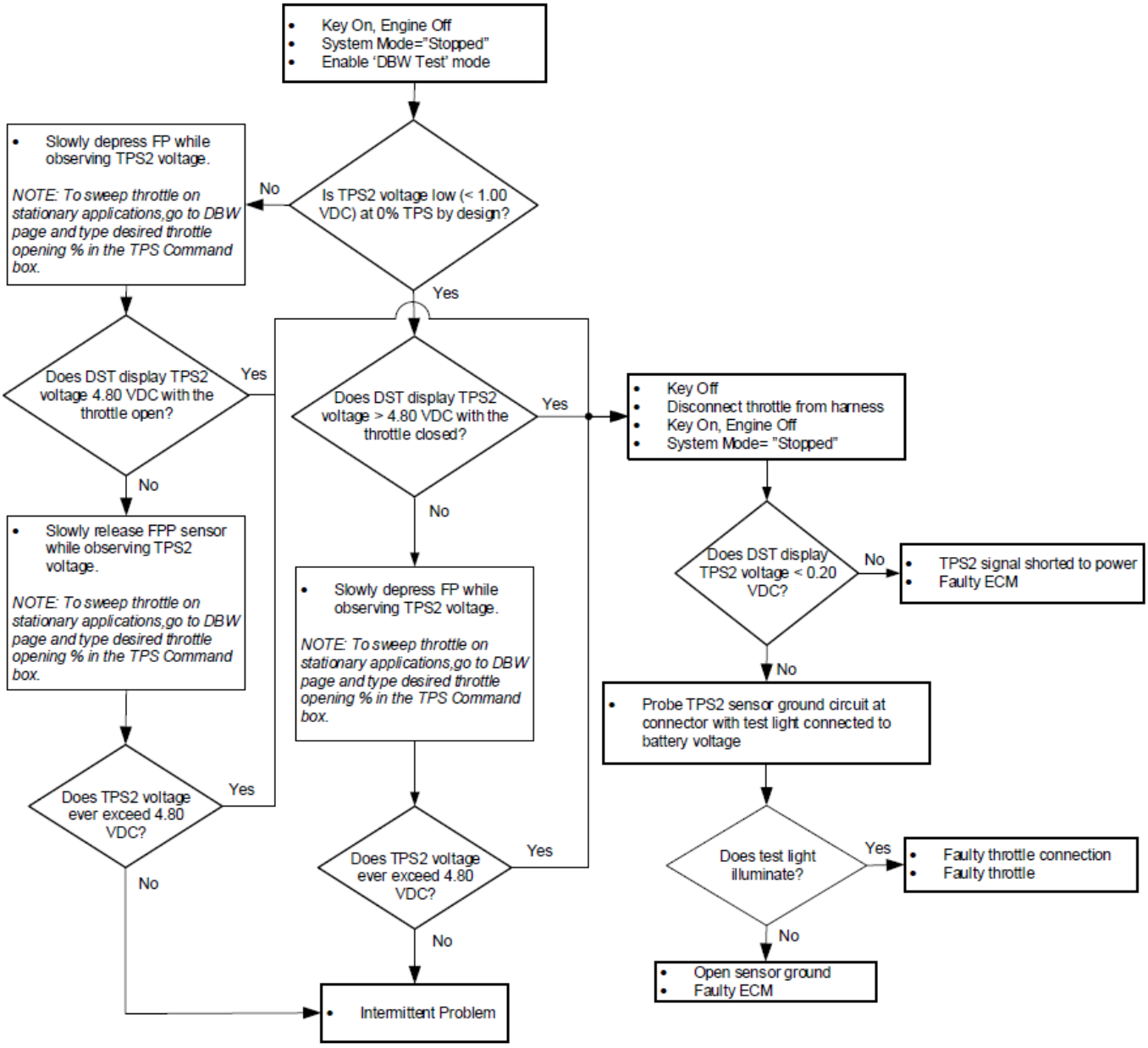
Conditions for Setting the DTC

- Check Condition: Cranking or Running
- Fault Condition: TPS 2 sensor exceeds 4.800 volts
- MIL: ON during active fault

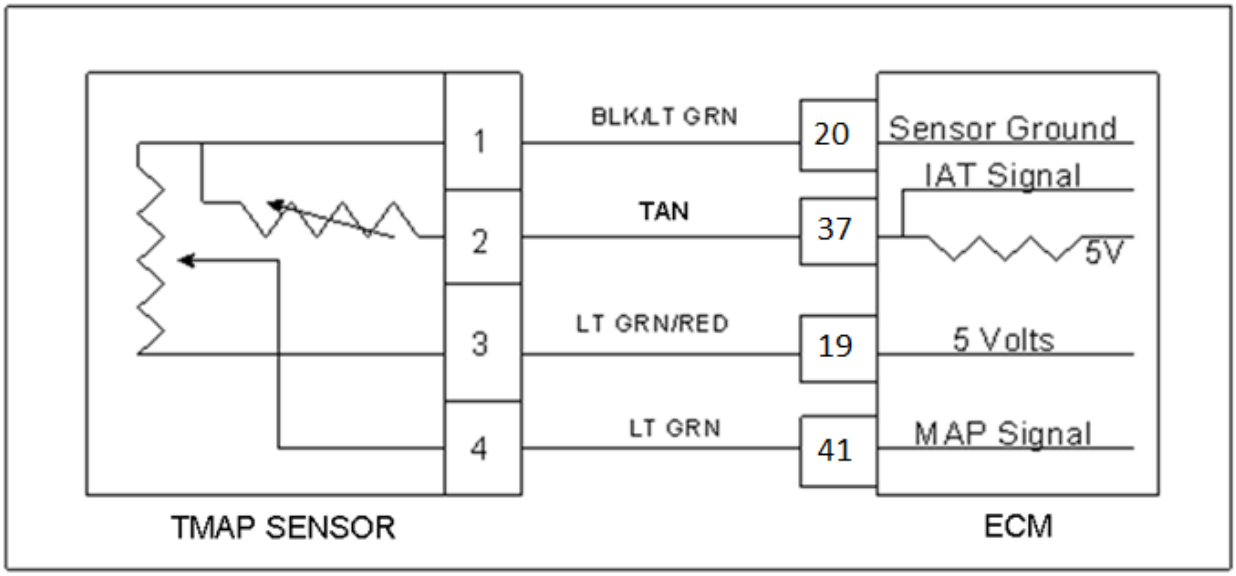
Circuit Description

Dual throttle position sensors are used within the throttle that uses variable resistors to determine signal voltage based on throttle plate position. TPS1 will read lower voltage when closed and TPS2 will read higher voltage when closed. The TPS1 and TPS2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded. The TPS is not serviceable and in the event of a failure the electronic throttle assembly must be replaced. This fault will set if the TPS 2 voltage is greater than 4.800 volts. The MIL command is ON.

DTC 223 TPS 2 Signal Voltage High



DTC 234 – Boost Control Overboost Failure



Conditions for Setting the DTC

- Check Condition: Key-On, Engine Running
- Fault Condition: MAP is greater than 8 psia, slave MAP is 1.5 psi higher than master MAP for 45 seconds
- MIL: ON during active fault
- Engine Shutdown

Fault Description

A V-series engine has separate fuel systems and throttles for the master (right) side and slave (left) side of the engine. In order to ensure that all cylinders are equally contributing power the manifold absolute pressure must be nearly the same on both sides of the engine. The engine compares the data coming from the MAP sensors on both sides. This fault will set if the ECU measures MAP on the slave side is at least 1.5 psi higher than the master MAP for 45 seconds. The MIL command is ON and the engine will shut down.

Diagnostic Aid

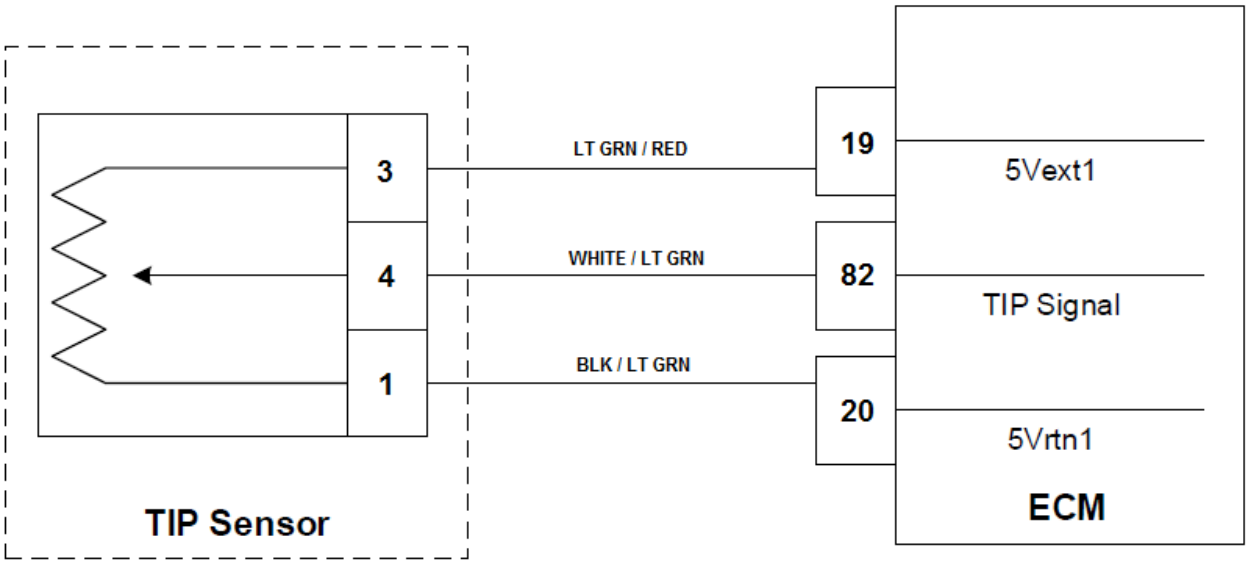
This fault indicates that the boost on the master side is lower than the boost on the slave side; it does not necessarily mean the slave side boost is too high. This is most often caused by a leak in the CAC piping on the master side, causing the master side boost to be lower than the slave. Check all hose clamps on the CAC piping to make sure they're properly clamped and tight, and make sure there are no tears in any of the silicone boots. Pay particular attention to the boots and clamps located underneath the bridge over the valley of the engine by the ECUs, as they are prone to coming loose due to vibration and are difficult to inspect.

DTC 234 – Boost Control Overboost Failure

Step	Action	Yes	No
1	Check all hose clamps on the CAC piping to make sure they are in the proper locations and tight. Clamps are located at the turbocharger compressor outlet, underneath the bridge over the valley of the engine, at the CAC core inlet, at the CAC core outlet, and at the throttle body inlet. Are clamps tight?	Proceed to Step 2	Tighten clamps, making sure the clamp is not located on the edge of either the silicone boot or the pipe. Clear fault and test engine
2	Inspect all silicone boots on CAC piping to make sure there are no tears or holes in the boots. Are boots OK?	Proceed to Step 3	Replace damaged boot(s), clear fault and retest engine
3	Check the wastegate actuator pressure lines on both turbos to make sure they are connected, the clamps are tight, and the hose is not damaged and leaking. Are the hoses OK?	Proceed to Step 4	Repair loose/damaged hose, clear fault and retest engine
4	Perform a spark kill test while running the engine under approximately 20% load. Monitor MAP for changes as each cylinder is disabled. See “Performing a spark kill test” section of this manual for more information. Are all cylinders contributing equally?	Proceed to Step 5	Diagnose the issue with the weak cylinder
5A	Remove the TIP and MAP sensors and inspect for damage/dirt. Clean the sensors. Reinstall the MAP sensor from the slave side on the master side, and the MAP sensor from the master side in the slave side. Clear all faults, run the engine and try to recreate the fault. Did the DTC 234 fault come back?	Proceed to Step 6	Proceed to Step 5B
5B	Is DTC 299 now active?	Replace MAP sensor currently installed on slave side	Intermittent fault
6	Inspect the turbocharger: Remove the exhaust pipe from the turbine outlet of the slave turbo, and remove the fuel system and intake boot from the compressor inlet. Inspect the compressor and turbine wheels for damage. Make sure the wheels spin freely. Do turbine/compressor wheels pass inspection?	Proceed to Step 7	Replace the turbocharger

Step	Action	Yes	No
7	Remove the wastegate cover from the turbochargers and inspect the wastegate. Make sure the wastegate is undamaged and sealing properly. Remove the retaining ring from the actuator linkage and remove the wastegate actuator from the arm. Make sure the wastegate arm moves freely and the valve opens and closes. Make sure the wastegate actuator moves – there will be substantial spring pressure but you should be able to pull the rod out of the actuator slightly. Does the wastegate pass inspection?	Intermittent problem	Replace the turbocharger

DTC 236 – TIP/TOP Active



Conditions for Setting the DTC

- Check Condition: Key On, Engine Running
- Fault Condition: TIP < 16 psia and MAP > 18 psia
- MIL on
- Adaptive disabled

Fault Description

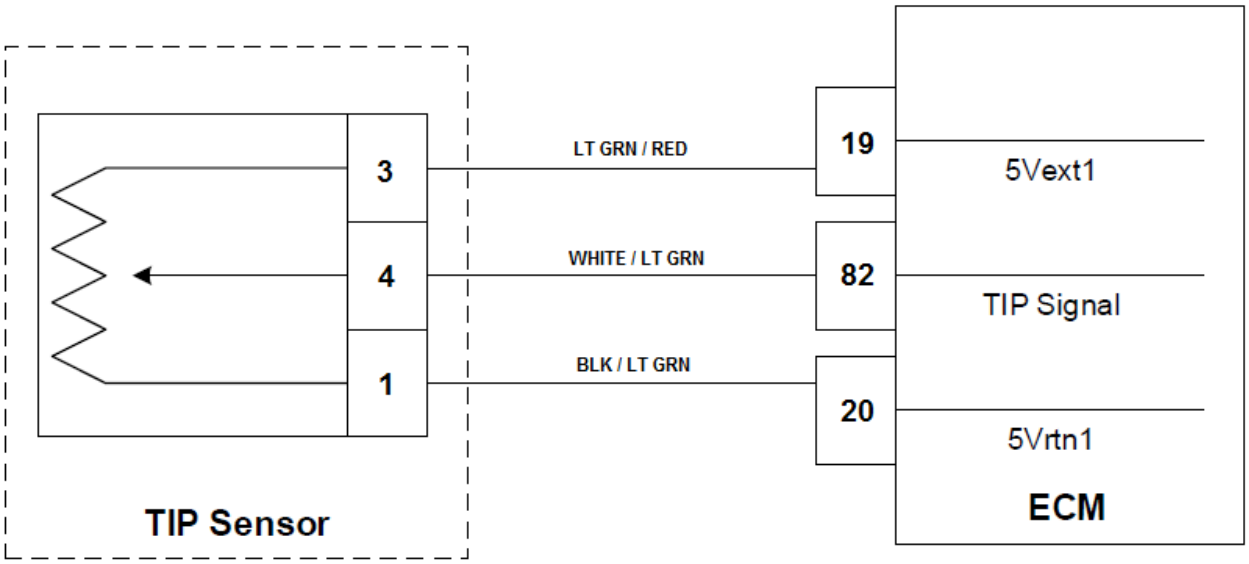
The engine uses a throttle inlet pressure (TIP) sensor upstream of the throttle valve to monitor incoming throttle pressure. The TIP should always be higher than the MAP. If MAP is ever at 18 psia or higher and TIP is reading at less than 16 psia, a TIP/TOP active fault is logged.

Diagnosing the Fault

Check to make sure the wiring for the TIP and MAP sensors is not reversed. The two sensors are identical and they are close enough to each other that it is possible to swap the connectors. The TIP sensor, located on the charge air piping, should have three wires at the connector while the MAP sensor, located on the throttle body adapter on the intake manifold, should have four wires at the connector. If the wiring for the sensors is correct, check to ensure the sensor is properly installed in the CAC piping. It should be held in place with a retaining bolt. Ensure it is fully installed into the pipe and the bolt is tight.

If the installation is correct, remove the sensor and inspect for damage. Replace the sensor with a known good part and test again.

DTC 237 – TIP/TOP Low Voltage



Conditions for Setting the DTC

- Throttle Inlet Pressure
- Check Condition: Key On, Engine Off
- Fault Condition: TIP voltage less than 0.2V
- MIL on
- Adaptive disabled

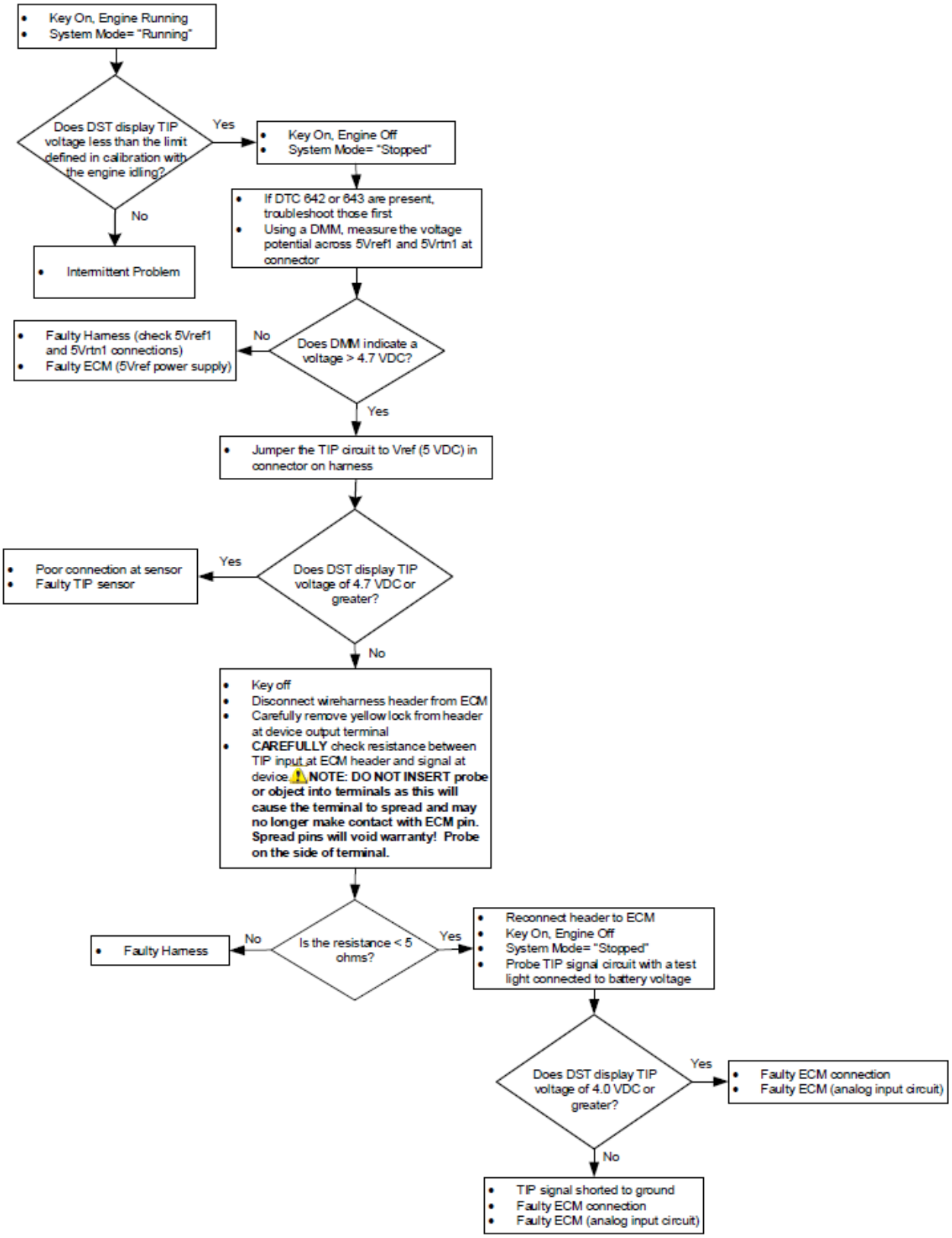
Fault Description

The engine uses a throttle inlet pressure (TIP) sensor upstream of the throttle valve to monitor incoming throttle pressure. This fault will set when the TIP sensor voltage feedback is sensed as lower than the sensor should normally produce as set in the diagnostic calibration.

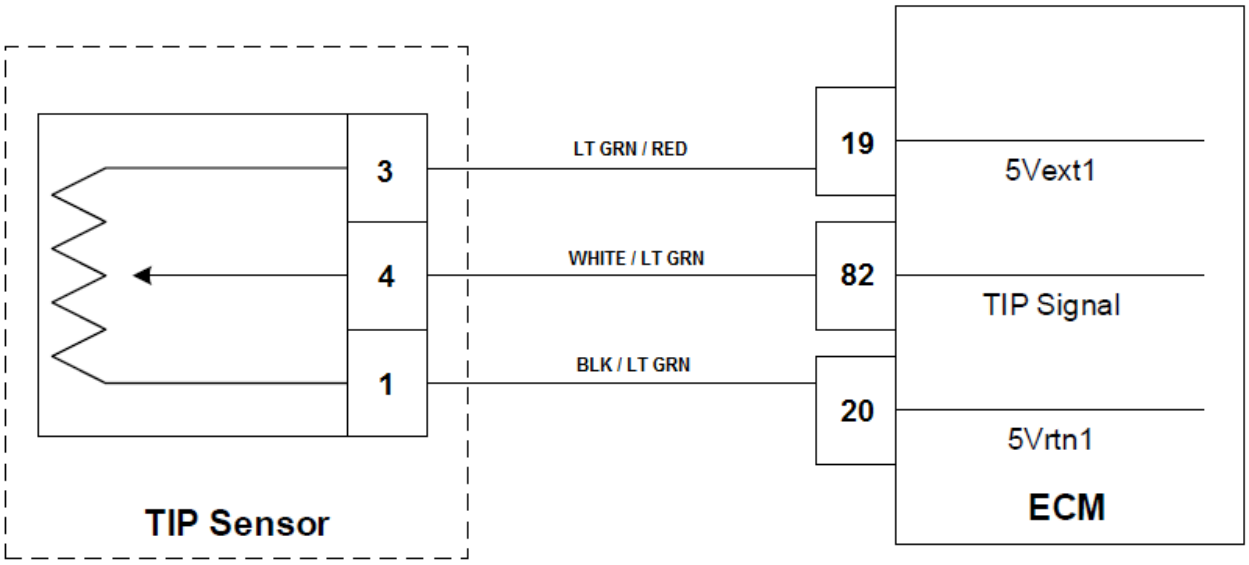
Diagnosing the Fault

In many cases, this condition is caused by the TIP sensor being disconnected from the engine harness, an open-circuit or short-to-ground of the TIP sensor circuit in the wire harness, a loss of sensor reference voltage, or a failure of the sensor.

DTC 237 – TIP/TOP Low Voltage



DTC 238 – TIP/TOP High Voltage



Conditions for Setting the DTC

- Throttle Inlet Pressure
- Check Condition: Key On, Engine Off
- Fault Condition: TIP voltage greater than 4.8V
- MIL on
- Adaptive disabled

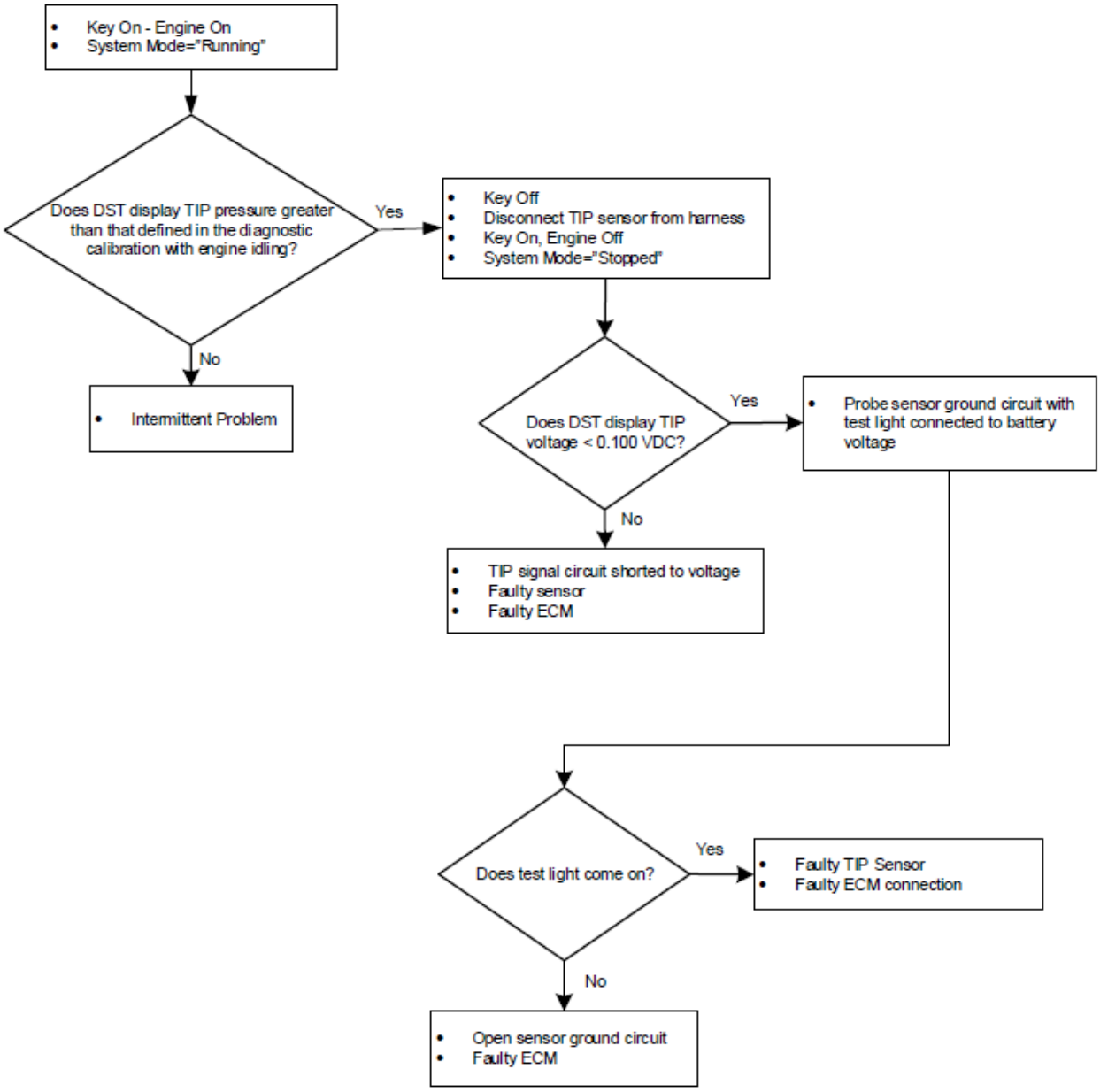
Fault Description

The engine uses a throttle inlet pressure (TIP) sensor upstream of the throttle valve to monitor incoming throttle pressure. This fault will set when the TIP sensor voltage feedback is sensed as higher than the sensor should normally produce as set in the diagnostic calibration.

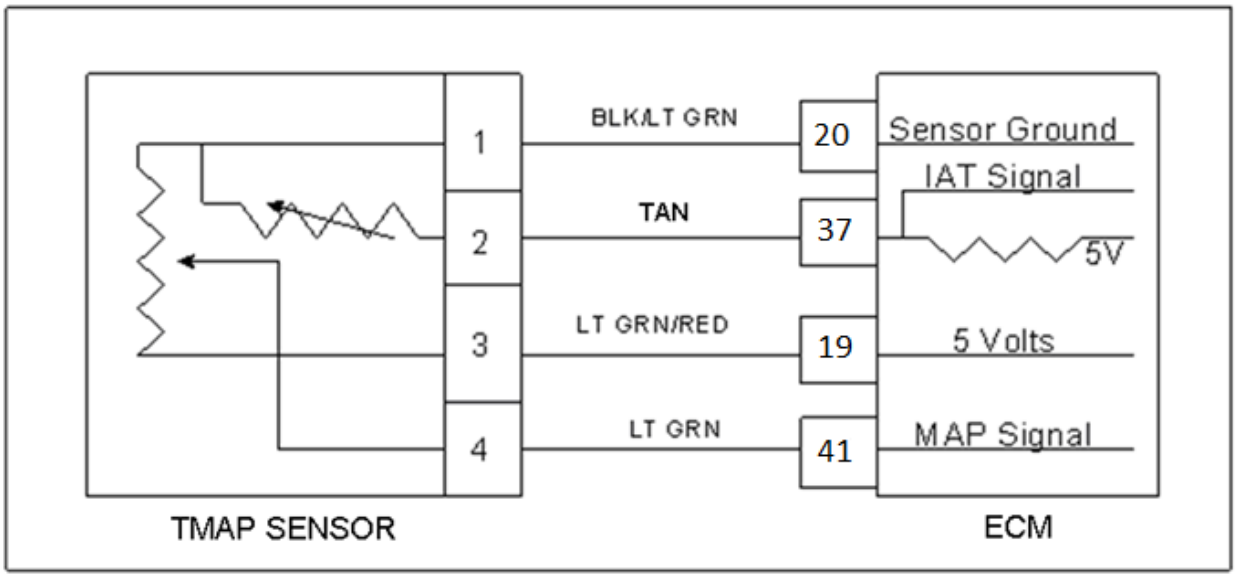
Diagnosing the Fault

In many cases, this condition is caused by the TIP circuit being shorted to a voltage source of a failure of the sensor.

DTC 238 – TIP/TOP High Voltage



DTC 299 – Boost Control Underboost Failure



Conditions for Setting the DTC

- Check Condition: Key On, Engine Running
- Fault Condition: MAP is greater than 8 psia, slave MAP is 1.5 psi lower than master MAP for 45 seconds
- MIL: ON during active fault
- Engine Shutdown

Fault Description

A V-series engine has separate fuel systems and throttles for the master (right) side and slave (left) side of the engine. In order to ensure that all cylinders are equally contributing power the manifold absolute pressure must be nearly the same on both sides of the engine. The engine compares the data coming from the MAP sensors on both sides. This fault will set if the ECU measures MAP on the slave side is at least 1.5 psi lower than the master MAP for 45 seconds. The MIL command is ON and the engine will shut down.

Diagnostic Aid

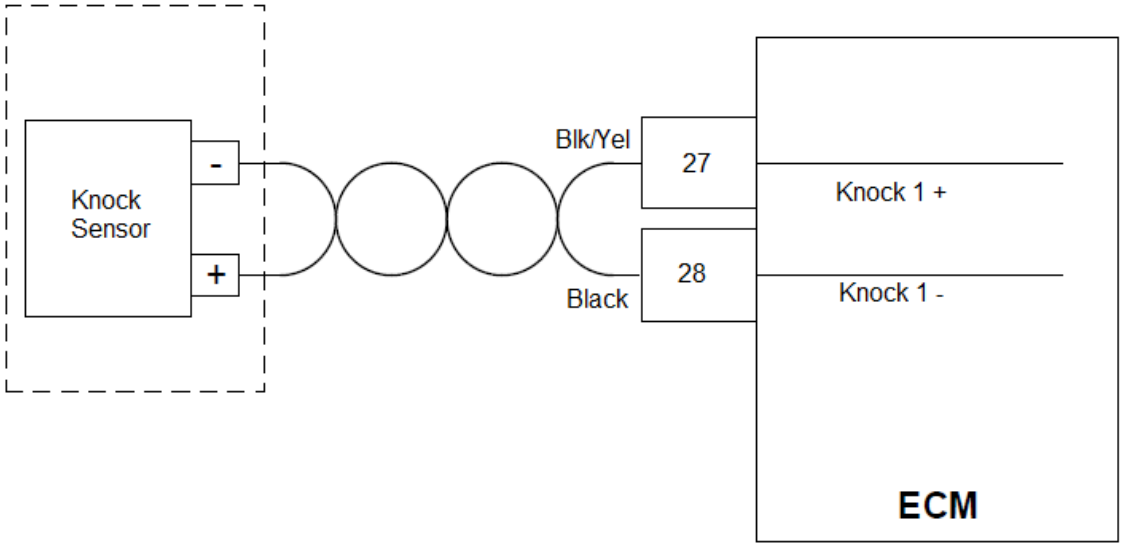
This fault indicates that the boost on the slave side is lower than the boost on the master side. This is most often caused by a leak in the CAC piping. Check all hose clamps on the CAC piping to make sure they're properly clamped and tight, and make sure there are no tears in any of the silicone boots. Pay particular attention to the boots located underneath the bridge over the valley of the engine by the ECUs, as they are prone to coming loose due to vibration and are difficult to inspect.

DTC 299 – Boost Control Underboost Failure

Step	Action	Yes	No
1	Check all hose clamps on the CAC piping to make sure they are in the proper locations and tight. Clamps are located at the turbocharger compressor outlet, underneath the bridge over the valley of the engine, at the CAC core inlet, at the CAC core outlet, and at the throttle body inlet. Are clamps tight?	Proceed to Step 2	Tighten clamps, making sure the clamp is not located on the edge of either the silicone boot or the pipe. Clear fault and test engine
2	Inspect all silicone boots on CAC piping to make sure there are no tears or holes in the boots. Are boots OK?	Proceed to Step 3	Replace damaged boot(s), clear fault and retest engine
3	Check the wastegate actuator pressure lines on both turbos to make sure they are connected, the clamps are tight, and the hose is not damaged and leaking. Are the hoses OK?	Proceed to Step 4	Repair loose/damaged hose, clear fault and retest engine
4	Perform a spark kill test while running the engine under approximately 20% load. Monitor MAP for changes as each cylinder is disabled. See “Performing a spark kill test” section of this manual for more information. Are all cylinders contributing equally?	Proceed to Step 5	Diagnose the issue with the weak cylinder
5A	Remove the TIP and MAP sensors and inspect for damage/dirt. Clean the sensors. Reinstall the MAP sensor from the slave side on the master side, and the MAP sensor from the master side in the slave side. Clear all faults, run the engine and try to recreate the fault. Did the DTC 299 fault come back?	Proceed to Step 6	Proceed to Step 5B
5B	Is DTC 234 now active?	Replace MAP sensor currently installed on master side	Intermittent fault
6	Inspect the turbocharger: Remove the exhaust pipe from the turbine outlet of the slave turbo, and remove the fuel system and intake boot from the compressor inlet. Inspect the compressor and turbine wheels for damage. Make sure the wheels spin freely. Do turbine/compressor wheels pass inspection?	Proceed to Step 7	Replace the turbocharger

Step	Action	Yes	No
7	Remove the wastegate cover from the turbochargers and inspect the wastegate. Make sure the wastegate is undamaged and sealing properly. Remove the retaining ring from the actuator linkage and remove the wastegate actuator from the arm. Make sure the wastegate arm moves freely and the valve opens and closes. Make sure the wastegate actuator moves – there will be substantial spring pressure but you should be able to pull the rod out of the actuator slightly. Does the wastegate pass inspection?	Intermittent problem	Replace the turbocharger

DTC 326 – Knock 1 Excessive Signal



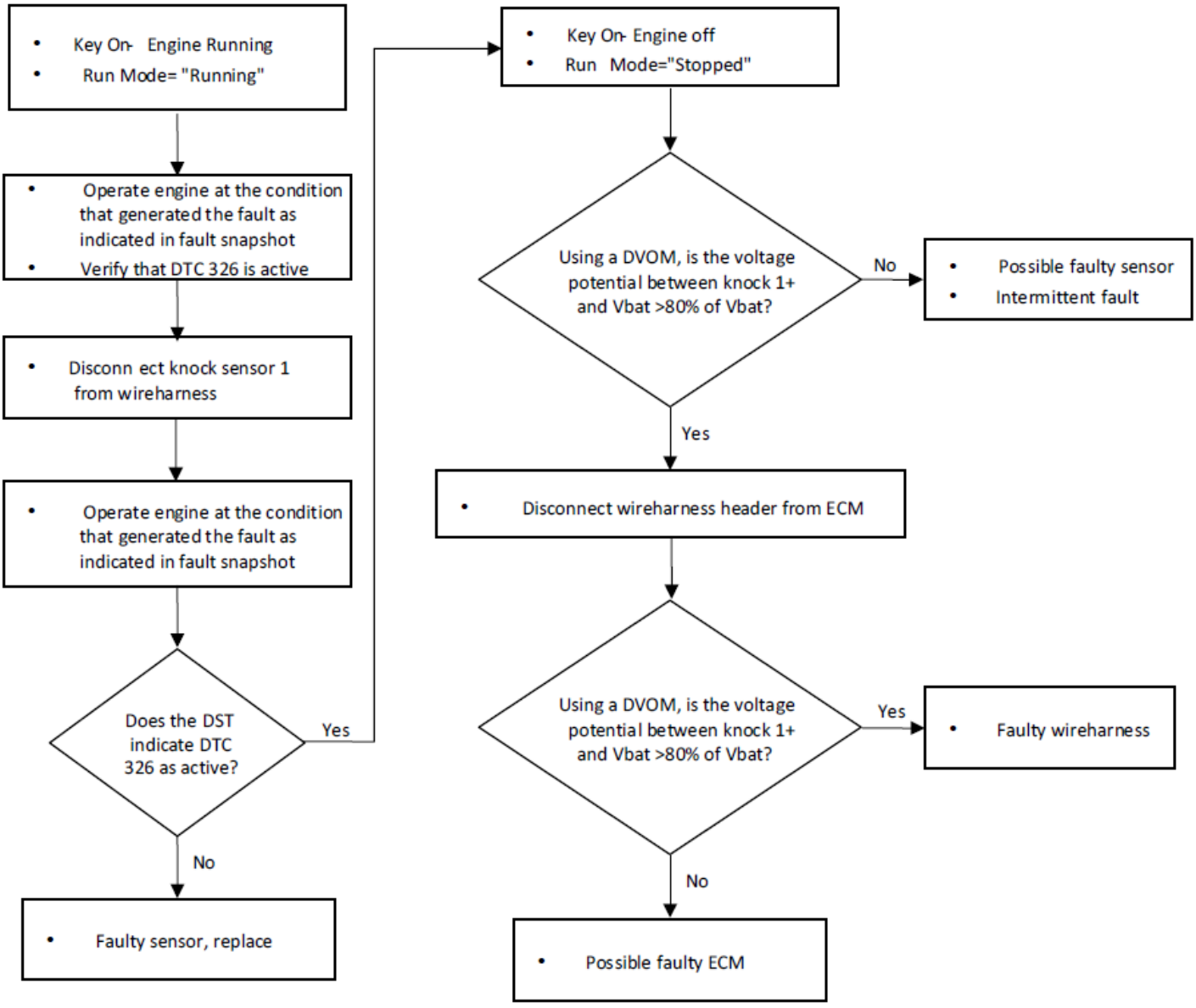
Conditions for Setting the DTC

- Check Condition: Key On, Engine Running
- Fault Condition: With MAP below 10 psia, knock sensor input voltage is greater than 4V for 3 seconds
- MIL: ON during active fault
- Engine Shutdown

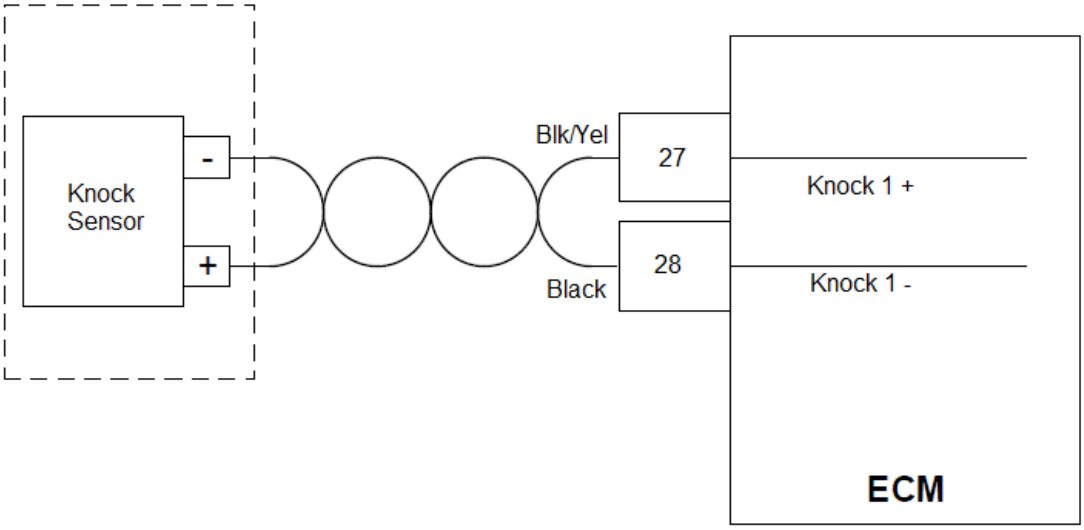
Fault Description

The knock sensor is used to detect detonation through mechanical vibration in the engine block and/or cylinder heads and provide feedback for the ignition system to retard spark timing to reduce knock intensity. In most applications the knock sensor is used to protect the engine from damage that ca be caused from detonation or knock based on fixed spark advance. This fault sets if the signal from knock sensor 1 is higher than expected for low load operation. If the fault sets, the MIL light is active and the engine will shut down.

DTC 326 – Knock 1 Excessive Signal



DTC 327 – Knock1 Sensor Open



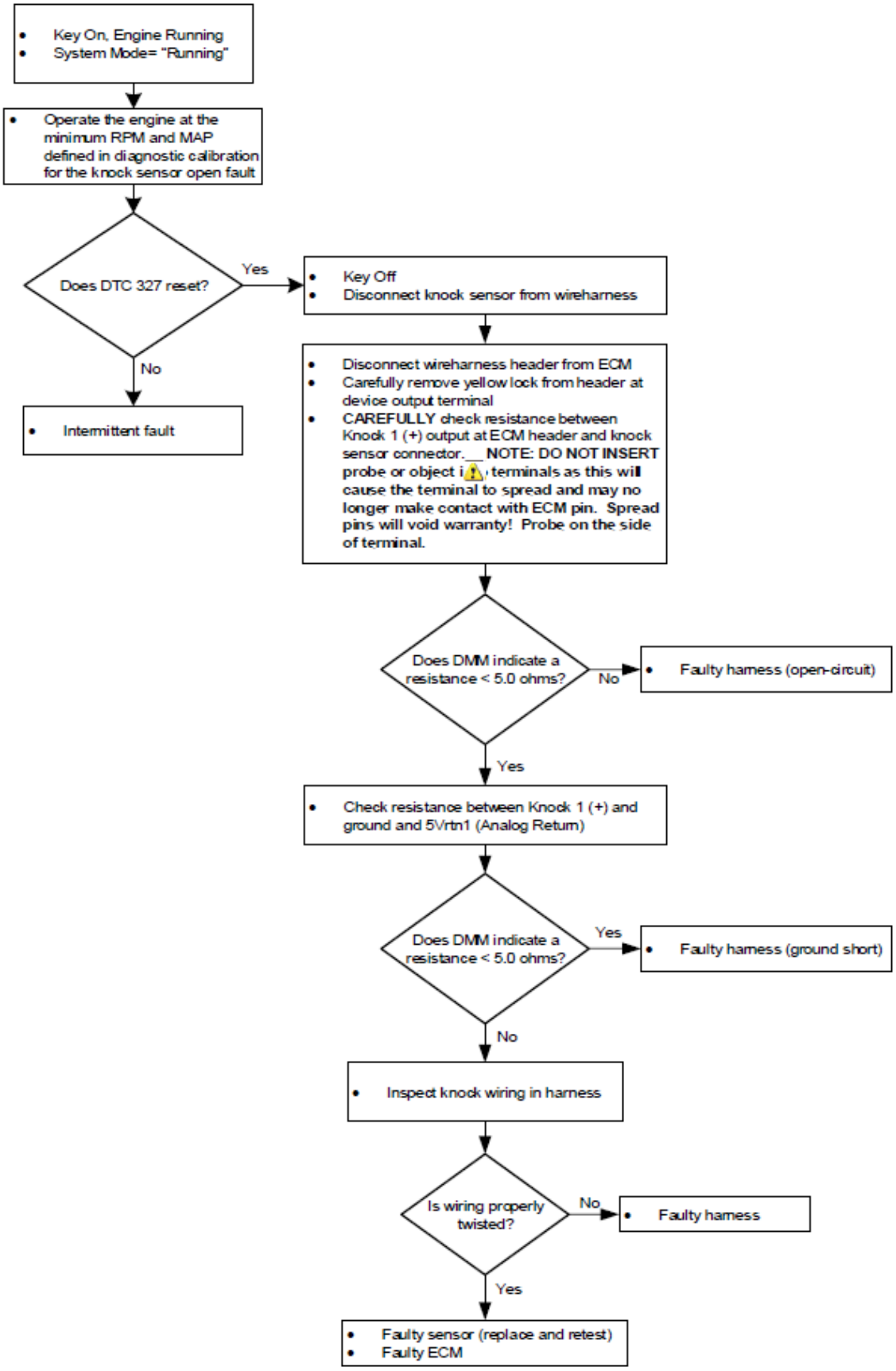
Conditions for Setting the DTC

- Check Condition: Key On, Engine Running
- Fault Condition: With MAP below 10 psia, knock sensor input voltage is less than 0.001V for 3 seconds
- MIL: ON during active fault
- Engine Shutdown

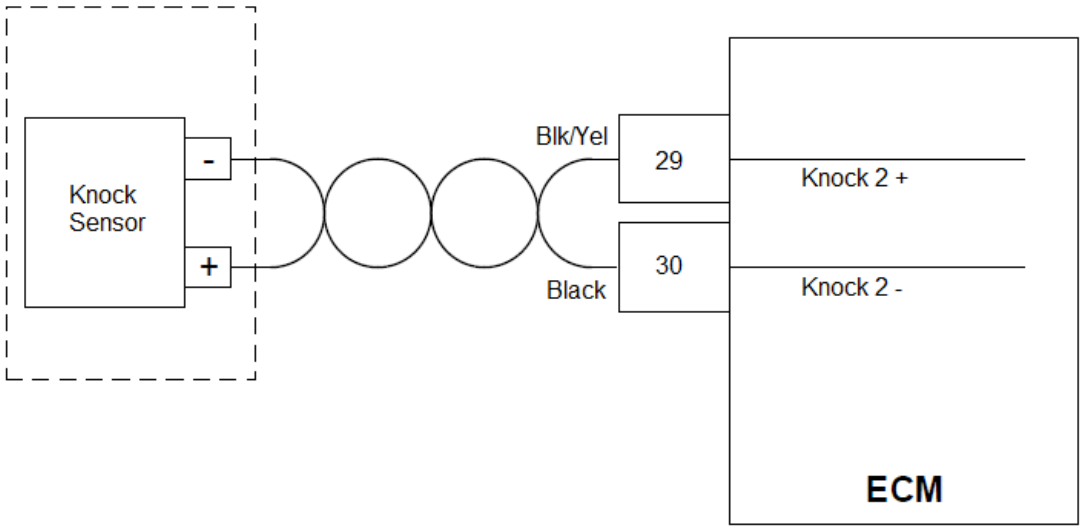
Fault Description

The knock sensor is used to detect detonation through mechanical vibration in the engine block and/or cylinder heads and provide feedback for the ignition system to retard spark timing to reduce knock intensity. In most applications the knock sensor is used to protect the engine from damage that ca be caused from detonation or knock based on fixed spark advance. This fault sets if the signal from knock sensor 1 is lower than expected for low load operation. If the fault sets, the MIL light is active and the engine will shut down.

DTC 327 – Knock1 Sensor Open



DTC 331 – Knock 2 Excessive Signal



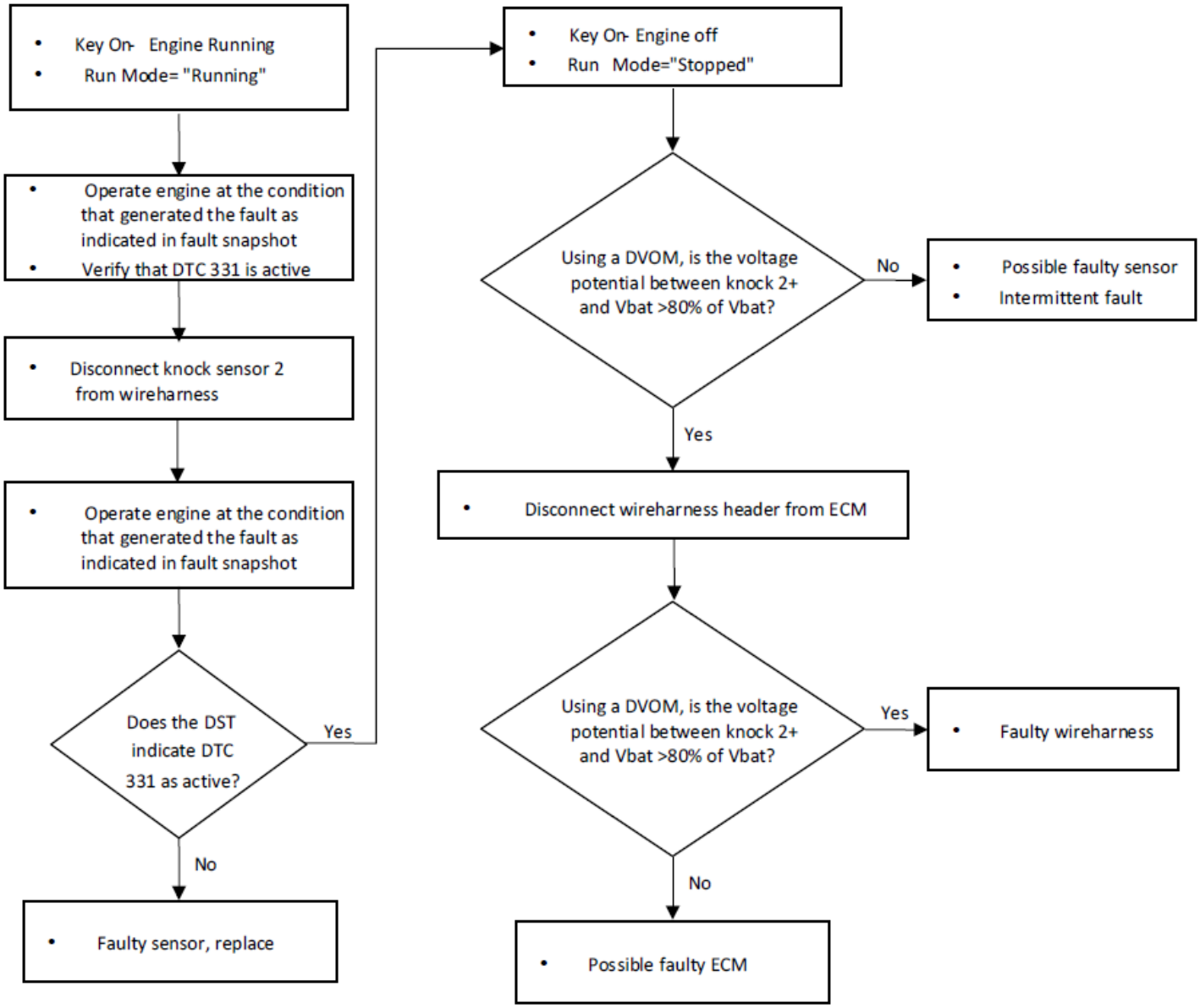
Conditions for Setting the DTC

- Check Condition: Key On, Engine Running
- Fault Condition: With MAP below 10 psia, knock sensor input voltage is greater than 4V for 3 seconds
- MIL: ON during active fault
- Engine Shutdown

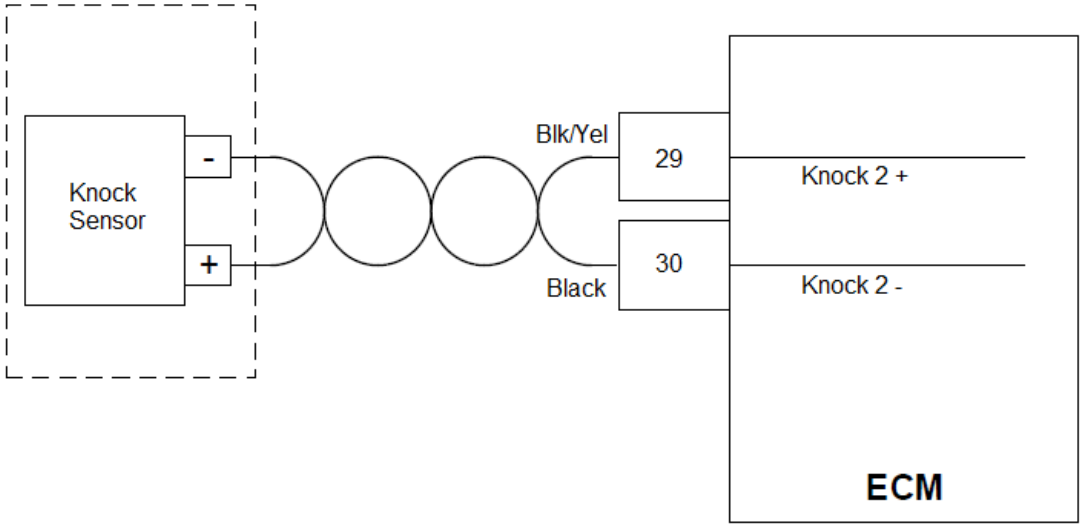
Fault Description

The knock sensor is used to detect detonation through mechanical vibration in the engine block and/or cylinder heads and provide feedback for the ignition system to retard spark timing to reduce knock intensity. In most applications the knock sensor is used to protect the engine from damage that ca be caused from detonation or knock based on fixed spark advance. This fault sets if the signal from knock sensor 2 is higher than expected for low load operation. If the fault sets, the MIL light is active and the engine will shut down.

DTC 331 – Knock 2 Excessive Signal



DTC 332 – Knock2 Sensor Open



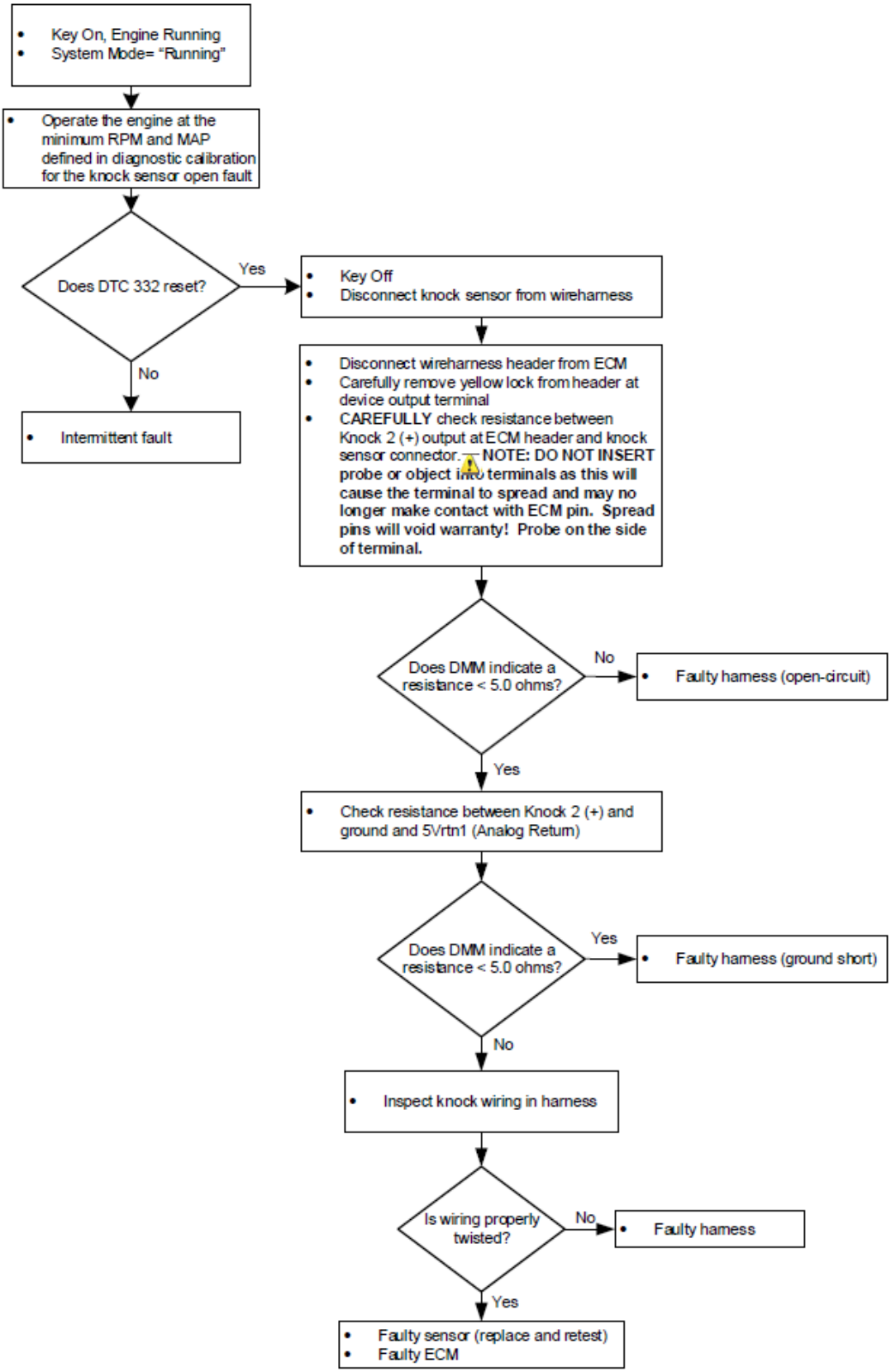
Conditions for Setting the DTC

- Check Condition: Key On, Engine Running
- Fault Condition: With MAP below 10 psia, knock sensor input voltage is less than 0.001V for 3 seconds
- MIL: ON during active fault
- Engine Shutdown

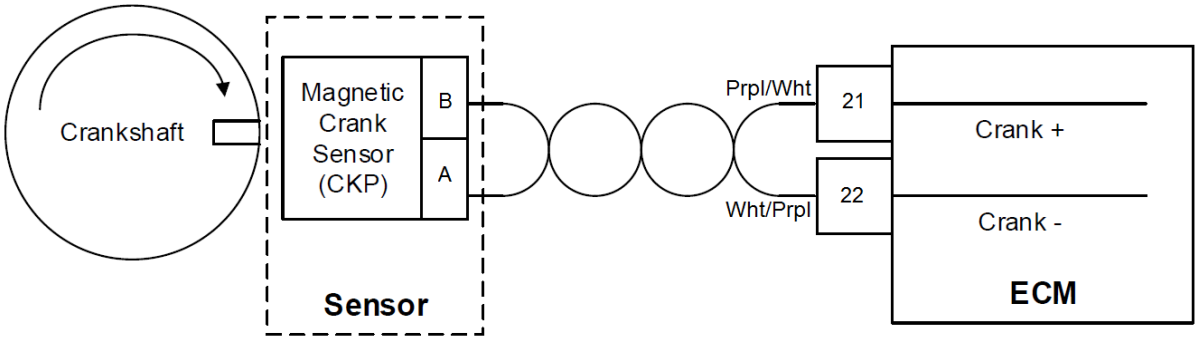
Fault Description

The knock sensor is used to detect detonation through mechanical vibration in the engine block and/or cylinder heads and provide feedback for the ignition system to retard spark timing to reduce knock intensity. In most applications the knock sensor is used to protect the engine from damage that ca be caused from detonation or knock based on fixed spark advance. This fault sets if the signal from knock sensor 2 is lower than expected for low load operation. If the fault sets, the MIL light is active and the engine will shut down.

DTC 332 – Knock2 Sensor Open



DTC 336 – Crank Sync Noise



Conditions for Setting the DTC

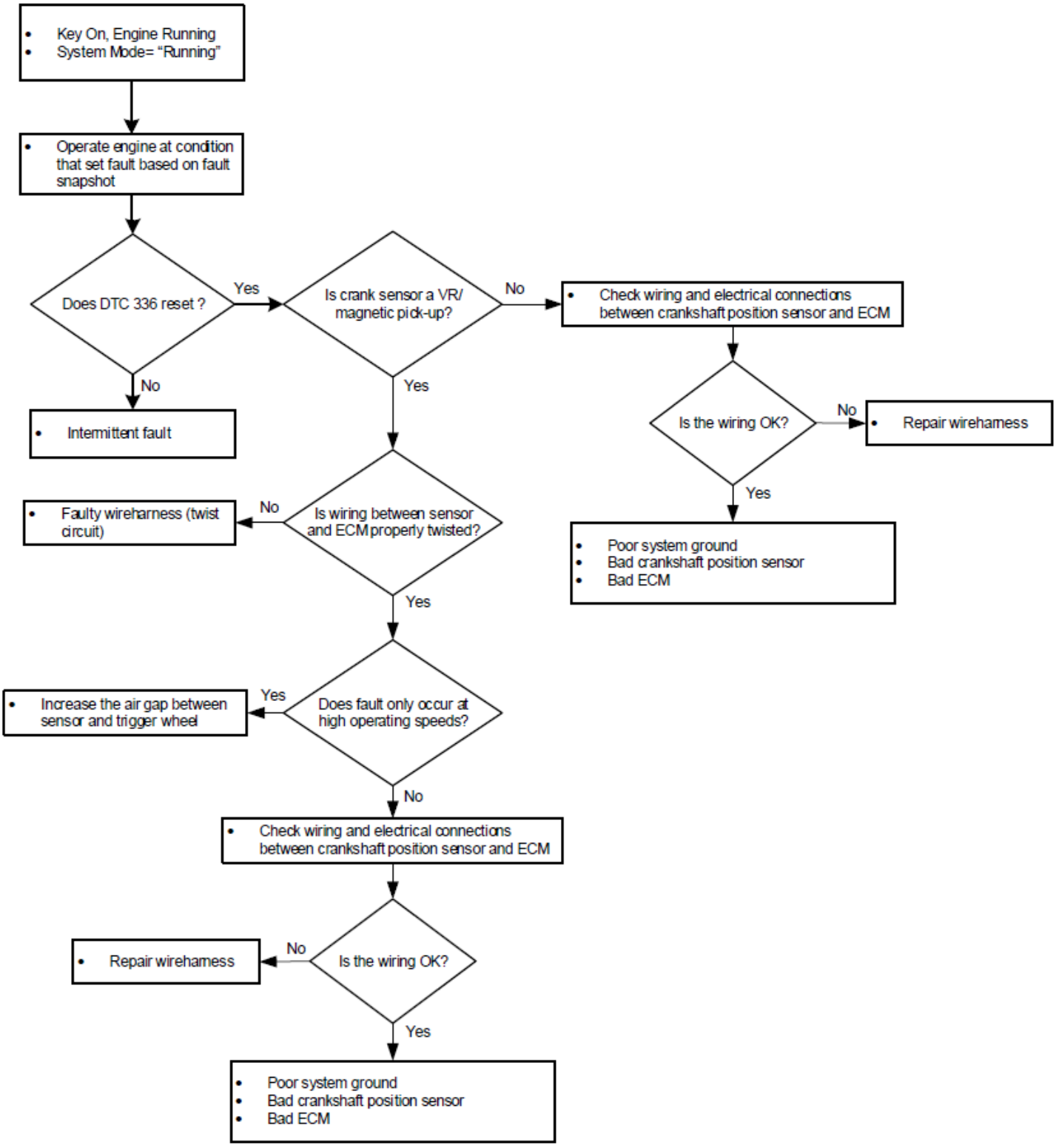
- Check Condition: Key On, Engine Running
- Fault Condition: 1 invalid resync within a time window of 800 milliseconds
- MIL: ON during active fault
- Adaptive learn disabled

Fault Description

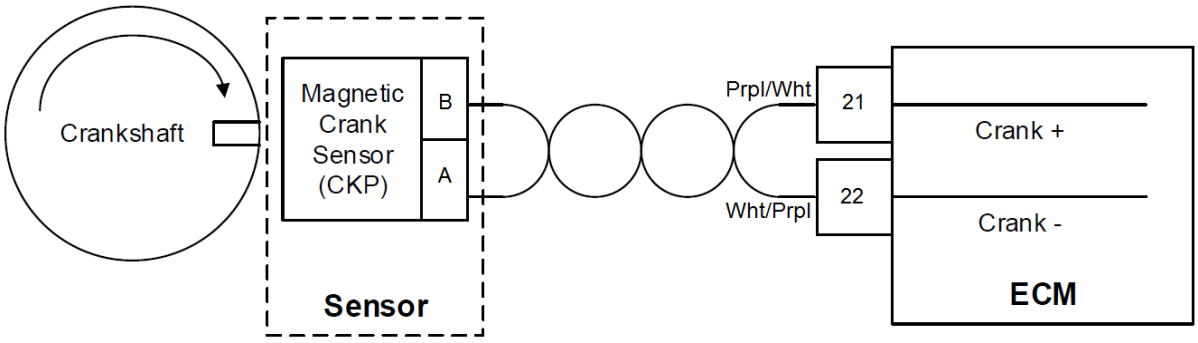
The crankshaft position sensor is a magnetic sensor installed on the engine adjacent to a “coded” trigger wheel located on the vibration dampener. The sensor-trigger wheel combination is used to determine crankshaft position (with respect to TDC cylinder #1 compression) and the rotational engine speed. Determination of the crankshaft position and speed is necessary to properly activate the ignition, fuel injection, and throttle governing systems for precise engine control.

The ECM must see a valid crankshaft position while running. If no signal is present, the signal amplitude is too high (due to improper air gap with respect to trigger wheel), or an irregular crank pattern is detected causing the ECU to resynchronize more than once in 800 milliseconds, the fault will set. Irregular crank patterns can be detected by the ECM due to electrical noise, poor machining of the trigger wheel, or trigger wheel runout and/or gear lash.

DTC 336 – Crank Sync Noise



DTC 337 – Loss of Crankshaft Signal



Conditions for Setting the DTC

- Check Condition: Key On, Engine Running
- Fault Condition: ECM sees six cam pulses without crank activity
- MIL: ON during active fault
- Engine shutdown

Fault Description

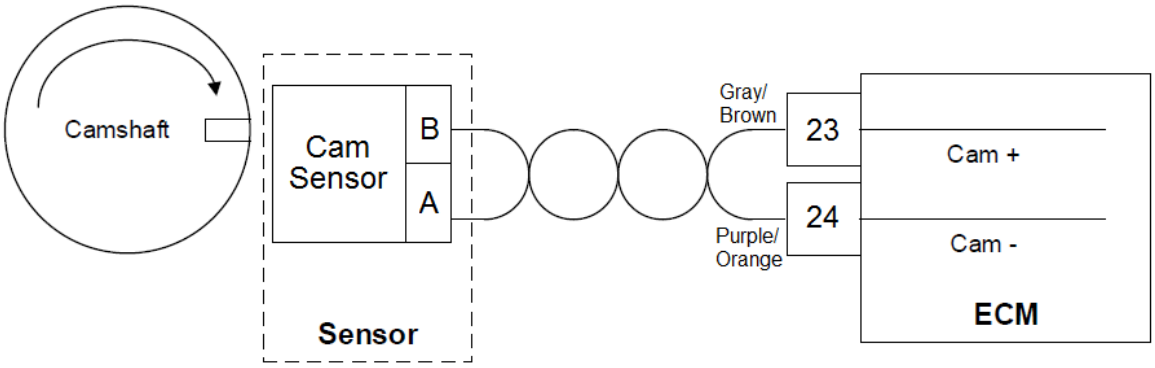
The crankshaft position sensor is a magnetic sensor installed on the engine adjacent to a “coded” trigger wheel located on the vibration dampener. The sensor-trigger wheel combination is used to determine crankshaft position (with respect to TDC cylinder #1 compression) and the rotational engine speed. Determination of the crankshaft position and speed is necessary to properly activate the ignition, fuel injection, and throttle governing systems for precise engine control.

The ECM must see a valid crankshaft position while running. If no signal is present while six cam pulses continue the fault will set. The MIL will come on and the engine will shut down.

Diagnostic Aids

- Check that the crankshaft position sensor is securely connected to harness
- Check that the crankshaft position sensor is securely installed in bracket, and bracket is tight and properly aligned with the crankshaft position wheel
- Check crankshaft position sensor circuit wiring for open circuit

DTC 341 – Cam Input Signal Noise



Conditions for Setting the DTC

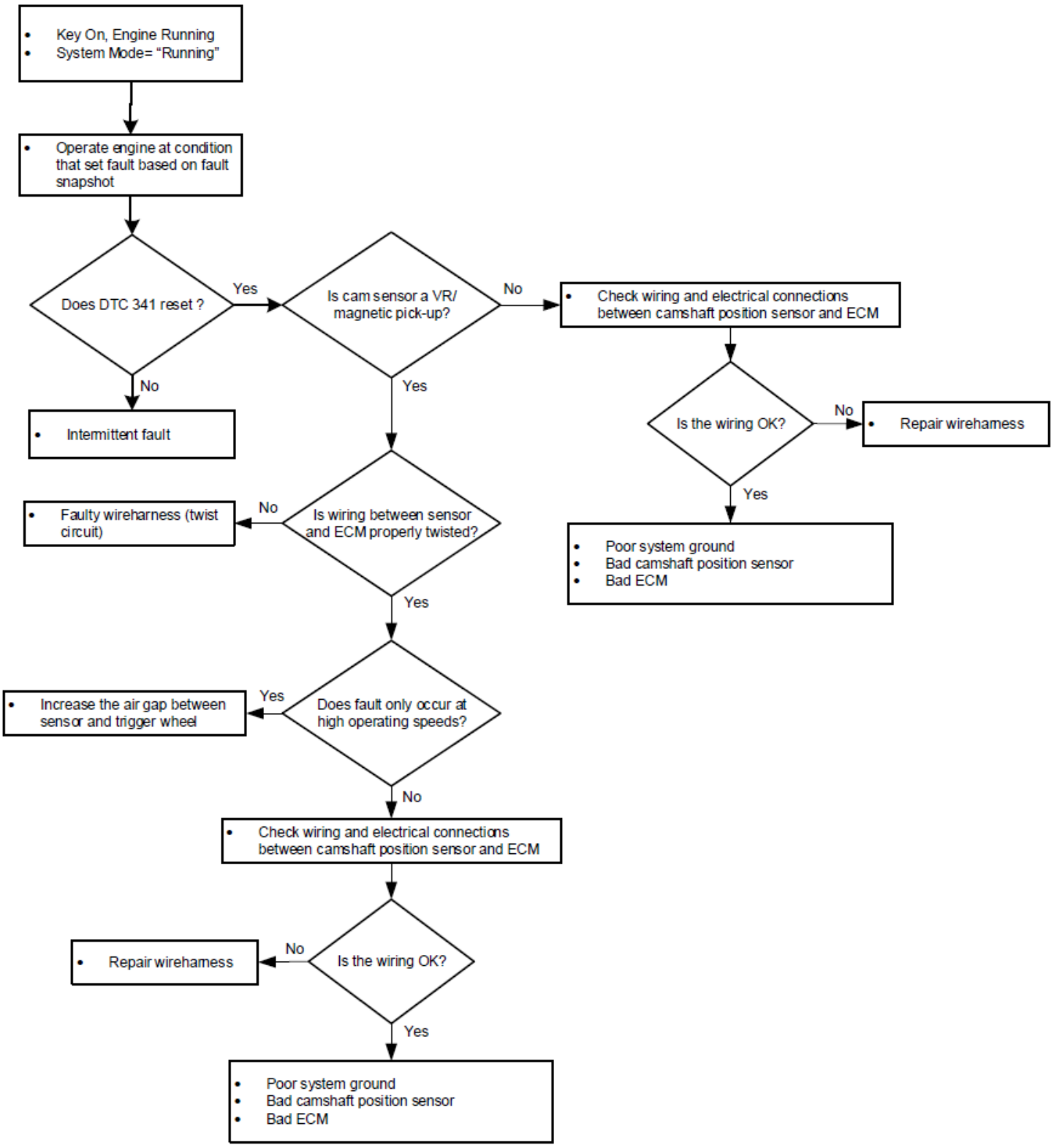
- Check Condition: Key On, Engine Running
- Fault Condition: 1 invalid resyncs in 700 milliseconds
- MIL: ON during active fault
- Adaptive learn disabled

Fault Description

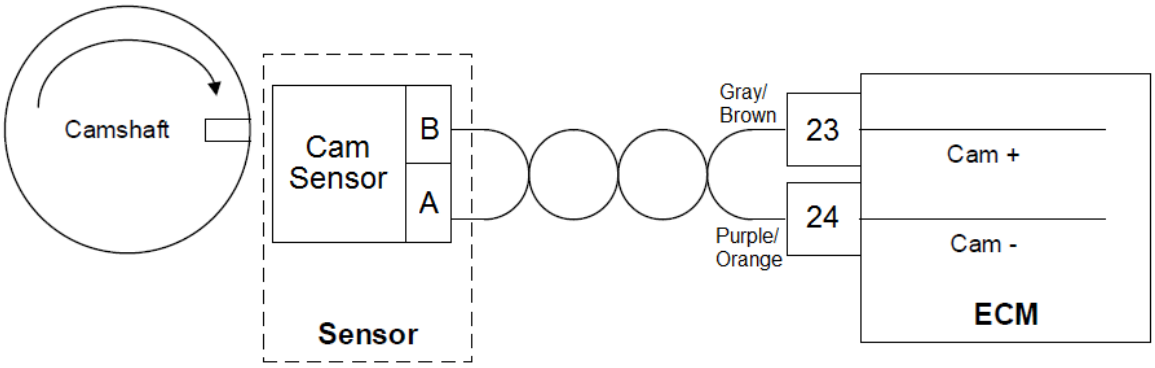
The camshaft position sensor is a magnetic sensor installed in the engine block adjacent to a “coded” trigger wheel. The sensor-trigger wheel combination is used to determine cam position with respect to TDC #1 compression. Determination of the camshaft position is necessary to identify the stroke (or cycle) of the engine to properly activate the ignition for precise engine control.

For a cam synchronized engine, the ECM must see a valid camshaft position signal while running. If no signal is present, the signal amplitude is too high (due to improper air gap with respect to the trigger wheel), or an irregular cam pattern is detected causing the ECM to resynchronize once in 700 milliseconds, this fault will set. Irregular cam patterns can be detected by the ECM due to electrical noise, poor machining of the trigger wheel, or trigger wheel runout and/or gear lash. When the fault is set the MIL will light and the engine will not enter adaptive learn mode. In some instances, this fault can cause rough engine operation and can cause the engine to stall and die if equipped with a coil-on-plug ignition system.

DTC 341 – Cam Input Signal Noise



DTC 342 – Loss of Camshaft Input Signal



Conditions for Setting the DTC

- Check Condition: Key On, Engine Running
- Fault Condition: No cam pulses in 2.5 engine cycles with engine RPM > 1000
- MIL: ON during active fault
- Engine shutdown

Fault Description

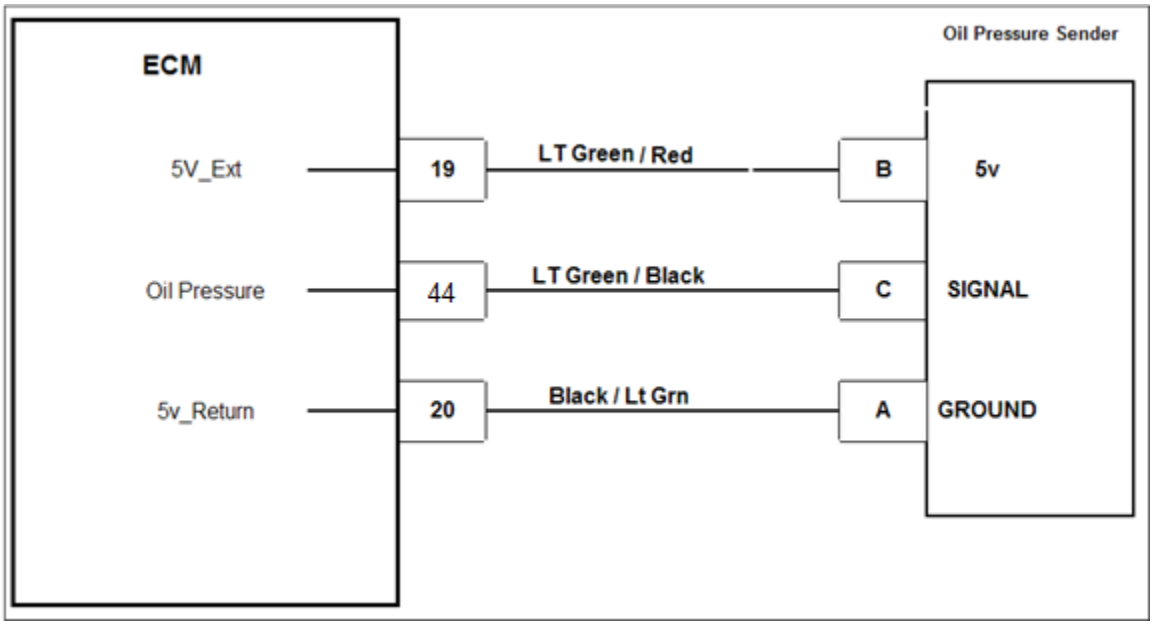
The camshaft position sensor is a magnetic sensor installed in the engine block adjacent to a “coded” trigger wheel. The sensor-trigger wheel combination is used to determine cam position with respect to TDC #1 compression. Determination of the camshaft position is necessary to identify the stroke (or cycle) of the engine to properly activate the ignition for precise engine control.

For a cam synchronized engine, the ECM must see a valid camshaft position signal while running. This fault will set if valid crankshaft position data is received for 2.5 engine cycles with an engine speed greater than 1000 RPM and no camshaft signal is received. The MIL will light and the engine will shut down.

Diagnostic Aids

- Check that the camshaft position sensor is securely connected to harness
- Check that the camshaft position sensor is securely installed, and bracket (if used) is tight and properly aligned with the crankshaft position wheel.
- Check camshaft position sensor circuit wiring for open circuit

DTC 520-Oil Pressure Low Stage 1

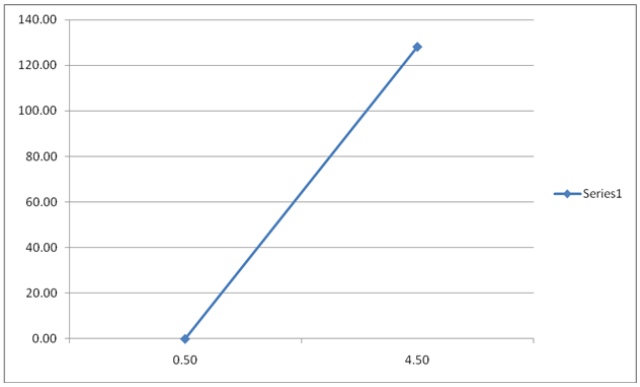


Conditions for Setting the DTC

- Engine Oil Pressure low.
- Check Condition: Engine running for 20 seconds or more with engine speed greater than 600 rpm.
- Fault Condition: Oil pressure less than 15 PSI if engine speed is less than 1,400rpm
- Fault Condition: Oil pressure less than 30 PSI if engine speed is greater than 1,450rpm
- MIL is illuminated

Circuit Description

The Oil Pressure Sender is used to communicate the oil pressure condition to the ECM. Engine damage can occur if the engine is operated with low oil pressure. The ECM sends a 5v signal to the oil pressure sender. The sender will report a signal back to the ECM on the signal wire depending on the pressure that is applied on its diaphragm. The voltage is linear in comparison to the pressure applied (see chart below). The MIL command is ON and the engine will shut down in the event of this fault to help prevent possible engine damage.

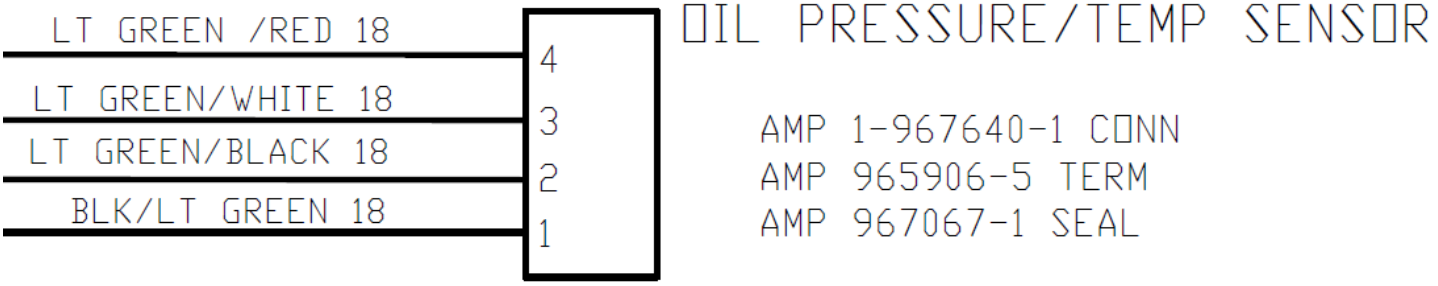


Code #	Code Name	RPM	Pressure
520	Oil Pres Low Stage 1	<= 1,400	15 psi
520	Oil Pres Low Stage 1	>= 1,450	30 psi
524	Oil Pres Low Stage 2	<= 1,400	8 psi
524	Oil Pres Low Stage 2	>= 1,450	25 psi

DTC 520-Oil Pressure Low Stage 1

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	Verify that the engine has oil pressure using a mechanical oil pressure gauge before proceeding with this chart. Does the engine have oil pressure above 8 psi?	8 psi	Go to Step (3)	Repair faulty Oiling System
3	Key ON, Engine Running DST connected in System Data Mode Clear DTC 520 Warm the engine by idling until the ECT temperature is above 160 degrees F. and has been running for at least 20 seconds or more Does DTC 520 become active?		Go to Step (4)	Intermittent problem Go to Intermittent section
4	With a volt meter, check terminal B on the sensor for a 5 volt reference from the ECM. Do you have 5 volts on terminal B?	5v	Go to Step (6)	Go to Step (5)
5	With a volt meter, check terminal 19 on the ECM for a 5 volt reference. Do you have a 5v reference coming out of the ECM?	5v	Repair faulty wiring between ECM and Oil pressure sensor	Go to Step (8)
6	With the oil pressure sender connected check for a signal coming out of terminal C. Do you have a voltage signal coming out of terminal C?		Go to Step (7)	Replace faulty oil pressure sender
7	With the oil pressure sender connected check for a signal at terminal 44 of the ECM. Do you have a signal voltage at pin 44 of the ECM that matches the voltage at terminal C of the oil pressure sensor?		Go to Step (8)	Repair faulty wiring between terminal C and Terminal 25.
8	Replace ECM Is the replacement complete?		Go to Step (9)	-
9	Remove all test equipment except the DST. Connect any disconnected components, fuses, etc. Using the DST clear DTC information from the ECM. Turn the ignition OFF and wait 30 seconds. Start the engine and operate the vehicle to full operating temperature Observe the MIL Observe engine performance and drivability After operating the engine within the test parameters of DTC-520 check for any stored codes. Does the engine operate normally with no stored codes?		System OK	Go to OBD System Check

DTC 521 – Oil Pressure High (Sender)



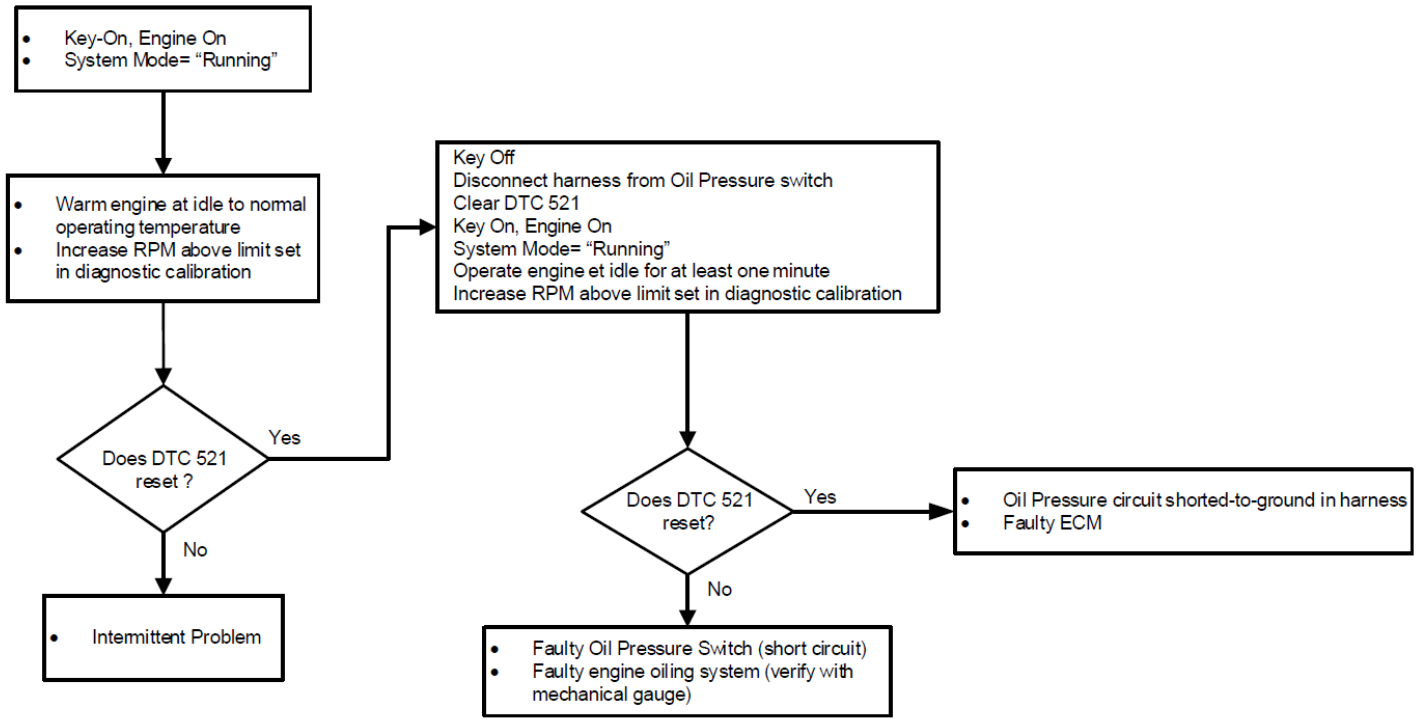
Conditions for setting the DTC

- Key on, Engine on
- Fault Conditions: Oil pressure less than normal operating pressure.
- MIL:ON
- Engine Shutdown

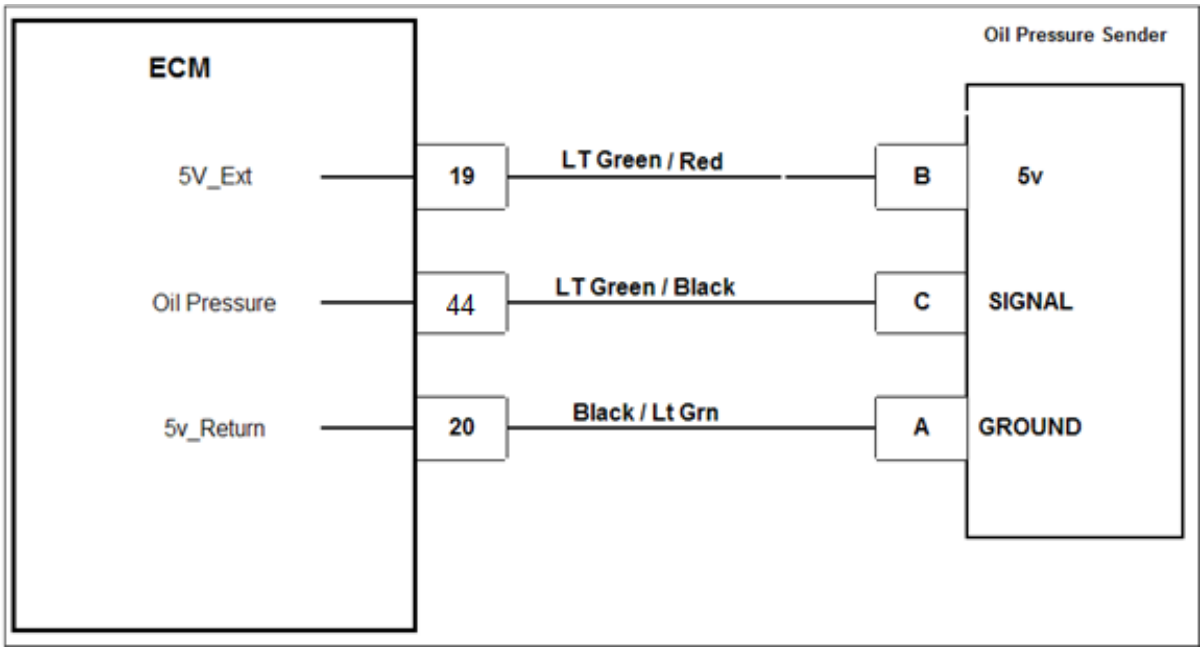
Fault Description

The oil pressure sensor measure oil pressure through a transducer or through a switch. Oil pressure monitoring is important to prevent engine damage due to low oil pressure resulting in higher friction and lack of lubrication. High oil pressure can be undesirable because it can cause oil to leak past seals and rings, can also be a result of a restriction in the oil flow path or it can be a sign of a mal-functioning oiling system.

DTC 521 – Diagnostic troubleshooting tree



DTC 522- Oil Pressure Sender low voltage

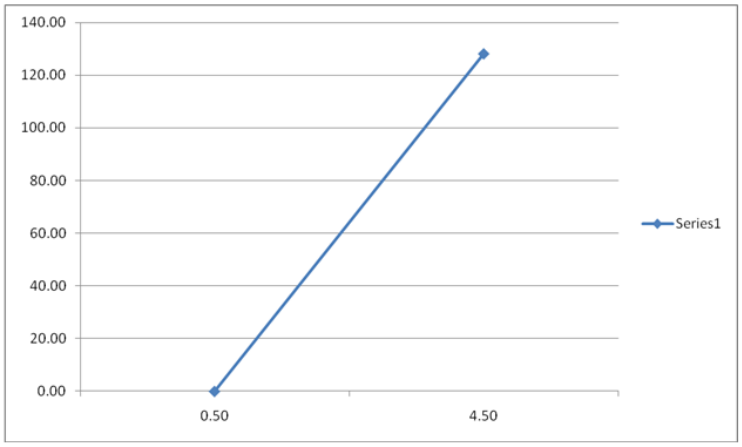


Conditions for Setting the DTC

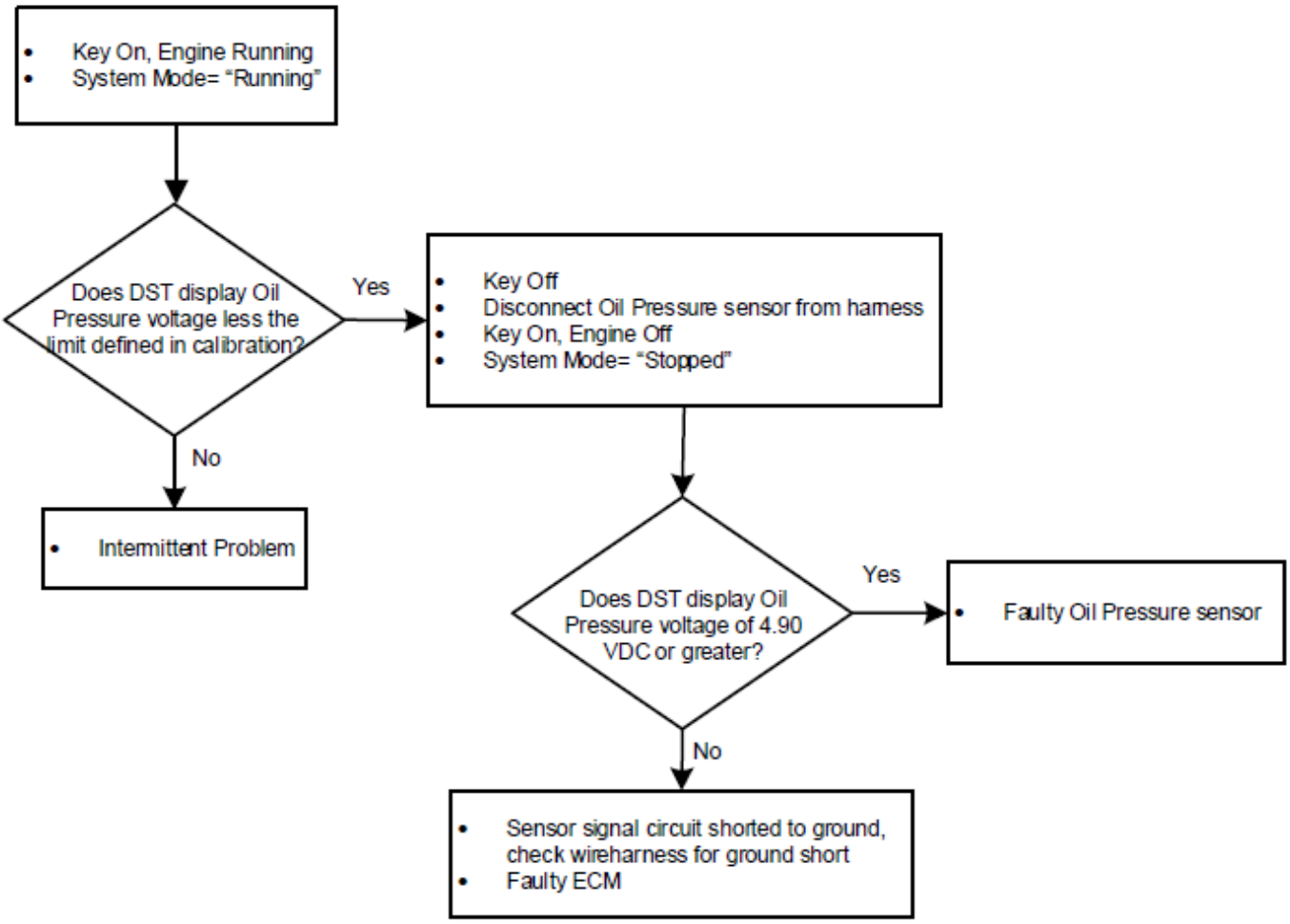
- Check Condition: Engine running for 20 seconds or more with engine speed greater than 600 rpm.
- Fault Condition: Voltage on terminal 44 is less than 0.2v for more than 1 second
- MIL: ON during active fault and for 2 seconds after active fault.

Circuit Description

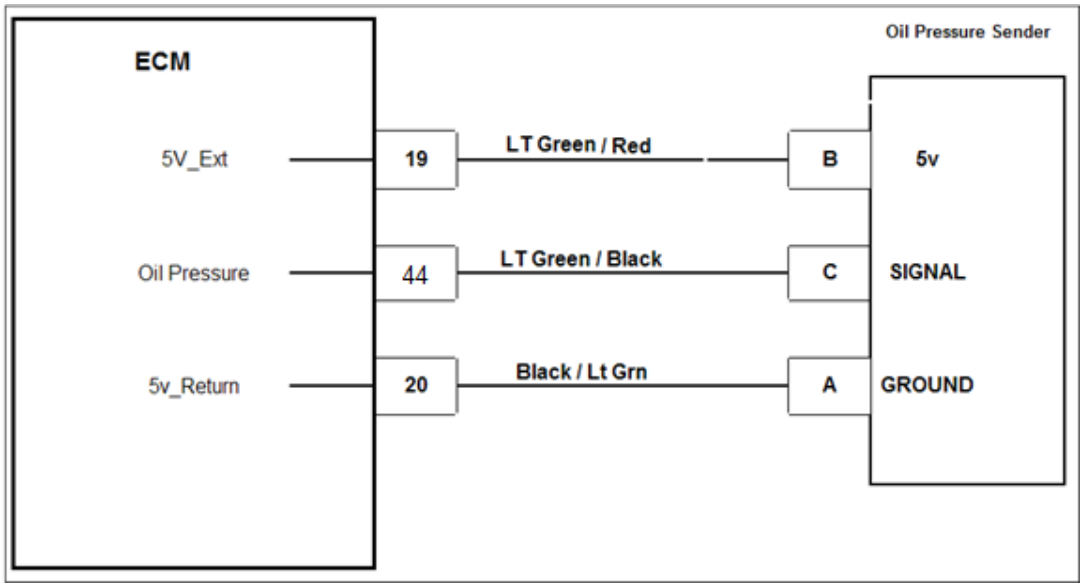
The Oil Pressure Sender is used to communicate the oil pressure condition to the ECM. Engine damage can occur if the engine is operated with low oil pressure. The ECM sends a 5v signal to the oil pressure sender. The sender will report a signal back to the ECM on the signal wire depending on the pressure that is applied on its diaphragm. The voltage is linear in comparison to the pressure applied (see chart below). The MIL command is ON and the engine will shut down in the event of this fault to help prevent possible engine damage.



DTC 522- Oil Pressure Sender low voltage



DTC 523- Oil Pressure Sender high voltage

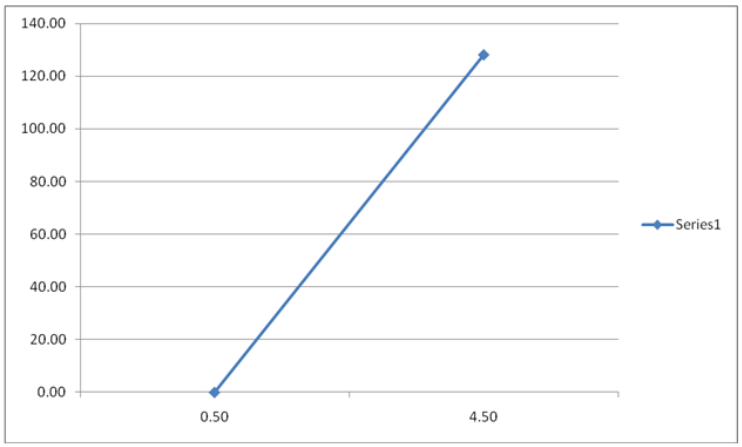


Conditions for Setting the DTC

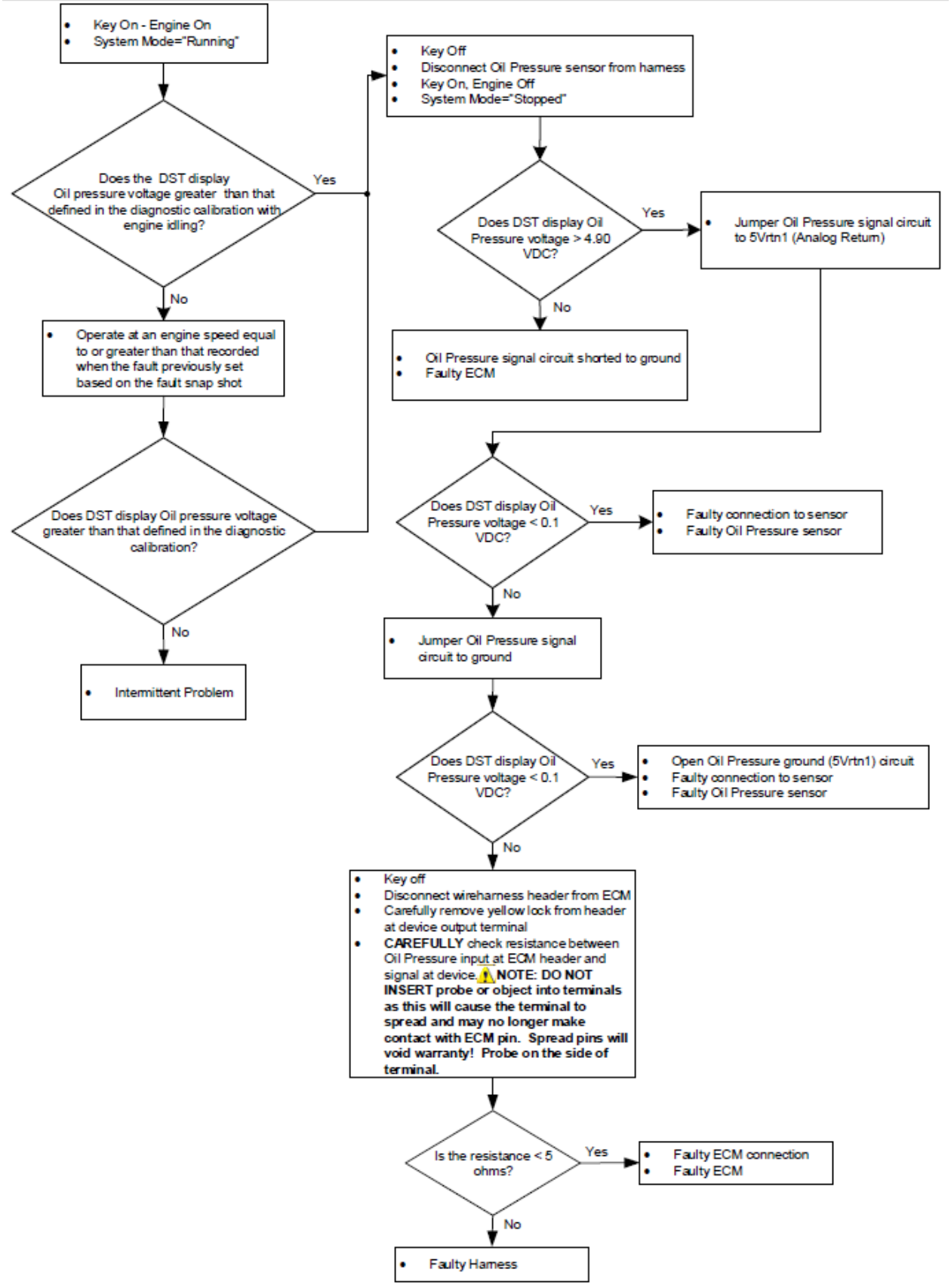
- Check Condition: Engine running for 20 seconds or more with engine speed greater than 600 rpm.
- Fault Condition: Voltage on terminal 44 is greater than 4.8v for more than 1 second
- MIL: ON during active fault and for 2 seconds after active fault.
- Engine Shutdown

Circuit Description

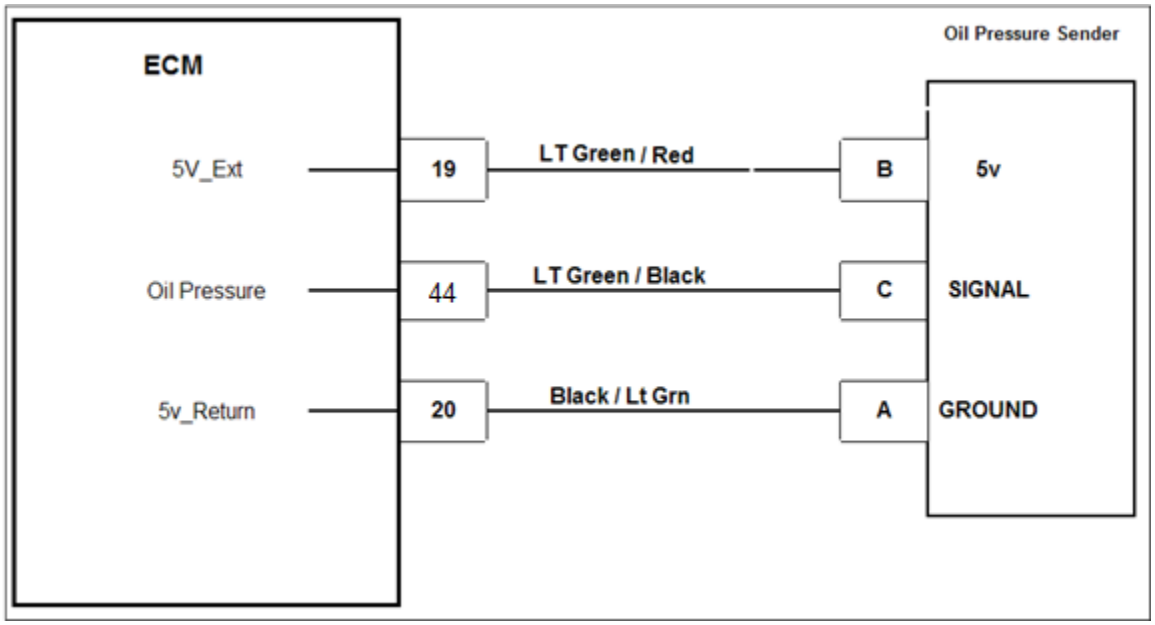
The Oil Pressure Sender is used to communicate the oil pressure condition to the ECM. Engine damage can occur if the engine is operated with low oil pressure. The ECM sends a 5v signal to the oil pressure sender. The sender will report a signal back to the ECM on the signal wire depending on the pressure that is applied on its diaphragm. The voltage is linear in comparison to the pressure applied (see chart below). The MIL command is ON and the engine will shut down in the event of this fault to help prevent possible engine damage.



DTC 523- Oil Pressure Sender high voltage



DTC 524-Oil Pressure Low Stage 2

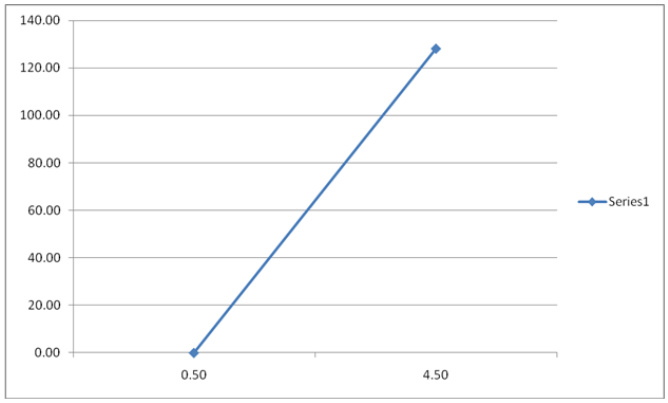


Conditions for Setting the DTC

- Engine Oil Pressure low.
- Check Condition: Engine running for 20 seconds or more with engine speed greater than 600 rpm.
- Fault Condition: Oil pressure less than 8 PSI with engine RPM less than 1,400rpm
- Fault Condition: Oil pressure less than 25psi with engine RPM greater than 1,450rpm
- Engine Shut Down.

Circuit Description

The Oil Pressure Sender is used to communicate the oil pressure condition to the ECM. Engine damage can occur if the engine is operated with low oil pressure. The ECM sends a 5v signal to the oil pressure sender. The sender will report a signal back to the ECM on the signal wire depending on the pressure that is applied on its diaphragm. The voltage is linear in comparison to the pressure applied (see chart below). The MIL command is ON and the engine will shut down in the event of this fault to help prevent possible engine damage.



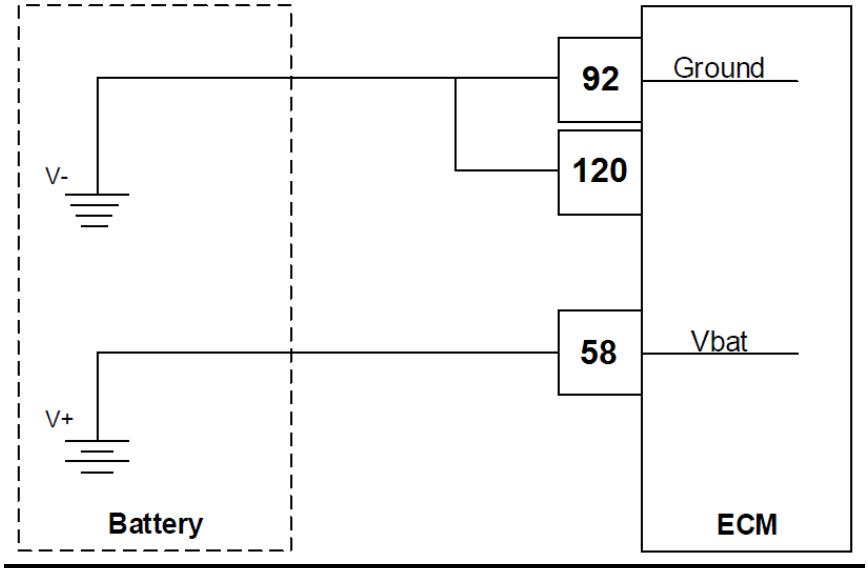
Code #	Code Name	RPM	Pressure
520	Oil Pres Low Stage 1	<= 1,400	15 psi
520	Oil Pres Low Stage 1	>= 1,450	30 psi
524	Oil Pres Low Stage 2	<= 1,400	8 psi
524	Oil Pres Low Stage 2	>= 1,450	25 psi

DTC 524-Oil Pressure Low Stage 2

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	• Verify that the engine has oil pressure using a mechanical oil pressure gauge before proceeding with this chart. Does the engine have oil pressure above 8 NGE?	8 NGE	Go to Step (3)	Repair faulty Oiling System
3	• Key ON, Engine Running DST connected in System Data Mode • Clear DTC 524 • Warm the engine by idling until the ECT temperature is above 160 degrees F. and has been running for at least 20 seconds or more Does DTC 524 reset and cause the engine to shut down?		Go to Step (4)	Intermittent problem Go to Intermittent section
4	• With a volt meter, check terminal B on the sensor for a 5 volt reference from the ECM. Do you have 5 volts on terminal B?	5v	Go to Step (6)	Go to Step (5)
5	• With a volt meter, check terminal 19 on the ECM for a 5 volt reference. Do you have a 5v reference coming out of the ECM?	5v	Repair faulty wiring between ECM and Oil pressure sensor	Go to Step (8)
6	• With the oil pressure sender connected check for a signal coming out of terminal C. Do you have a voltage signal coming out of terminal C?		Go to Step (7)	Replace faulty oil pressure sender
7	• With the oil pressure sender connected check for a signal at terminal 44 of the ECM. Do you have a signal voltage at pin 44 of the ECM?		Go to Step (8)	Repair faulty wiring between terminal C and Terminal 25.
8	• Replace DEPR / ECM Is the replacement complete?		Go to Step (9)	-

Step	Action	Value(s)	Yes	No
9	• Remove all test equipment except the DST. • Connect any disconnected components, fuses, etc. • Using the DST clear DTC information from the ECM. • Turn the ignition OFF and wait 30 seconds. • Start the engine and operate the vehicle to full operating temperature • Observe the MIL • Observe engine performance and drivability • After operating the engine within the test parameters of DTC-524 check for any stored codes. Does the engine operate normally with no stored codes?		System OK	Go to OBD System Check

DTC 562-System Voltage Low



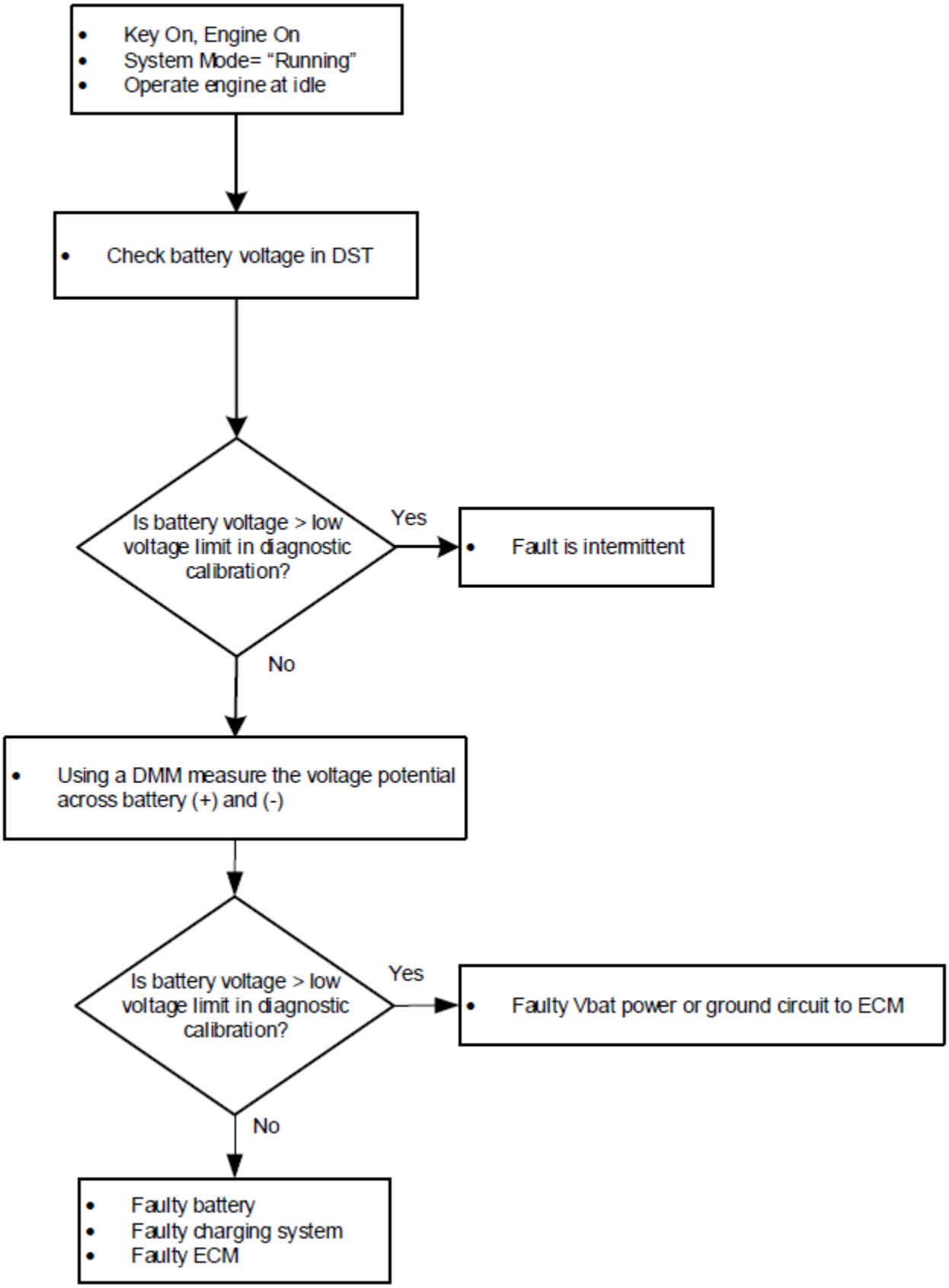
Conditions for Setting the DTC

- Check Condition: Key on with engine speed greater than 1000 RPM
- Fault Condition: Battery voltage at ECM less than 18.0
- Fault Condition is present for longer than 5 seconds.
- MIL: ON for active fault
- Adaptive: Disabled

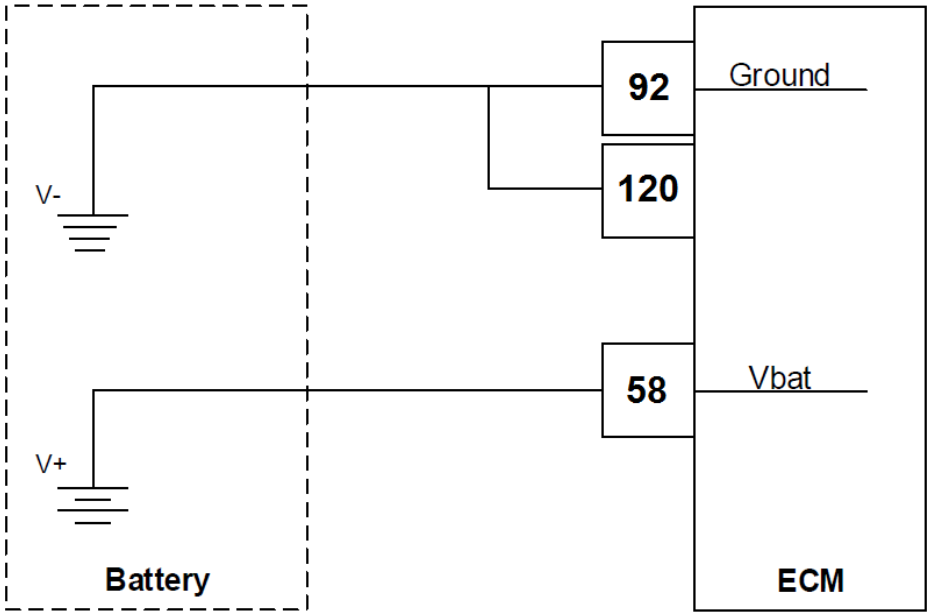
Circuit Description

The battery voltage powers the ECM and must be measured to correctly to properly operate injector drivers, solenoid valves and ignition coils. This fault will set if the ECM detects system voltage less than 18.00 volts while the alternator should be charging. The adaptive learn is disabled during this fault.

DTC 562-System Voltage Low



DTC 563 – Battery Voltage High



Conditions for Setting the DTC

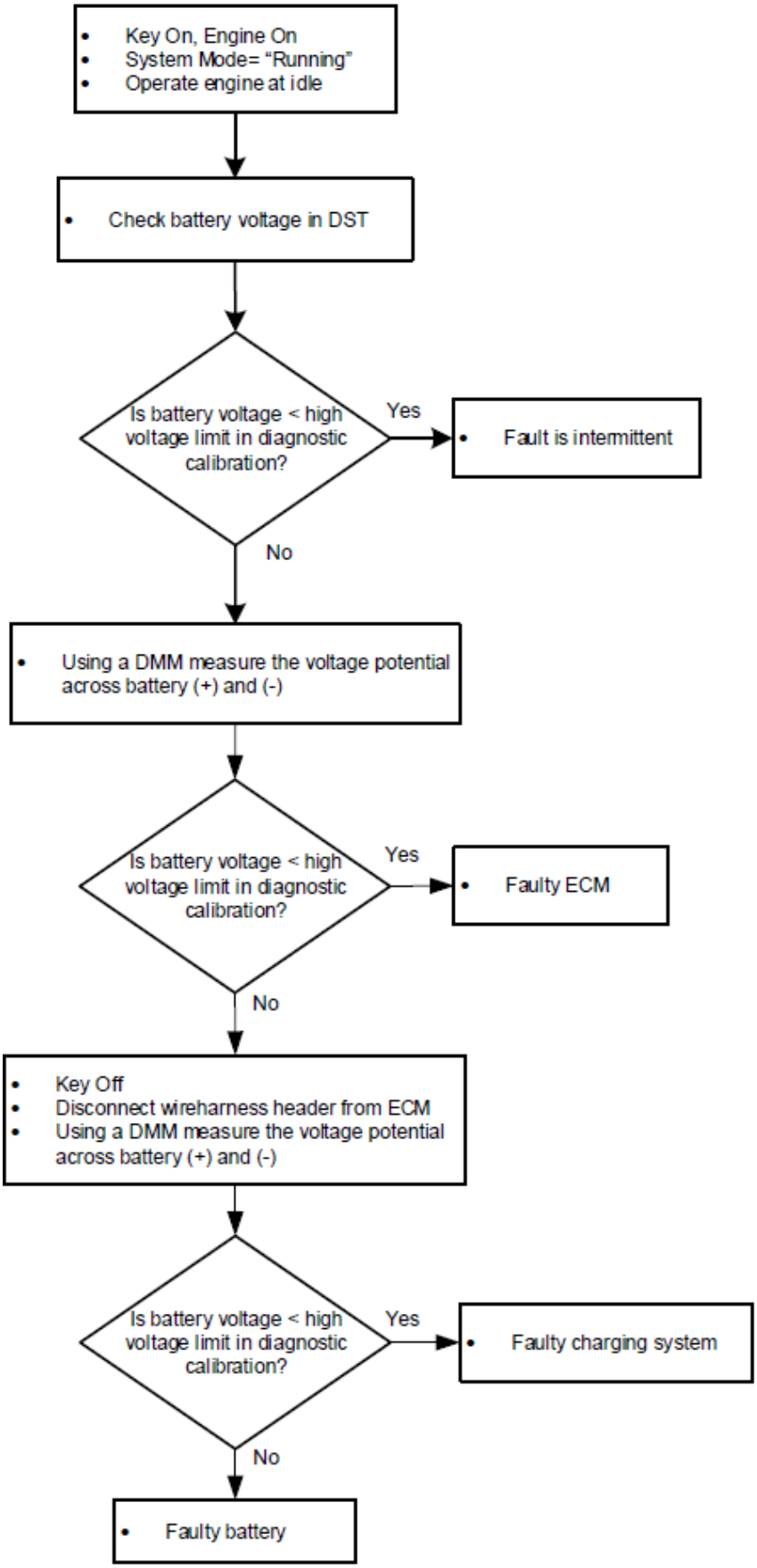
- Check Condition: Key On, Engine cranking or running
- Fault Condition: Battery voltage exceeds 33V for 3 seconds
- MIL: ON during active fault
- Adaptive learn disabled

Fault Description

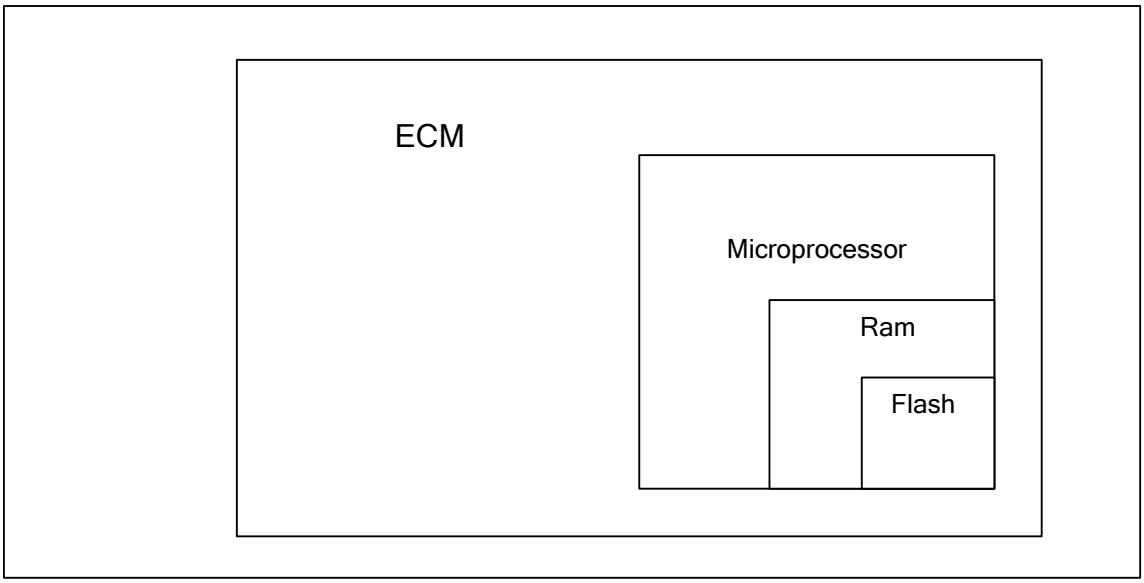
The battery voltage powers the ECM and must be within limits to correctly operate ignition coils, throttle, power supplies, and other powered devices that the ECM controls.

This fault will set if the ECM detects system voltage greater than 33V while the engine is running or cranking. The MIL will light and adaptive learn is disabled to avoid improper adaptive learning.

DTC 563 – Battery Voltage High



DTC 601-Flash Checksum Invalid



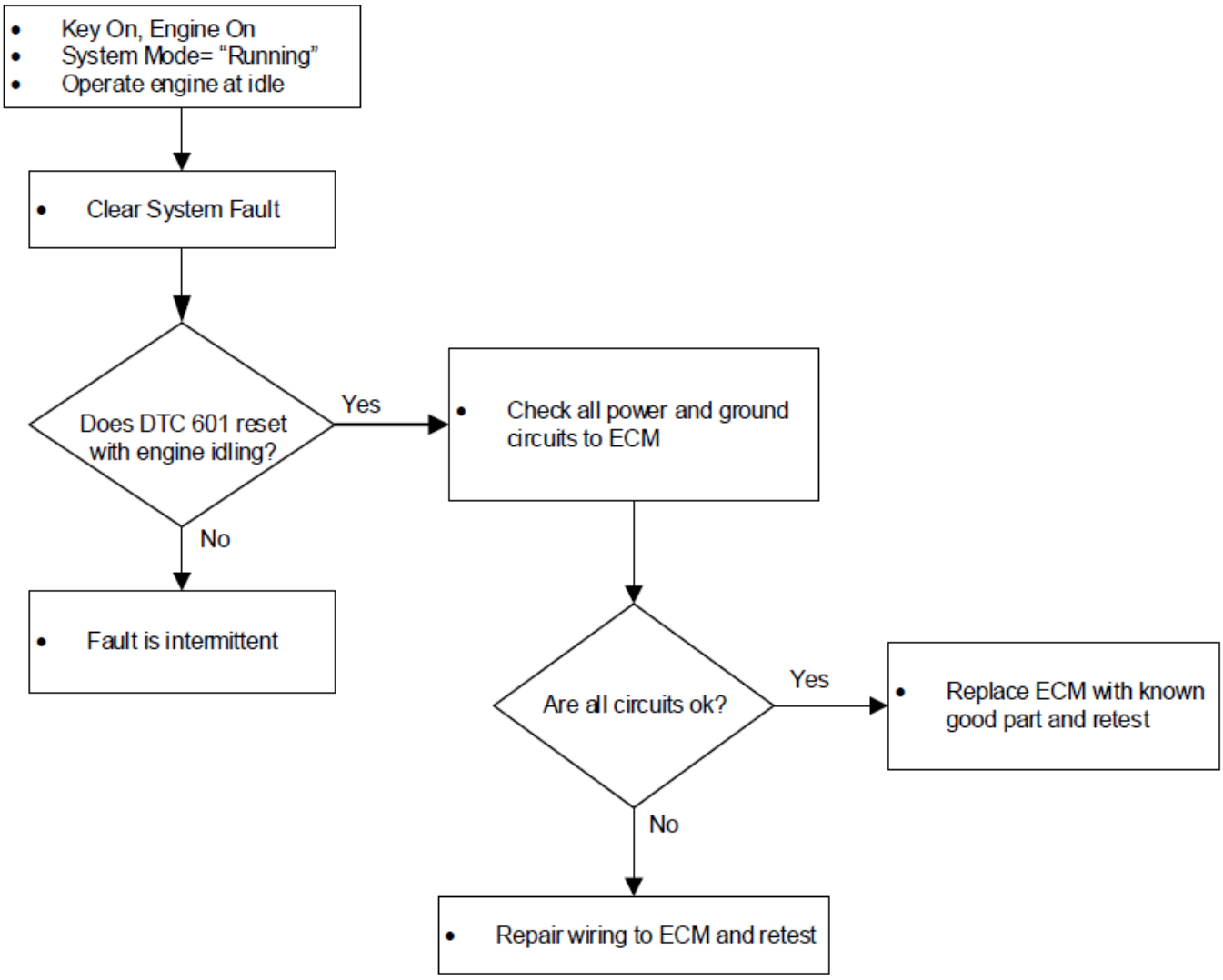
Conditions for Setting the DTC

- Check Condition: Key on
- Fault Condition: Internal microprocessor error
- MIL: ON
- Engine Shutdown will occur

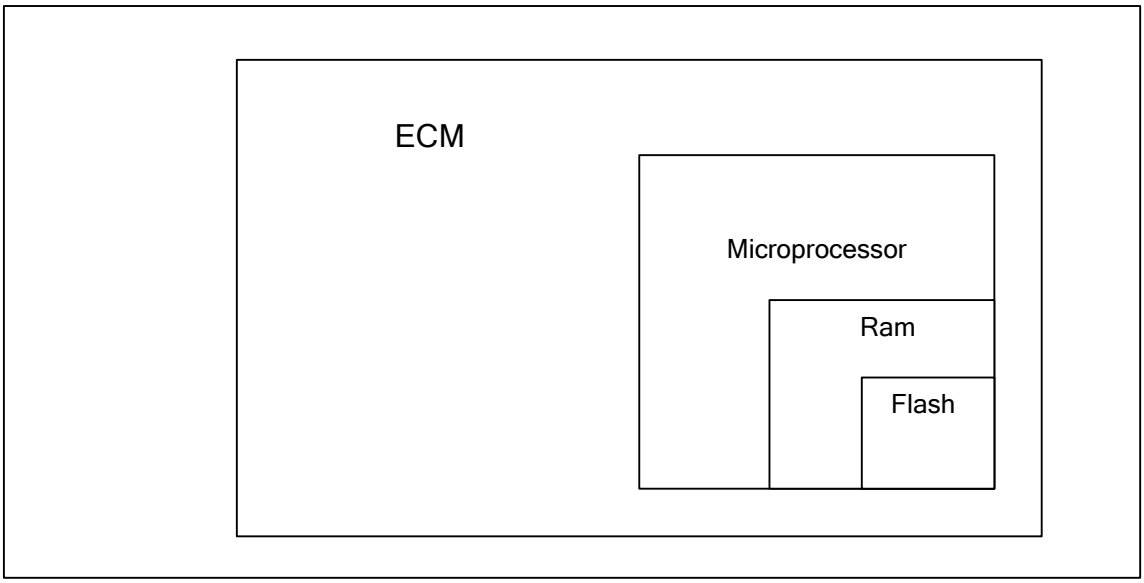
Circuit Description

The ECM has several internal checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will attempt to reset itself in the event this fault is set. The MIL command is on and will remain on until the code is cleared using the DST. The engine will shut down when this fault occurs.

DTC 601-Flash Checksum Invalid



DTC 604-RAM Failure



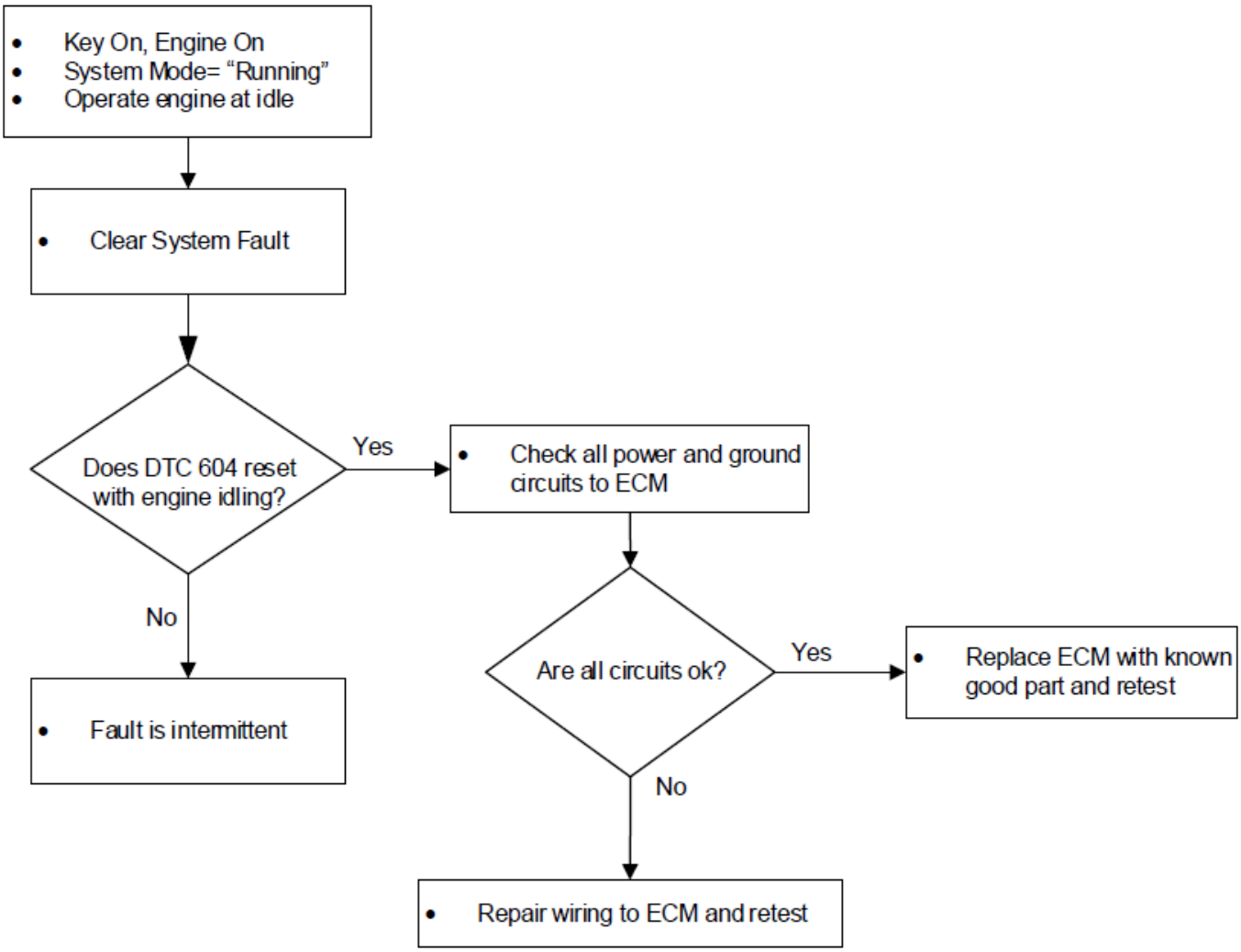
Conditions for Setting the DTC

- Check Condition: Key on
- Fault Condition: Internal microprocessor error
- MIL: ON
- Engine Shutdown will occur

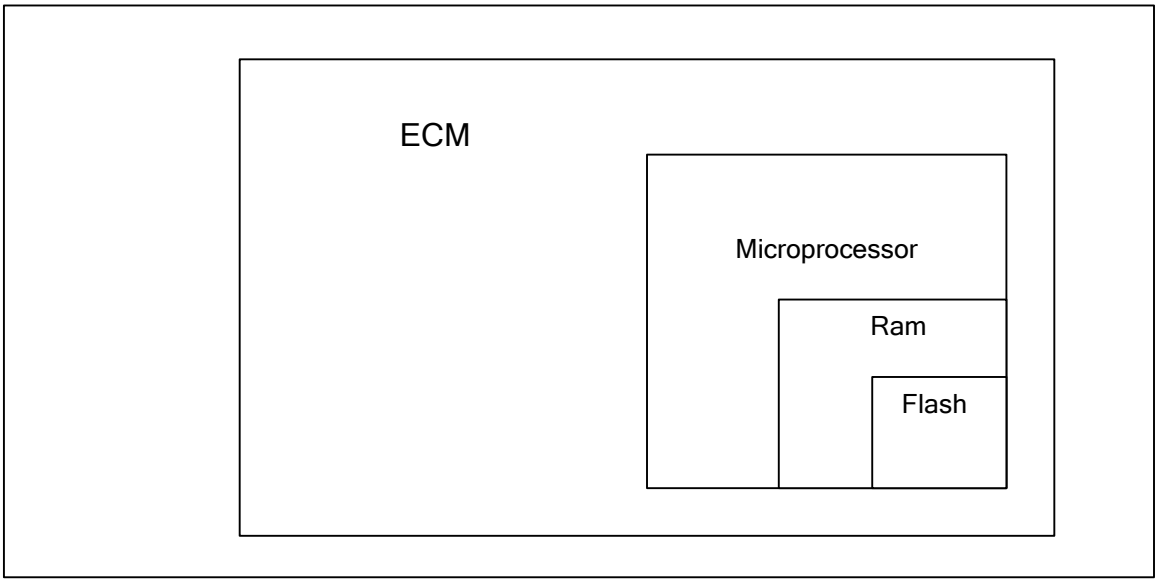
Circuit Description

The ECM has several internal checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will attempt to reset itself in the event this fault is set. The MIL command is on and will remain on until the code is cleared using the DST. The engine will shut down if this fault occurs.

DTC 604-RAM Failure



DTC 606-COP Failure



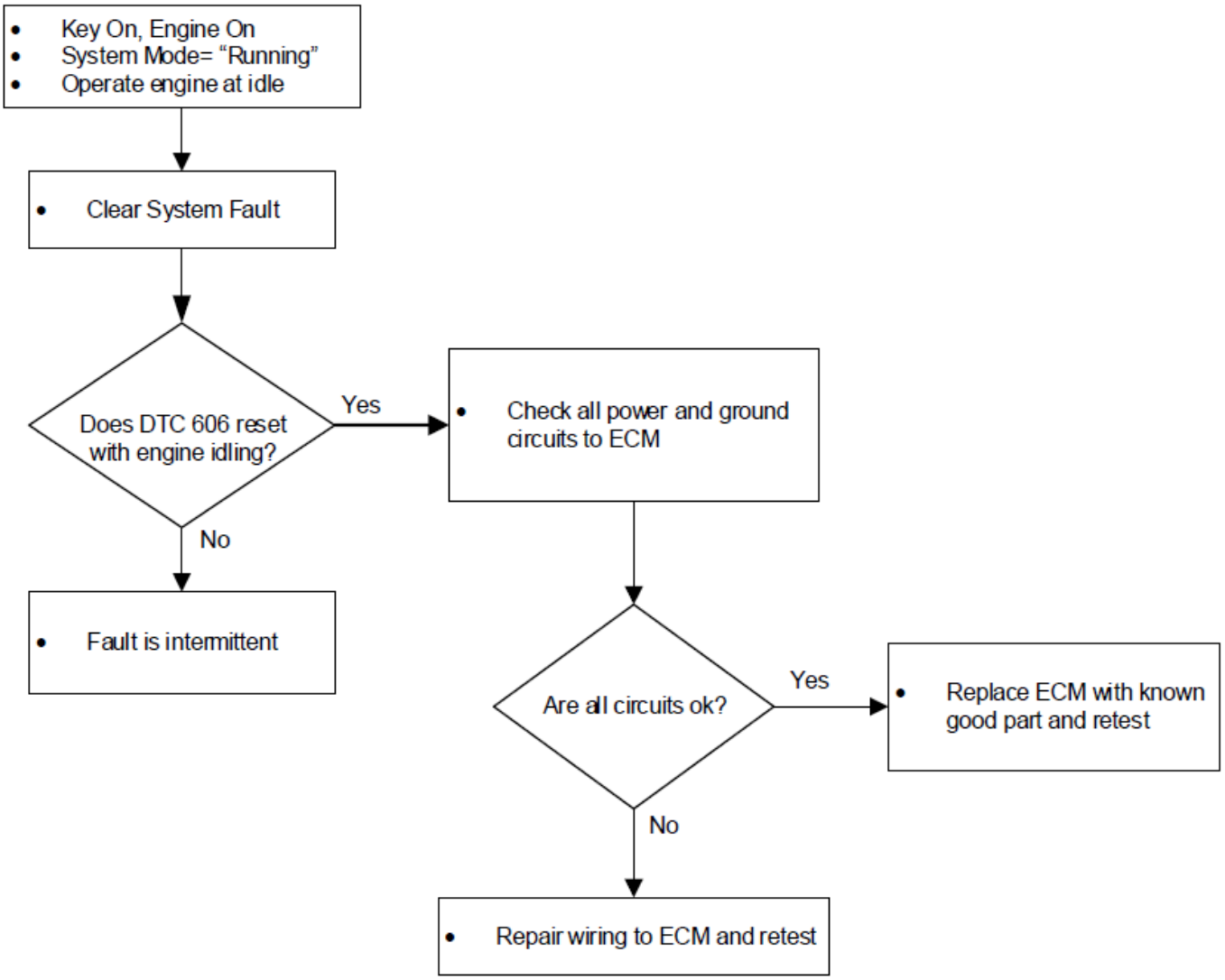
Conditions for Setting the DTC

- Check Condition: Key on
- Fault Condition: Internal microprocessor error
- MIL: ON
- Engine Shutdown will occur

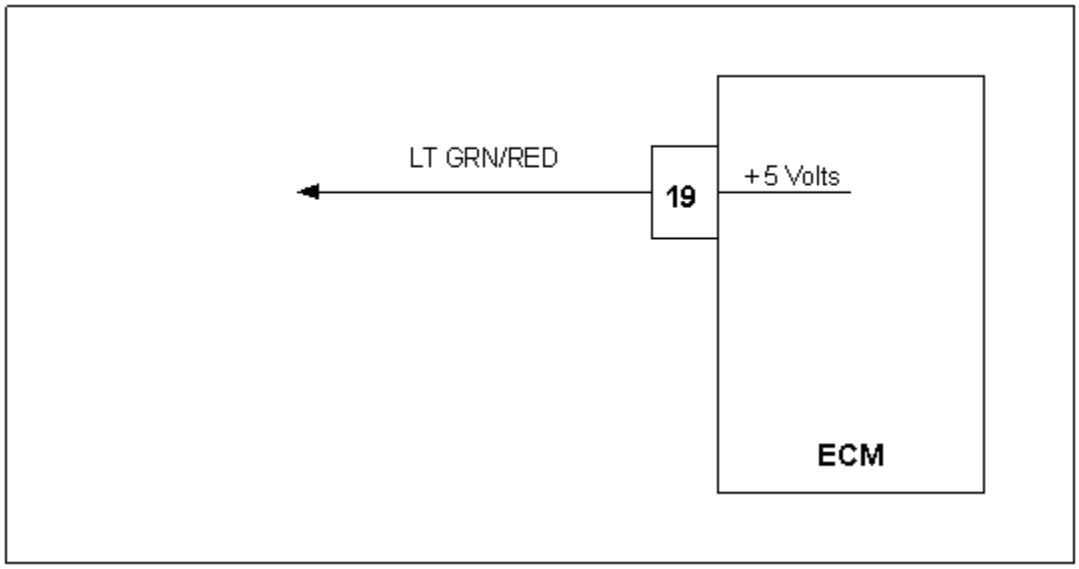
Circuit Description

The ECM has several internal checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will attempt to reset itself in the event this fault is set. The MIL command is on and will remain on until the code is cleared using the DST. The engine will shut down if this fault occurs.

DTC 606-COP Failure



DTC 642-External 5 Volt 1 Reference Low



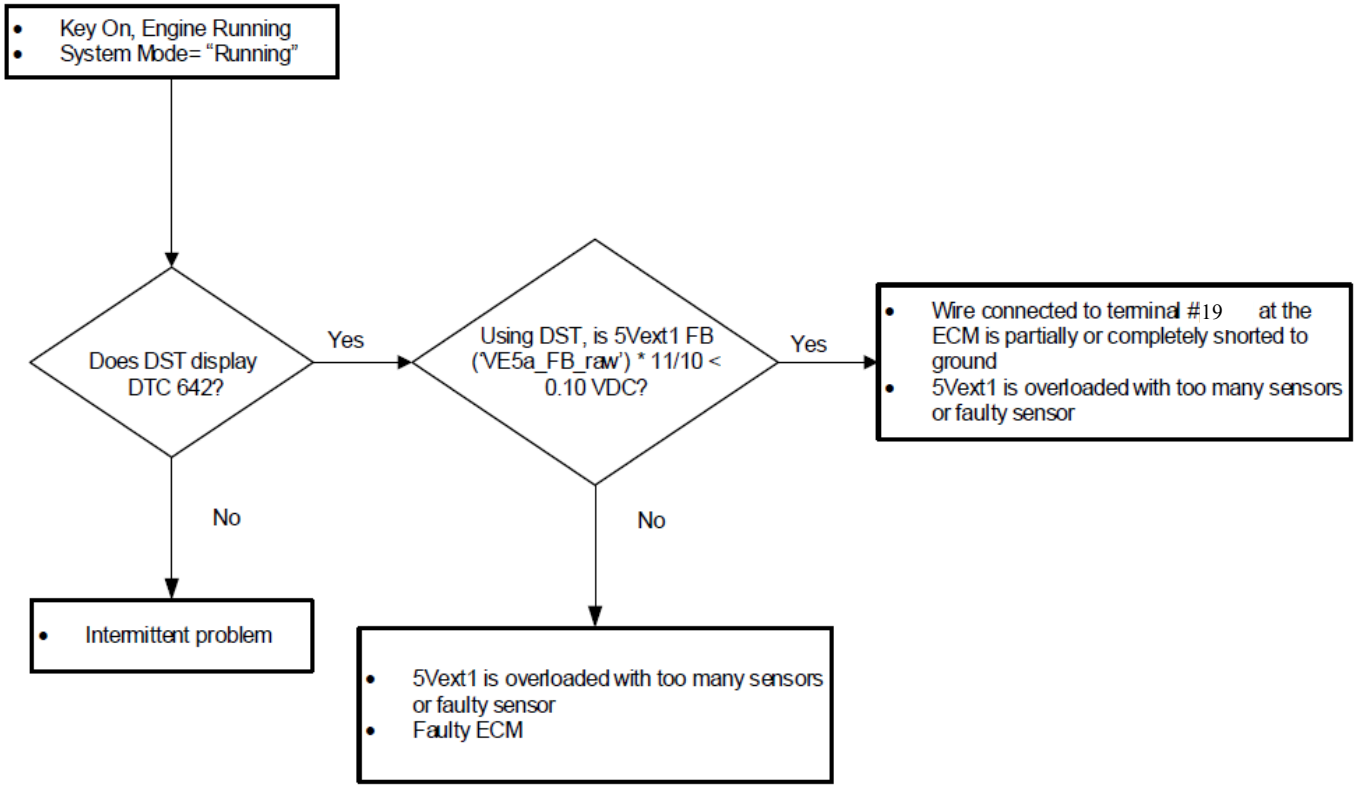
Conditions for Setting the DTC

- Check Condition: Engine cranking or running
- Fault Condition: 5 volt reference voltage lower than 4.60 volts
- MIL: ON during active fault
- Adaptive: Disabled during active fault

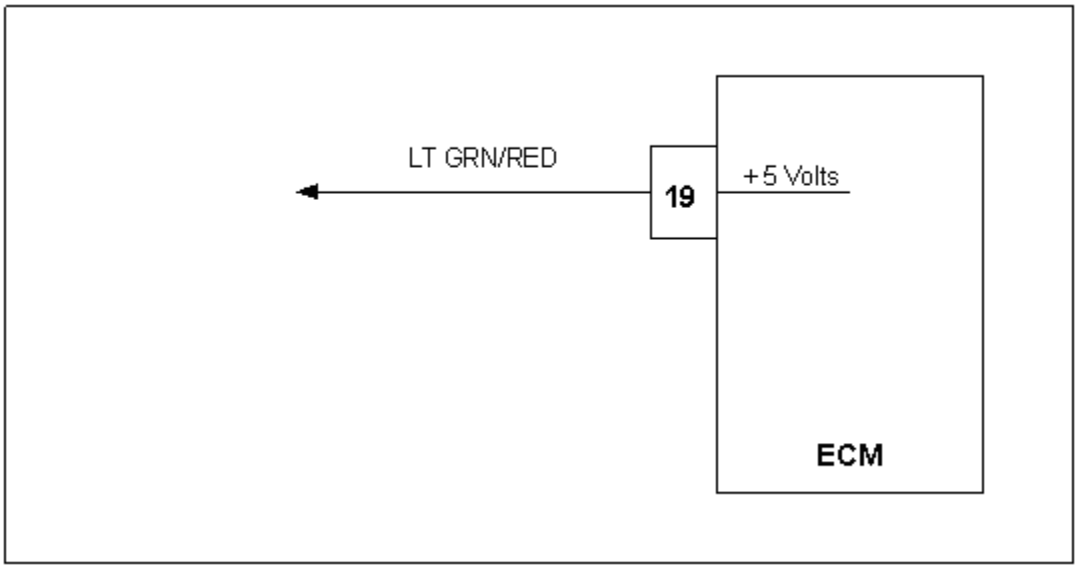
Circuit Description

The External 5 volt supply powers many of the sensors and other components of the fuel system. The accuracy of the 5 volt supply is very important to the accuracy of the powered sensors and fuel control by the ECM. The ECM is able to determine if they are overloaded, shorted, or otherwise out of specification by monitoring the 5 volt supply. This fault will set if the 5 volt reference is below 4.60 volts. Adaptive Learn will be disabled during this fault

DTC 642 External 5 Volt 1 Reference Low



DTC 643-External 5 Volt 1 Reference High



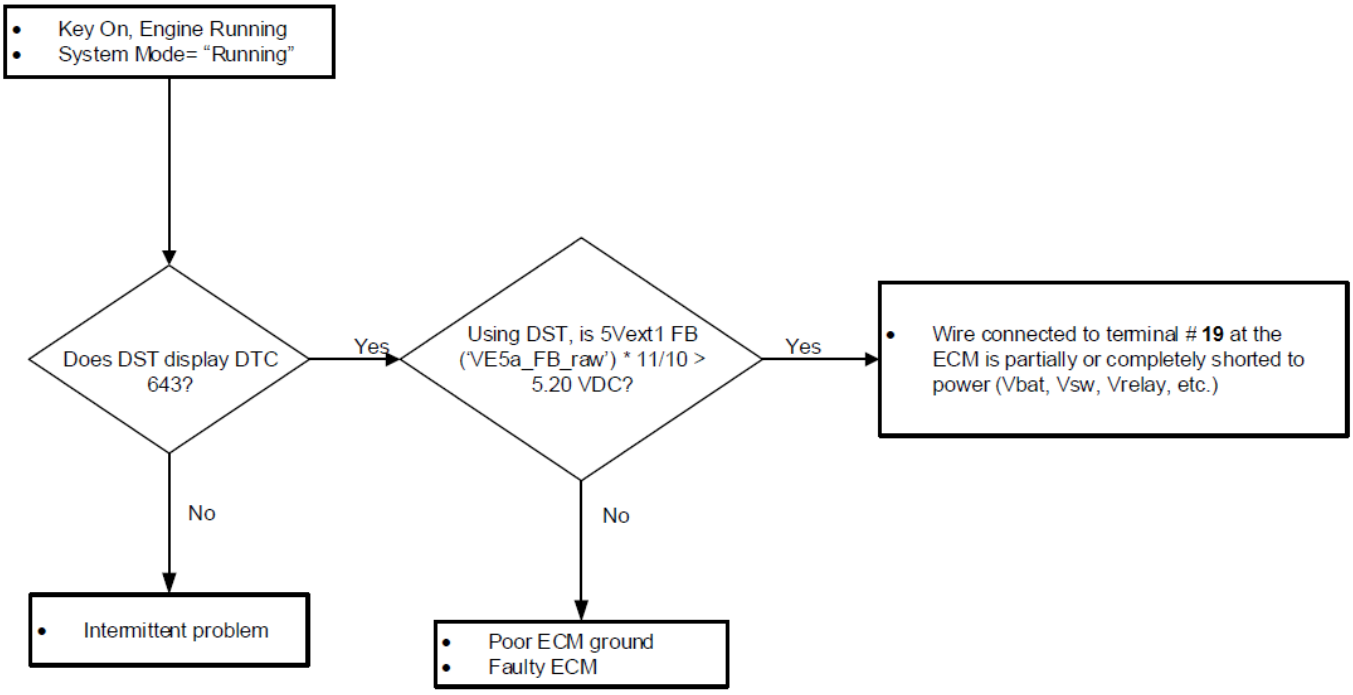
Conditions for Setting the DTC

- Check Condition: Engine cranking or running
- Fault Condition: 5 volt reference higher than 5.40 volts
- MIL: ON during active fault
- Adaptive: Disabled during active fault

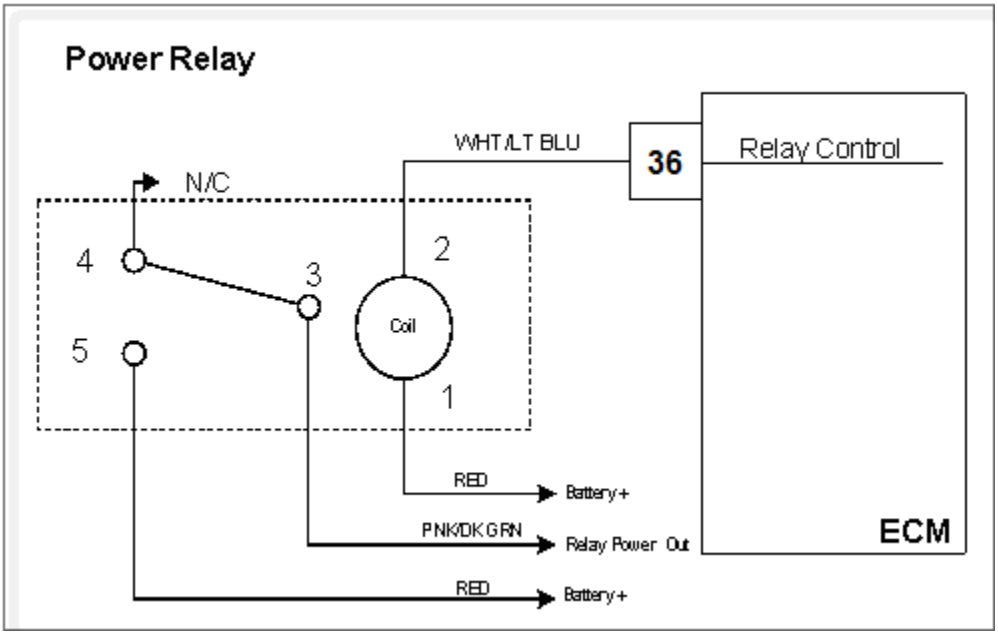
Circuit Description

The External 5 volt supply powers many of the sensors and other components in the fuel system. The accuracy of the 5 volt supply is very important to the accuracy of the powered sensors and fuel control by the ECM. The ECM is able to determine if they are overloaded, shorted, or otherwise out of specification by monitoring the 5volt supply. This fault will set if the 5 volt reference is greater than 5.40 volts anytime the engine is cranking or running. Adaptive Learn will be disabled during this fault

DTC 643 External 5 Volt 1 Reference High



DTC 685-Relay Coil Open



Conditions for Setting the DTC

- Check Condition: Key ON
- Fault Condition: Relay coil open

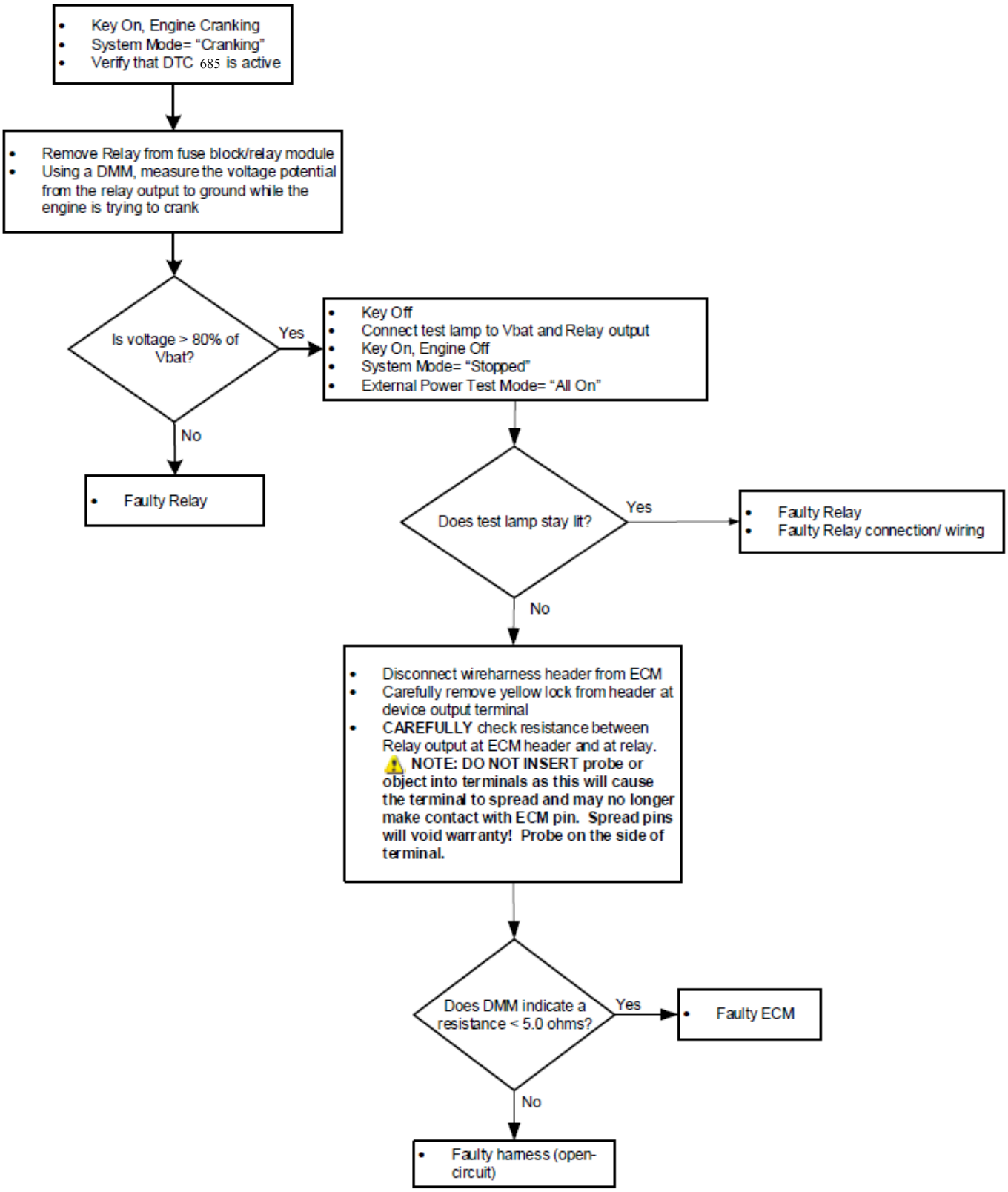
Circuit Description

The power relay switches power out to various sensors, actuators and solenoids in the fuel system. This fault will set if the ECM detects an open circuit on the relay control output.

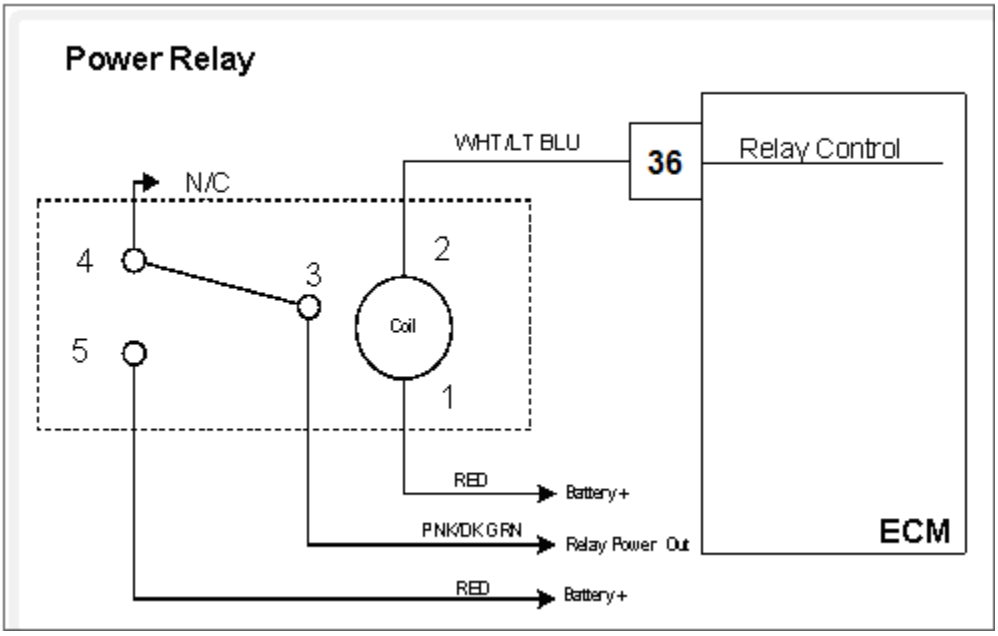
Diagnostic Aid

Relay coil resistance changes with temperature. The following diagnostic charts have steps to measure relay coil resistance values. When checking the resistance values be sure the relay is at a reasonable temperature, between +20 and +100 degrees F.

DTC 685-Relay Coil Open



DTC 686-Relay Control Ground Short



Conditions for Setting the DTC

- Check Condition: Key ON
- Fault Condition: Relay control shorted to ground

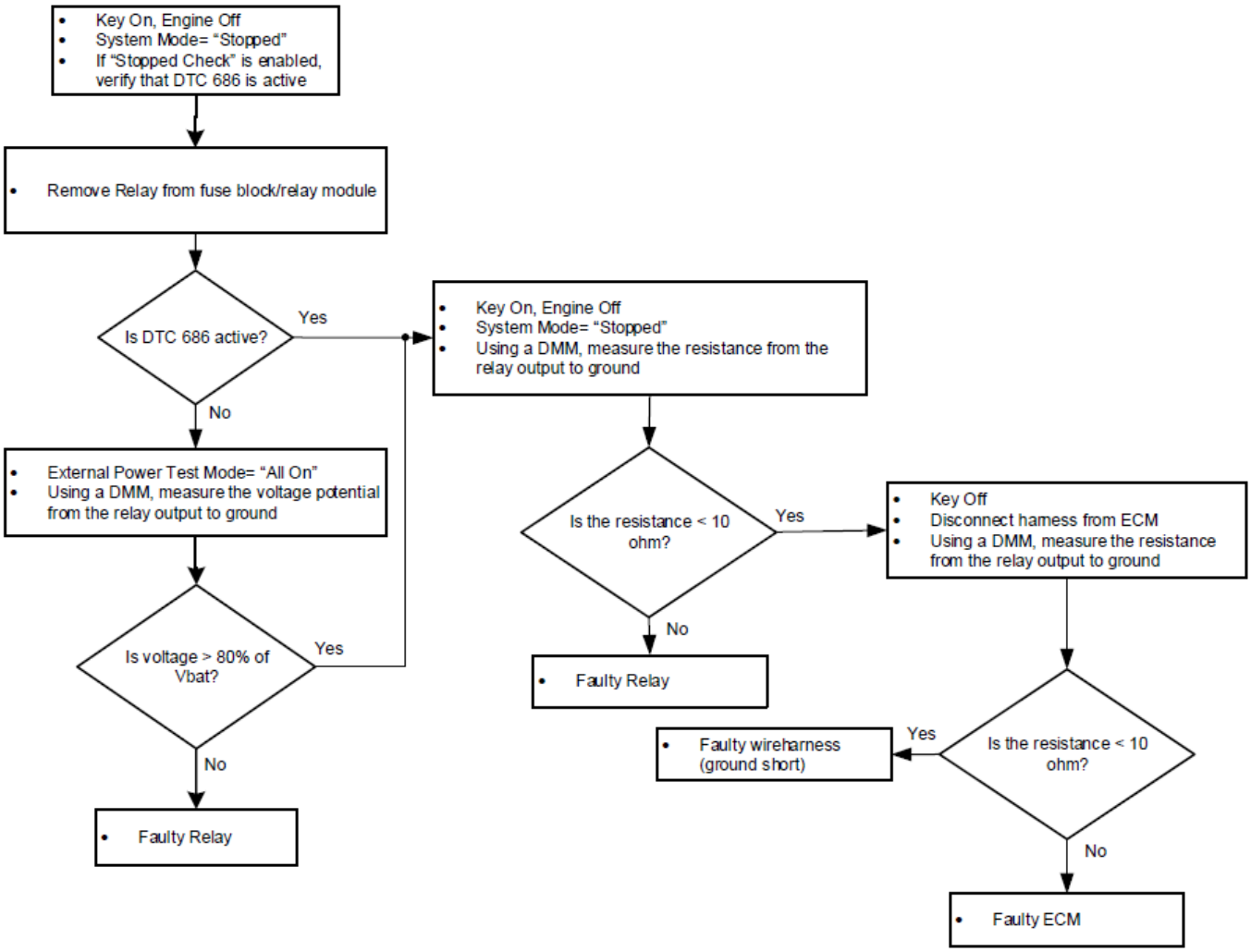
Circuit Description

The power relay switches power out to various sensors, actuators and solenoids in the fuel system. This fault will set if the ECM detects a short to ground on the relay control output.

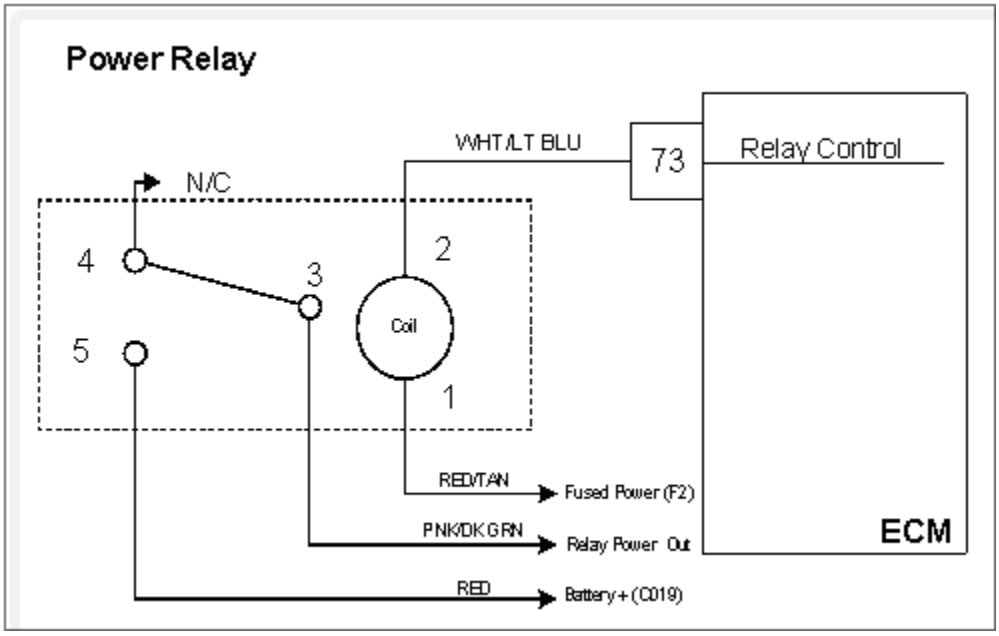
Diagnostic Aid

Relay coil resistance changes with temperature. The following diagnostic charts have steps to measure relay coil resistance values. When checking the resistance values be sure the relay is at a reasonable temperature, between +20 and +100 degrees F.

DTC 686-Relay Control Ground Short



DTC 687-Relay Coil Short to Power



Conditions for Setting the DTC

- Check Condition: Key ON
- Fault Condition: Relay coil shorted to power

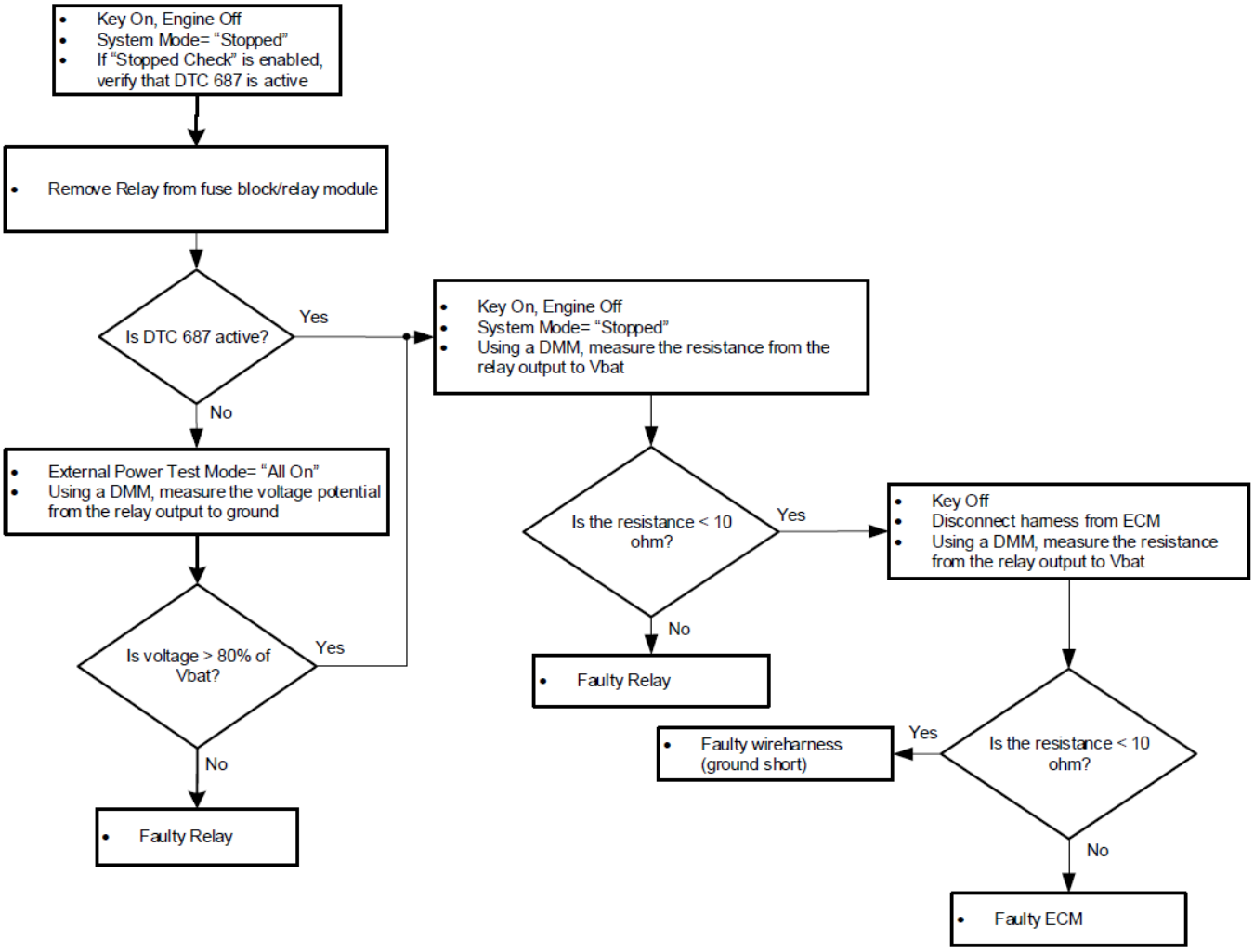
Circuit Description

The power relay switches power out to various sensors, actuators and solenoids in the fuel system. This fault will set if the ECM detects a short circuit to power on the relay control output.

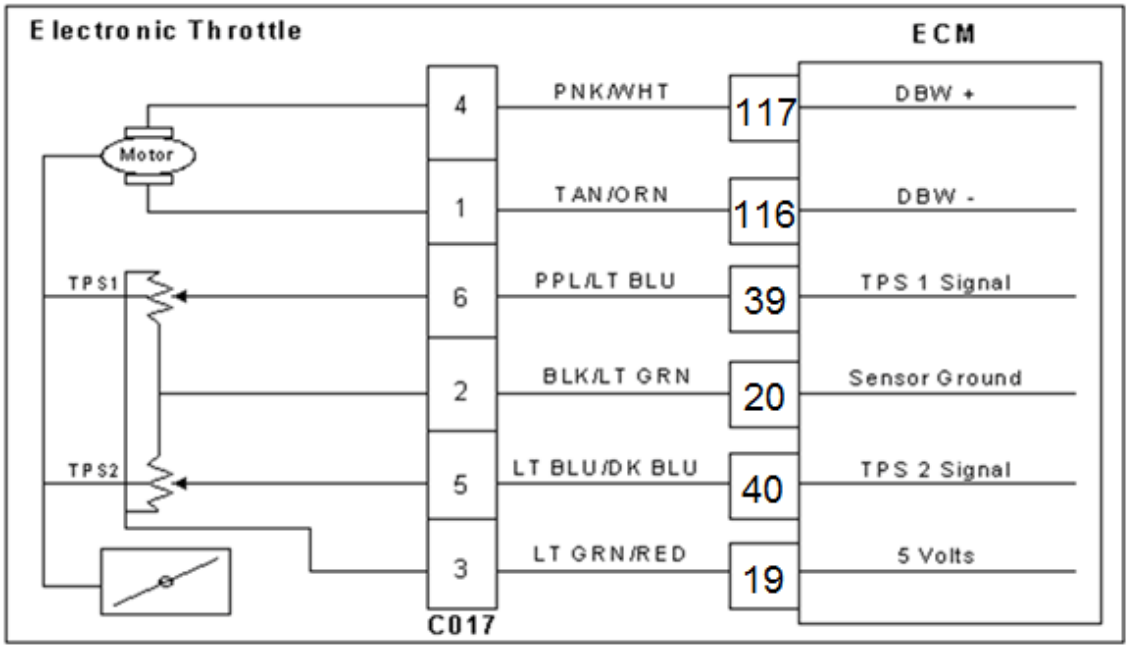
Diagnostic Aid

Relay coil resistance changes with temperature. The following diagnostic charts have steps to measure relay coil resistance values. When checking the resistance values be sure the relay is at a reasonable temperature, between +20 and +100 degrees F.

DTC 687-Relay Coil Short to Power



DTC 726-Max Govern Speed Override



Conditions for Setting the DTC

- Check Condition: Engine Running
- Fault Condition: Engine rpm greater than 2,250 rpm
- Fault condition active for 2 or more seconds
- MIL: ON during active fault

Circuit description

This fault will set anytime the engine rpm exceeds 2,250 rpm for longer than 2 seconds. The MIL command is ON during this active fault

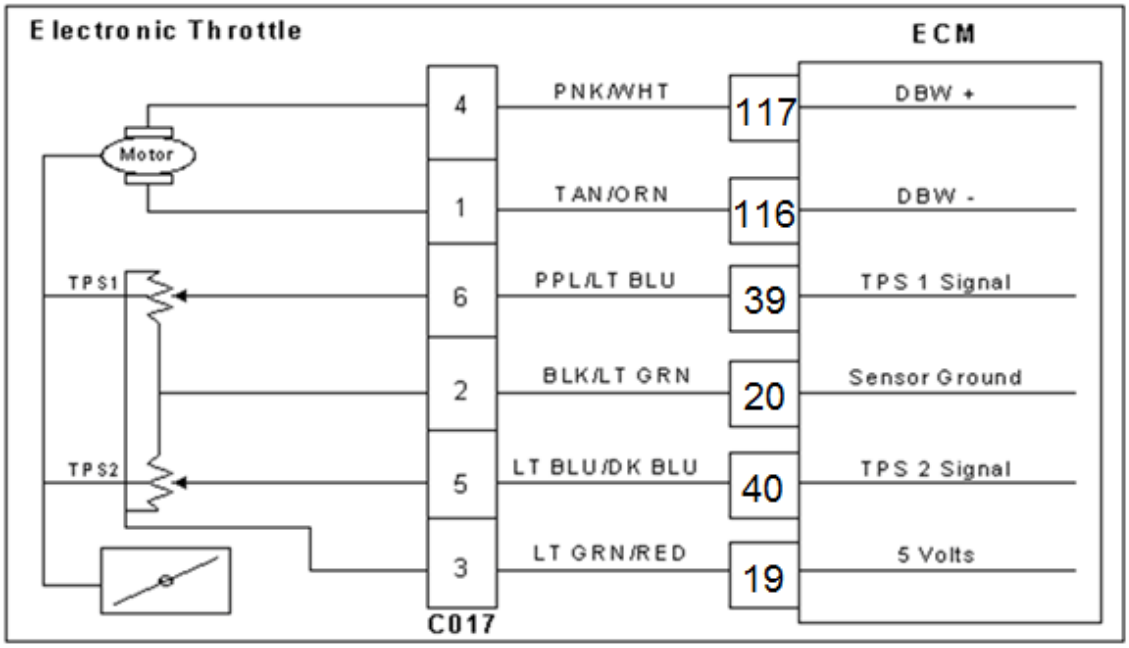
Diagnostic Aid

Check for other stored DTC codes before using the following DTC chart for this code set. Always diagnose and repair any existing codes starting with the lowest numerical code first.

DTC 726-Max Govern Speed Override

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	Key ON, Engine OFF DST connected Are any other DTC codes present with DTC 219?		Go to Step (3)	Go to Step (4)
3	Diagnose and repair any other DTC codes stored before proceeding with this chart. Have any other DTC codes been diagnosed and repaired?		Go to Step (4)	-
4	Check the service part number on the ECM to ensure the correct calibration is in use Is the Service Part Number Correct?		Go to Step (6)	Go to Step 5
5	Replace ECM with correct service part number Is the replacement complete?		Go to Step (9)	-
6	Check the mechanical operation of the throttle Is the mechanical operation of the throttle OK?		Go to Step (8)	Go to Step (7)
7	Correct mechanical operation of the throttle. Refer to Engine & Component section Has the mechanical operation of the throttle been corrected?		Go to Step (9)	-
8	Check engine for large manifold vacuum leaks. Refer to Symptom Diagnostic section Did you find and correct the vacuum leak?		Go to Step (9)	Go to OBD System Check Section
9	Remove all test equipment except the DST. Connect any disconnected components, fuses, etc. Using the DST clear DTC information from the ECM. Turn the ignition OFF and wait 30 seconds. Start the engine and operate the vehicle to full operating temperature Observe the MIL Observe engine performance and drivability After operating the engine within the test parameters of DTC-219 check for any stored codes. Does the engine operate normally with no stored codes?		System OK	Go to OBD System Check

DTC 1111-Fuel Rev Limit



Conditions for Setting the DTC

- Check Condition: Engine Running
- Fault Condition: Engine rpm greater than 2300rpm set limit
- MIL: ON during active fault

Circuit Description

This fault will set anytime the engine rpm exceeds the specified speed settings in the calibration. This is generally set at 2300 rpm. The MIL command is ON during this active fault

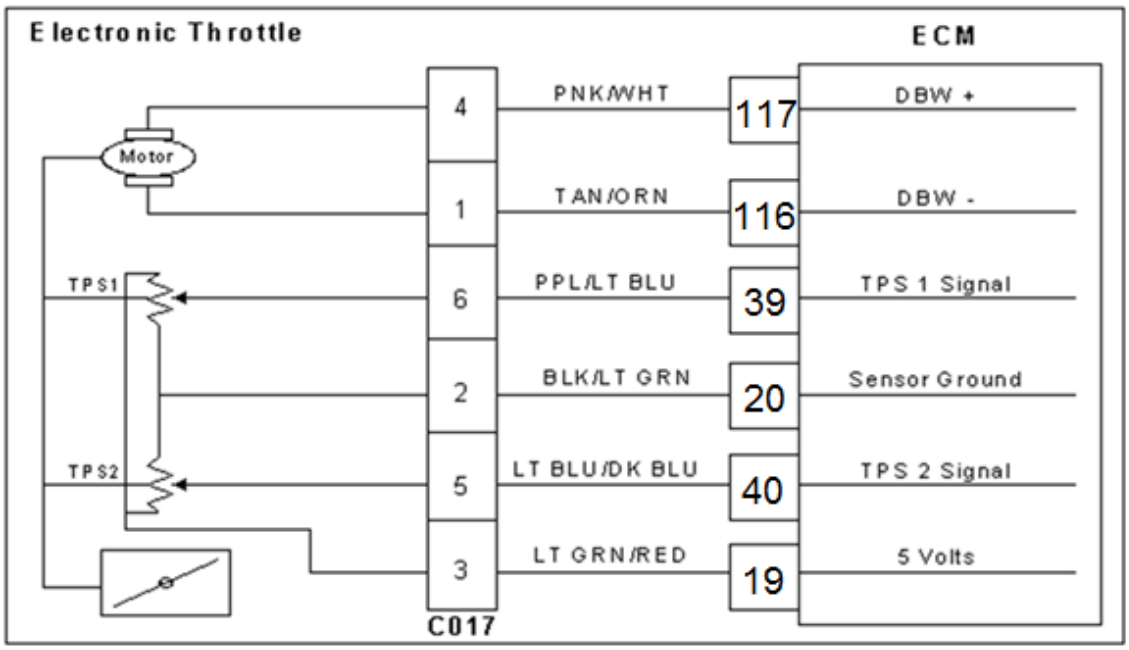
Diagnostic Aid

Always check for other stored DTC codes before using the following DTC chart for this code set. Repair any existing codes starting with the lowest numerical code first.

DTC 1111-Fuel Rev Limit

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	Key ON, Engine OFF DST in Active Fault Mode Are any other DTC codes present with DTC 1111?		Go to Step (3)	Go to Step (4)
3	Diagnose and repair any other DTC codes before proceeding with this chart. Have any other DTC codes been diagnosed and repaired?		Go to Step (4)	-
4	Check the service part number on the ECM to ensure correct calibration is in use Is the service part number correct?		Go to Step (6)	Go to Step 5
5	Replace ECM with the correct service part number Is the replacement complete?		Go to Step (9)	-
6	Check the mechanical operation of the throttle Is the mechanical operation of the throttle OK?		Go to Step (8)	Go to Step (7)
7	Correct mechanical operation of the throttle. Refer to Engine & Component section Has the mechanical operation of the throttle been corrected?		Go to Step (9)	-
8	Check engine for large manifold vacuum leaks. Refer to Fuel Systems symptom diagnostics Did you find and correct the vacuum leaks?		Go to Step (9)	Go to OBD System Check Section
9	Remove all test equipment except the DST. Connect any disconnected components, fuses, etc. Using the DST clear DTC information from the ECM. Turn the ignition OFF and wait 30 seconds. Start the engine and operate the vehicle to full operating temperature Observe the MIL Observe engine performance and drivability After operating the engine within the test parameters of DTC-1111 check for any stored codes. Does the engine operate normally with no stored codes?		System OK	Go to OBD System Check

DTC 1112-Spark Rev Limit



Conditions for Setting the DTC

- Check Condition: Engine running
- Fault Condition: Engine rpm greater than 2325 rpm set limit
- MIL: ON during active fault
- Engine Shut Down

Circuit description

This fault will set anytime the engine rpm exceeds the specified speed settings installed in the calibration. This is set at 2325 rpm. The MIL command is ON during this active fault and the engine will shut down.

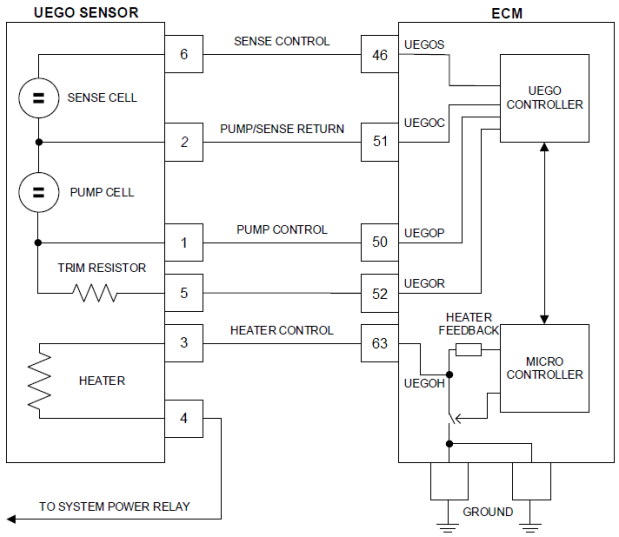
Diagnostic Aid

Always check for other stored DTC codes before using the following DTC chart for this code set. Repair any existing codes starting with the lowest numerical code first.

DTC 1112-Spark Rev Limit

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	Key ON, Engine OFF DST connected Are any other DTC codes present with DTC 1112?		Go to Step (3)	Go to Step (4)
3	Diagnose any other DTC codes before proceeding with this chart. Have any other DTC codes been diagnosed and repaired?		Go to Step (4)	-
4	Check the service part number on the ECM to ensure correct calibration is in use Is the service part number correct?		Go to Step (6)	Go to Step 5
5	Replace ECM with correct service part number Is the replacement complete?		Go to Step (9)	-
6	Check the mechanical operation of the throttle Is the mechanical operation of the throttle OK?		Go to Step (8)	Go to Step (7)
7	Correct mechanical operation of the throttle. Refer to Engine & Component section Has the mechanical operation of the throttle been corrected?		Go to Step (9)	-
8	Check engine for large manifold vacuum leaks. Refer to Fuel Systems section Symptom Diagnostics Did you find and correct the vacuum leak?		Go to Step (9)	Go to OBD System Check Section
9	Remove all test equipment except the DST. Connect any disconnected components, fuses, etc. Using the DST clear DTC information from the ECM. Turn the ignition OFF and wait 30 seconds. Start the engine and operate the vehicle to full operating temperature Observe the MIL Observe engine performance and drivability After operating the engine within the test parameters of DTC-1112 check for any stored codes. Does the engine operate normally with no stored codes?		System OK	Go to OBD System Check

DTC 1151-Closed Loop Multiplier High LPG



Conditions for Setting the DTC

- Check Condition-Engine running
- Fault Condition-Closed Loop multiplier out of range (greater than 35%) while running on propane
- MIL-ON

Circuit description

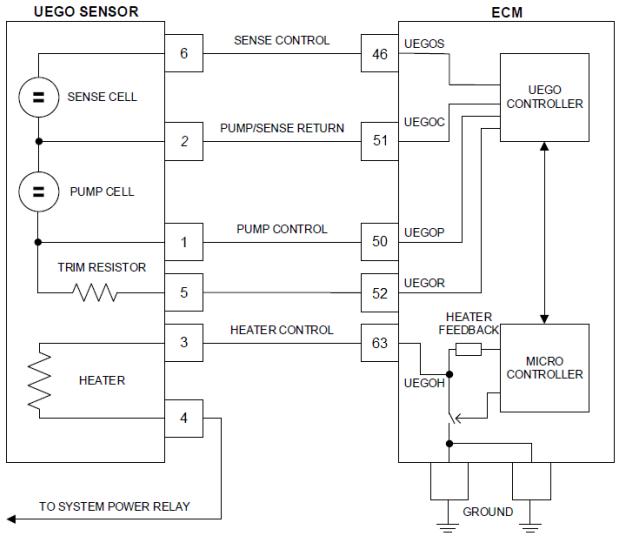
The UEGO sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and the adaptive multiplier. This fault sets if the Closed Loop multiplier exceeds the limits of normal operation and cannot correctly modify the fuel flow within its limits.

Diagnostic Aid

Vacuum Leaks - Large vacuum leaks and crankcase leaks can cause a lean exhaust condition at especially at light load.
Fuel Mixer - System can be lean due to faulty EPR (Electronic Pressure Regulator) or faulty fuel mixer.
Fuel Pressure - System will be lean if fuel pressure is too low. Ensure fuel pressure is not too low and that gaseous fuel control actuator/regulator has proper fuel pressure under all operating conditions. Ensure proper coolant flow to LP vaporizer.
Exhaust Leaks - If there is an exhaust leak, outside air can be pulled into the exhaust and past the 02 sensor causing a false lean condition.
Misfire - A misfiring cylinder will pass oxygen through rather than burning it. The sensor will interpret this oxygen as a lean condition and enrichen the fuel mixture.
Fuel Quality - A drastic variation in fuel quality may cause the system to be lean.
Ground Problem - ECM and engine must be grounded to the battery with very little resistance allowing for proper current flow. Faulty grounds can cause current supply issues resulting in many undesired problems.
Oxygen Sensor Wire - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor sense signal.

If all tests are OK, replace the O2 sensors with known good parts and retest.

DTC 1152-Closed Loop Multiplier Low LPG



Conditions for Setting the DTC

- Functional Fault: Closed Loop multiplier out of range (at limit of -35%) while running on propane
- MIL Disabled

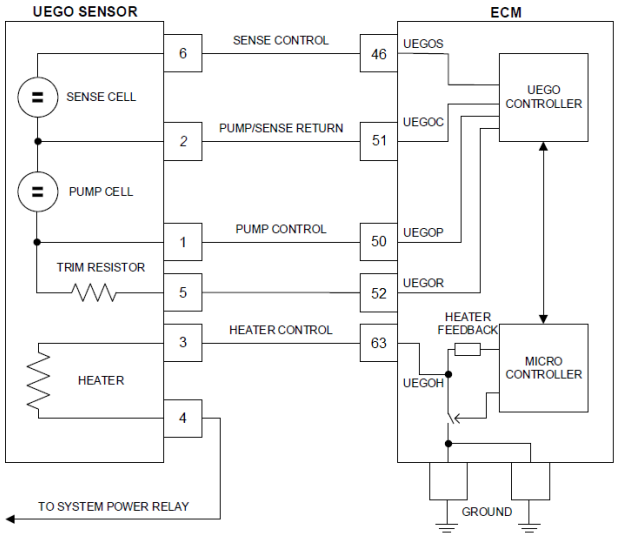
Circuit Description

The UEGO sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and the adaptive multiplier. This fault sets if the Closed Loop multiplier exceeds the limits of normal operation. When the multiplier cannot correctly modify the fuel flow within its limits, it is limited at -35%.

Diagnostic Aid

Fuel System High secondary fuel pressure will cause the system to run rich. A worn fuel mixer or faulty EPR (Electronic Pressure Regulator) may also cause the system to run rich.
Fuel Quality A drastic variation in fuel quality (very high butane content) may cause the fuel system to run rich. Be sure that the specified HD-5 or HD-10 motor fuel grade LPG is used.
Air Filter A plugged, damaged or modified air filter may cause the system to run rich.

DTC 1153-Closed Loop Multiplier High NG



Conditions for Setting the DTC

- Functional Fault: Closed Loop multiplier out of range (greater than 35%) while running on natural gas
- MIL: Disabled

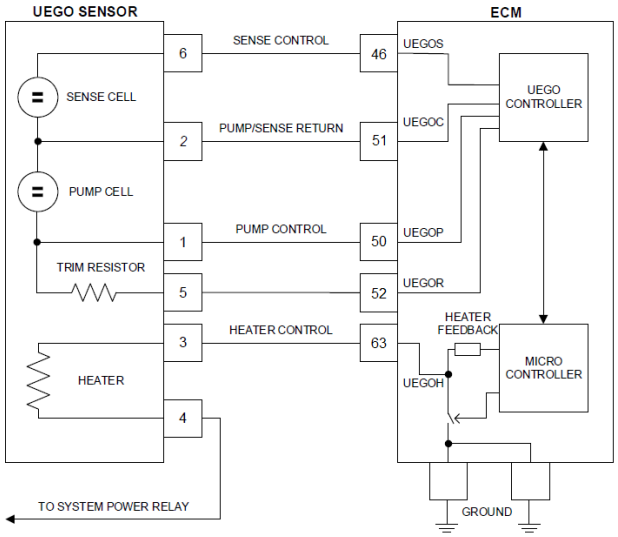
Circuit Description

The UEGO sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and the adaptive multiplier. This fault sets if the Closed Loop multiplier exceeds the limits of normal operation and cannot correctly modify the fuel flow within its limits.

Diagnostic Aid

Vacuum Leaks Large vacuum leaks and crankcase leaks can cause a lean exhaust condition, especially at light load.
Fuel Mixer System can be lean due to a faulty EPR (Electronic Pressure Regulator) or faulty fuel mixer.
Fuel Pressure System will be lean if fuel pressure is too low. Ensure fuel pressure is not too low and that gaseous fuel control actuator/regulator has proper fuel pressure under all operating conditions.
Exhaust Leaks If there is an exhaust leak, outside air can be pulled into the exhaust and past the 02 sensor causing a false lean condition.
Misfire A misfiring cylinder will pass oxygen through rather than burning it. The sensor will interpret this oxygen as a lean condition and enrichen the fuel mixture.
Fuel Quality A drastic variation in fuel quality may cause the system to be lean.
Ground Problem ECM and engine must be grounded to the battery with very little resistance allowing for proper current flow. Faulty grounds can cause current supply issues resulting in many undesired problems.
Oxygen Sensor Wire Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor sense signal.
If all tests are OK, replace the O2 sensors with known good parts and retest.

DTC 1154 - Closed Loop Multiplier Low NG



Conditions for Setting the DTC

- Functional Fault: Closed Loop multiplier out of range (at limit of -35%) while running on natural gas
- MIL: Disabled

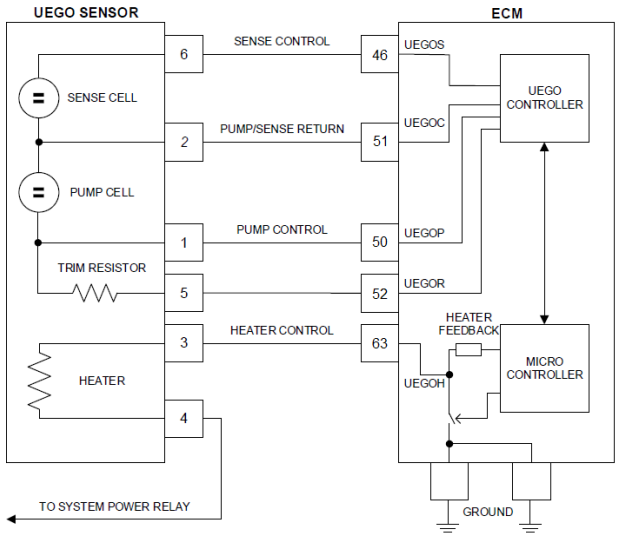
Circuit Description

The UEGO sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and the adaptive multiplier. This fault sets if the Closed Loop multiplier exceeds the limits of normal operation. When the multiplier cannot correctly modify the fuel flow within its limits, it is limited at -35%.

Diagnostic Aid

Fuel System High secondary fuel pressure will cause the system to run rich. A worn fuel mixer, faulty EPR (Electronic Pressure Regulator) may also cause the system to run rich.
Fuel Quality A drastic variation in fuel quality (high content of ethane and heavier hydrocarbons) may cause the fuel system to run rich. If running on wellhead gas, obtain a current gas analysis report for your fuel source. Wells can change over time and the gas supply may be different than when a sample was originally taken.
Air Filter A plugged, damaged or modified air filter may cause the system to run rich.

DTC 1161-Adaptive Learn High LPG



Conditions for Setting the DTC

- Check Condition: Engine Running
- Fault Condition: Adaptive multiplier out of range greater than 30% while running on propane
- MIL: ON

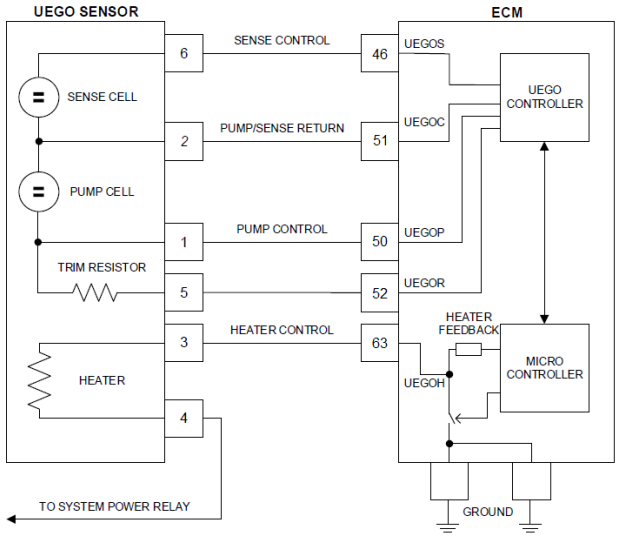
Circuit Description

The UEGO sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and Adaptive multiplier. This fault will set if the adaptive multiplier exceeds the limits of normal operation. Always run the fuel system diagnostic checks before using the following diagnostic chat.

Diagnostic Aid

Oxygen Sensor Wire - Oxygen sensor wires may be mis-routed and contacting the exhaust manifold, pipes, or other hot parts causing damage.
Vacuum Leaks - Large vacuum leaks and crankcase leaks can cause a lean exhaust condition at especially at light load.
Fuel Mixer - System can be lean due to faulty EPR (Electronic Pressure Regulator) or faulty fuel mixer.
Fuel Pressure - Low fuel pressure, faulty fuel regulator or contaminated fuel filter can cause fuel the system to run lean
Exhaust Leaks - If there is an exhaust leak, outside air can be pulled into the exhaust and past the 02 sensor causing a false lean condition.
Fuel Quality - Contaminated or spoiled fuel can cause the fuel system to be lean.
Ground Problem - ECM grounds must be clean, tight and in the proper location.

DTC 1162-Adaptive Learn Low LPG



Conditions for Setting the DTC

- Check Condition: Engine running
- Fault Condition: Adaptive multiplier out of range greater than -30% while running on propane
- MIL: ON

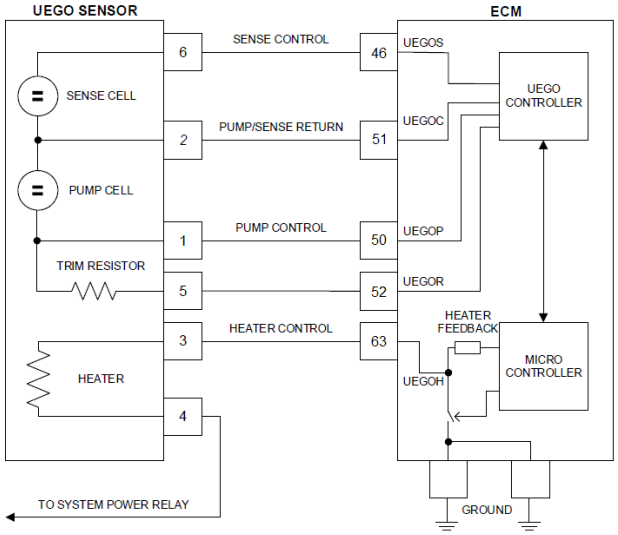
Circuit Description

The UEGO sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and Adaptive multiplier. This fault will set if the adaptive multiplier exceeds the limits of normal operation. Always run the fuel system diagnostics before using the following diagnostic chart.

Diagnostic Aid

Fuel System - High secondary fuel pressure will cause the system to run rich. A worn fuel mixer, faulty EPR (Electronic Pressure Regulator) may also cause the system to run rich.
Fuel Quality - A drastic variation in fuel quality (very high butane content) may cause the fuel system to run rich. Be sure that the specified HD-5 or HD-10 motor fuel grade propane is used.
Air Filter - A plugged, damaged or modified air filter may cause the system to run rich.

DTC 1163-Adaptive Learn High NG



Conditions for Setting the DTC

- Check Condition: Engine Running
- Fault Condition: Adaptive multiplier out of range greater than 30% while running on natural gas
- MIL: ON

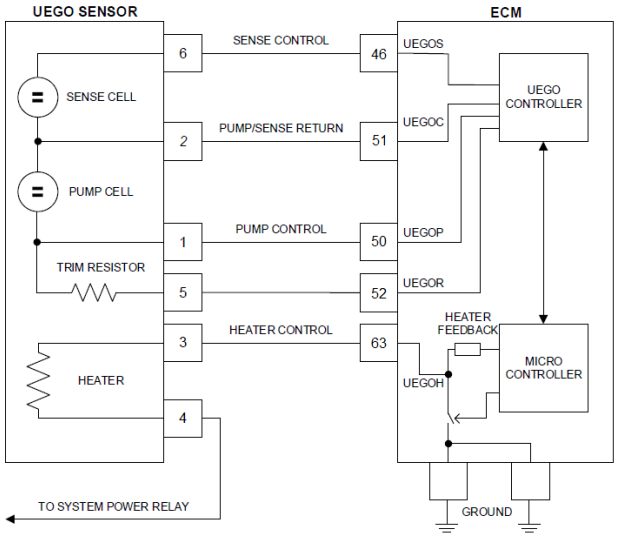
Circuit Description

The UEGO sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and Adaptive multiplier. This fault will set if the adaptive multiplier exceeds the limits of normal operation. Always run the fuel system diagnostic checks before using the following diagnostic chat.

Diagnostic Aid

Oxygen Sensor Wire - Heated Oxygen sensor wires may be mis-routed and contacting the exhaust manifold.
Vacuum Leaks Large - vacuum leaks and crankcase leaks can cause a lean exhaust condition at especially at light load.
Fuel Mixer - System can be lean due to faulty EPR (Electronic Pressure Regulator) or faulty fuel mixer.
Fuel Pressure - Low fuel pressure, faulty fuel regulator or contaminated fuel filter can cause fuel the system to run lean
Exhaust Leaks - If there is an exhaust leak, outside air can be pulled into the exhaust and past the 02 sensor causing a false lean condition.
Fuel Quality - Contaminated or spoiled fuel can cause the fuel system to be lean.
Ground Problem - ECM grounds must be clean, tight and in the proper location.

DTC 1164-Adaptive Learn Low NG



Conditions for Setting the DTC

- Check Condition: Engine running
- Fault Condition: Adaptive multiplier out of range greater than -30% while running on natural gas
- MIL: ON

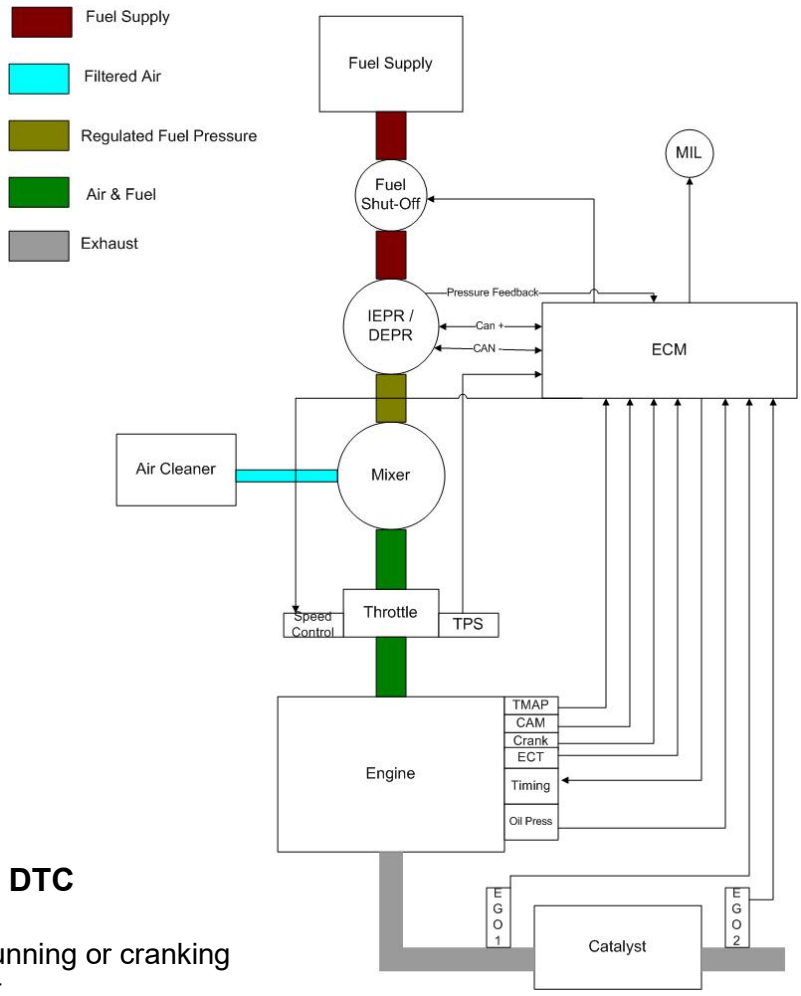
Circuit Description

The UEGO sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the Closed Loop multiplier and Adaptive multiplier. This fault will set if the adaptive multiplier exceeds the limits of normal operation. Always run the fuel system diagnostics before using the following diagnostic chart.

Diagnostic Aid

Fuel System - High secondary fuel pressure will cause the system to run rich. A worn fuel mixer, faulty EPR (Electronic Pressure Regulator) may also cause the system to run rich.
Fuel Quality - A drastic variation in fuel quality (very high butane content) may cause the fuel system to run rich. Be sure that the specified HD-5 or HD-10 fuel grade propane is used.
Air Filter - A plugged, damaged or modified air filter may cause the system to run rich.

DTC 1171-EPR Pressure Higher Than Expected



Conditions for Setting the DTC

- Check condition: Engine running or cranking
- MIL: ON during active fault
- Fault condition: EPR actual pressure greater than 1.5 inches above commanded pressure
- Adaptive disabled
- Engine shutdown will occur

Circuit Description

The EPR (Electronic Pressure Regulator) unit measures and controls the amount of fuel that is able to pass to the fuel mixer. This code will set in the event the actual pressure is 1.5 inches water pressure higher than the actual commanded pressure. Adaptive learn is disabled and the MIL command is ON during this fault. The engine will shut down if this fault occurs.

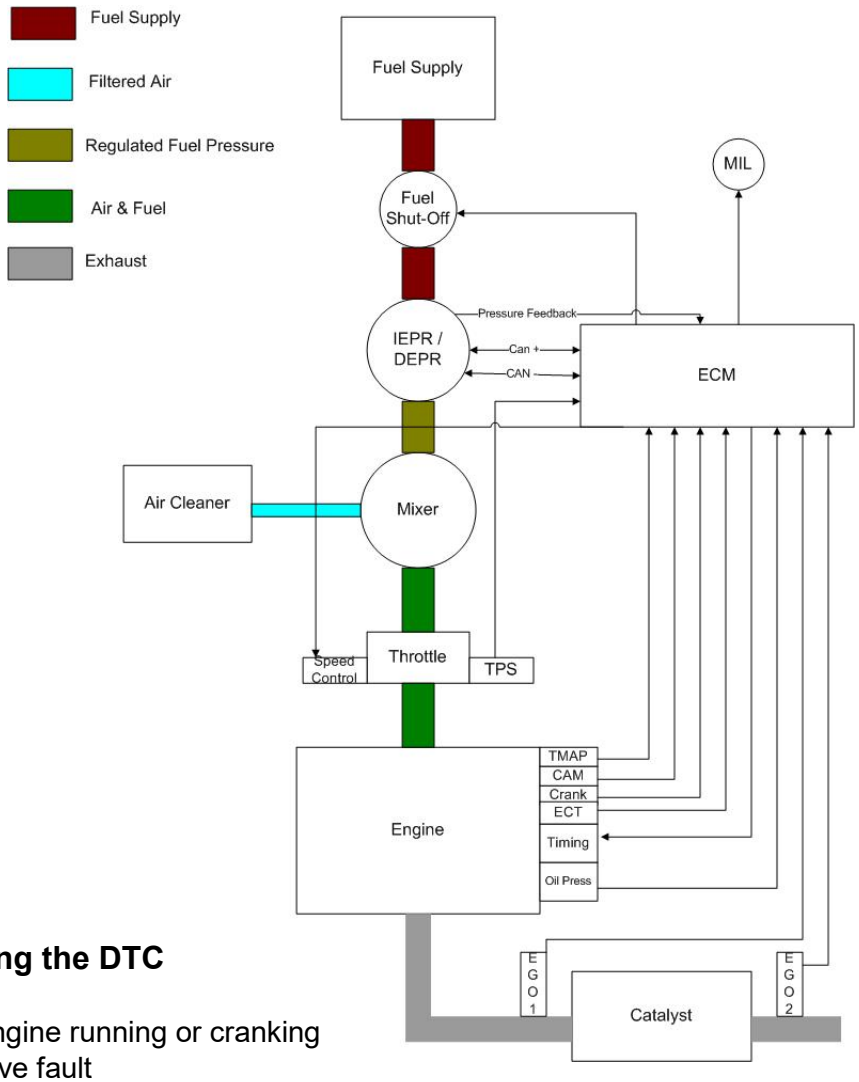
Diagnostic Aid

Always run the fuel system diagnostic pressure check before proceeding with the following diagnostic chart. **High fuel pressure into the EPR is the most common cause of this fault.**

DTC 1171-EPR Pressure Higher Than Expected

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	Did you run the fuel pressure diagnostic test in the fuel system diagnostic section with no problems found?		Go to Step (4)	Go to Step (3)
3	Run the EPR pressure test in the fuel system diagnostic section Did the EPR pass the fuel pressure test specifications?		Go to Step (4)	Follow the EPR service recommendations from the fuel pressure test chart.
4	Inspect the EPR electrical connector pins C018 for damage, corrosion or contamination. Did you find a problem?		Repair the circuit as necessary. Refer to wire harness repair section.	Go to Step (5)
5	Replace or repair the EPR Is the replacement complete?		Go to Step (6)	–
6	Remove all test equipment except the DST. Connect any disconnected components, fuses, etc. Using the DST clear DTC information from the ECM. Turn the ignition OFF and wait 30 seconds. Start the engine and operate the vehicle to full operating temperature Observe the MIL Observe engine performance and drivability After operating the engine within the test parameters of DTC1171 check for any stored codes. Does the engine operate normally with no stored codes?		System OK	Go to OBD System Check

DTC1172-EPR Pressure Lower Than Expected



Conditions for Setting the DTC

- Check condition: Engine running or cranking
- MIL: ON during active fault
- Fault condition: EPR actual pressure less than 1.5 inches below commanded pressure
- Adaptive disabled
- Engine shutdown will occur

Circuit Description

The EPR (Electronic Pressure Regulator) unit measures and controls the amount of fuel that is able to pass to the fuel mixer. This code will set in the event the actual pressure is 1.0 inches water pressure lower than the actual commanded pressure. Adaptive is disabled and the MIL command is ON during this fault. Engine will shut down if this fault occurs.

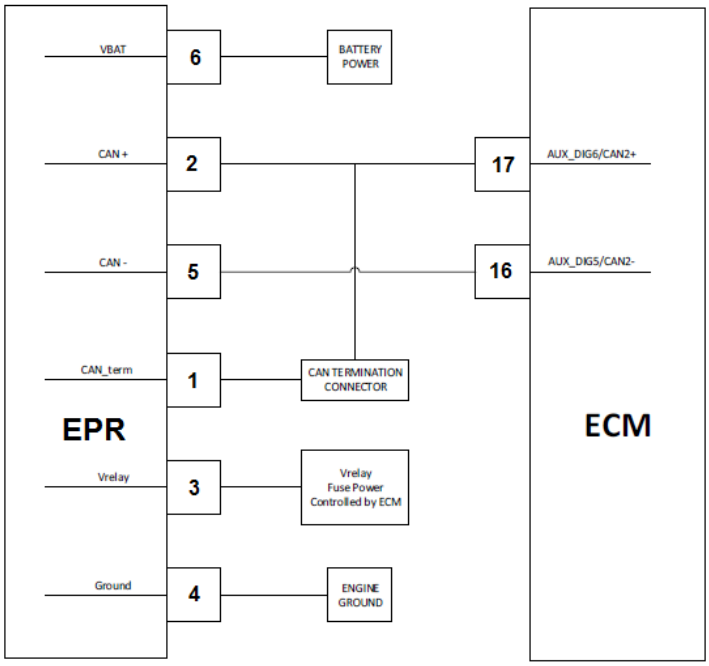
Diagnostic Aid

Always run the fuel system diagnostic pressure check before proceeding with the following diagnostic chart. **Low fuel pressure into the EPR is the most common cause of this fault.**

DTC 1172-EPR Pressure Lower Than Expected

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	Did you run the fuel pressure diagnostic test in the fuel system diagnostic section with no problems found?		Go to Step (4)	Go to Step (3)
3	Run the EPR pressure test in the fuel system diagnostic section Did the EPR pass the fuel pressure test specifications?		Go to Step (4)	Follow the EPR service recommendations from the fuel pressure test chart.
4	Inspect the EPR electrical connector C018 for damage, corrosion or contamination. Did you find a problem?		Repair the circuit as necessary. Refer to wire harness repair section.	Go to Step (5)
5	Replace or repair the EPR Is the replacement complete?		Go to Step (6)	–
6	Remove all test equipment except the DST. Connect any disconnected components, fuses, etc. Using the DST clear DTC information from the ECM. Turn the ignition OFF and wait 30 seconds. Start the engine and operate the vehicle to full operating temperature Observe the MIL Observe engine performance and drivability After operating the engine within the test parameters of DTC1172 check for any stored codes. Does the engine operate normally with no stored codes?		System OK	Go to OBD System Check

DTC 1173 – EPR/CFV Comm Lost



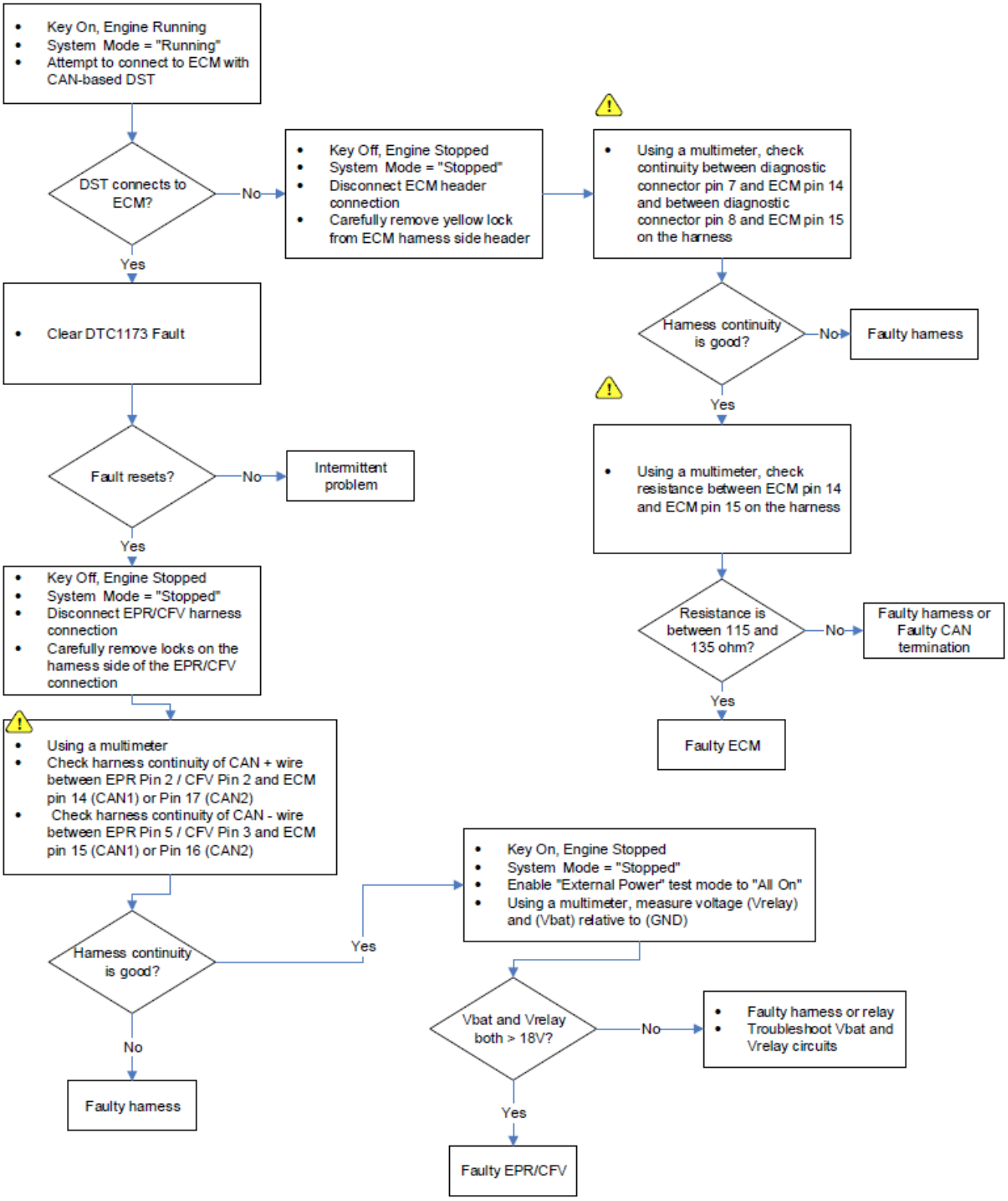
Conditions for Setting the DTC

- Check Condition: Key On
- Fault Condition: ECU received no communication from EPR for .5 seconds
- MIL: ON during active fault
- Engine shutdown

Fault Description

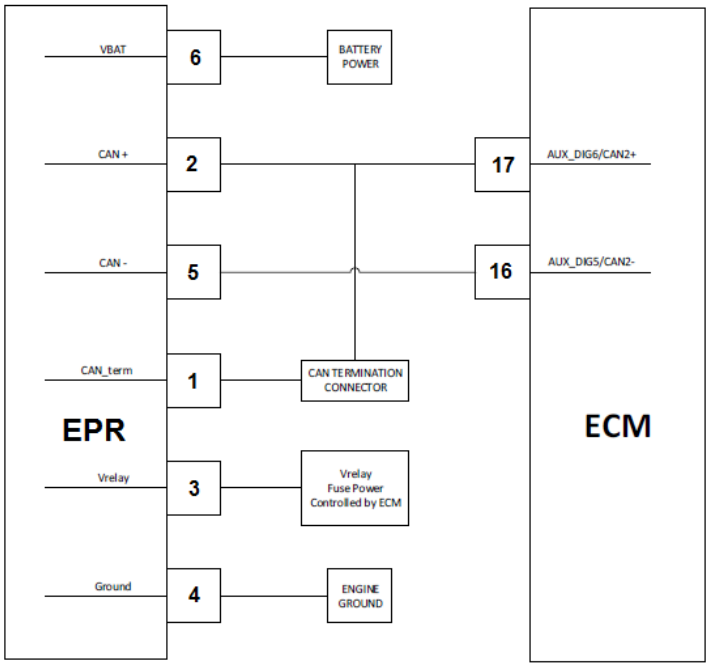
The EPR (Electronic Pressure Regulator) unit measures and controls the amount of fuel that is able to pass to the fuel mixer. This fault sets if he ECM loses CAN communication with the EPR. The fault indicates that the ECM is no longer receiving CAN packets from the EPR which also results in the EPR not receiving communication from the ECM. This is often the result of a power loss at the EPR or improper CAN termination or wiring. The MIL will light and the engine will shut down.

DTC 1173 – EPR/CFV Comm Lost



NOTE: Do not insert probe or object into terminalsas this will cause the terminal to spread and it may no longer make electrical contact with its mate. Spread pins will void warranty. Probe instead on side of terminal.

DTC 1176 – EPR/CFV Internal Actuator Fault Detection



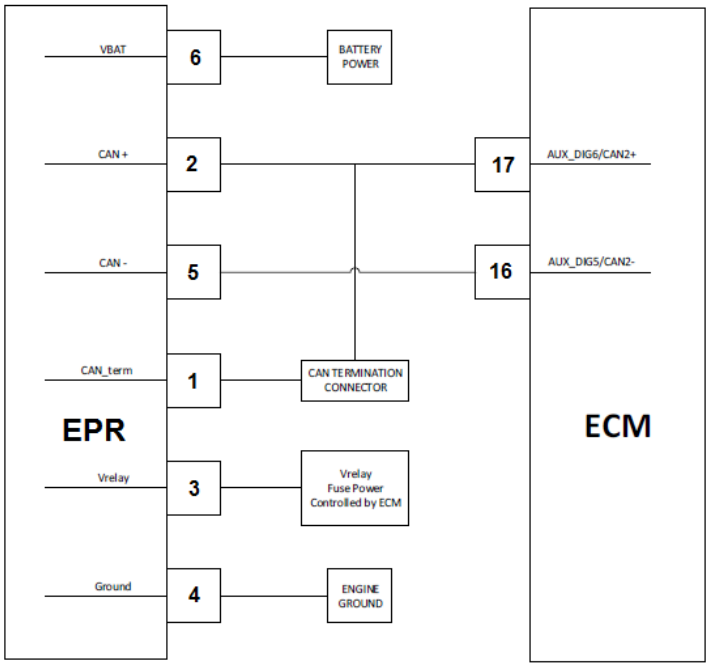
Conditions for Setting the DTC

- Check Condition: Key On
- Fault Condition: EPR detects an internal actuator fault
- MIL: ON during active fault
- Adaptive Disabled

Fault Description

The EPR (Electronic Pressure Regulator) unit measures and controls the amount of fuel that is able to pass to the fuel mixer. This fault sets if the EPR detects an internal actuator fault. The fault is transmitted from the EPR to the ECM via CAN. If the fault is active, adaptive learn is disabled to prevent improper learning and updating of the table. The MIL is illuminated for the duration of the key-on cycle. If the EPR does not trigger either 1171 or 1172 there is no issue with the EPR. If one or more of these faults are triggered, refer to the appropriate section for diagnostic information.

DTC 1177 – EPR/CFV Internal Circuitry Fault Detection



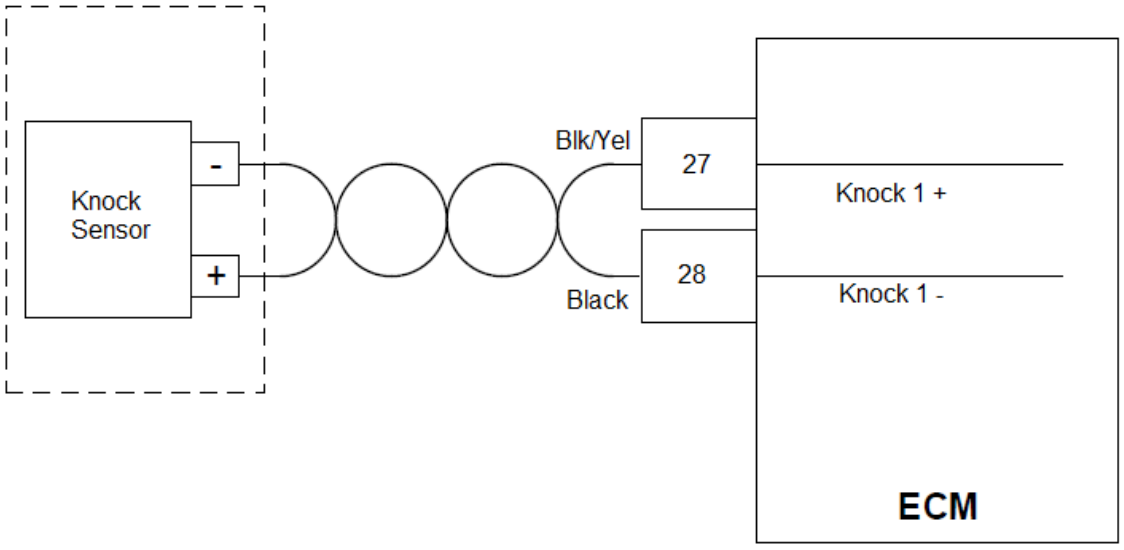
Conditions for Setting the DTC

- Check Condition: Key On
- Fault Condition: EPR detects an internal circuitry fault
- MIL: ON during active fault
- Adaptive Disabled

Fault Description

The EPR (Electronic Pressure Regulator) unit measures and controls the amount of fuel that is able to pass to the fuel mixer. This fault sets if the EPR detects an internal circuitry fault. The fault is transmitted from the EPR to the ECM via CAN. If the fault is active, adaptive learn is disabled to prevent improper learning and updating of the table. The MIL is illuminated for the duration of the key-on cycle.
If the EPR dies not trigger either 1171 or 1172 there is no issue with the EPR. If one or more of these faults are triggered, refer to the appropriate section for diagnostic information.

DTC 1325 – Knock Retard at Limit



Conditions for Setting the DTC

- Check Condition: Key On, Engine Running
- Fault Condition: With RPM greater than 1200 and MAP load greater than 11 psia, knock retard is at 100% for 125 combustion cycles (1 cycle = 2 revs, 8.3 seconds at 1800 RPM, 10 seconds at 1500 RPM)
- MIL: ON during active fault
- Engine Shutdown

Fault Description

The knock sensor is used to detect detonation through mechanical vibration in the engine block and/or cylinder heads and provide feedback for the ignition system to retard spark timing to reduce knock intensity. In most applications the knock sensor is used to protect the engine from damage that can be caused from detonation or knock based on fixed spark advance. This fault sets if the signals from the knock sensors indicate severe engine knocking, triggering maximum knock retard for 125 combustion cycles (one cycle = two crank rotations). The MIL will light and the engine will shut down

Diagnostic Aids

This fault occurs when the engine is actively knocking, and the shutdown is triggered to protect the engine from potentially catastrophic damage. Knock can be caused by a number of factors, including:

- Poor quality fuel
- Elevated intake air temperature
- Elevated coolant temperature
- Loads exceeding engine load limit
- Excessive exhaust backpressure

If running on wellhead gas, a gas analysis sample should be taken to check the makeup of the wellhead gas. Wellhead gas can vary greatly in quality, even from the same well over time. It is important to reduce the load when running on “hot” gas (gas containing a higher than usual concentration of ethane and larger hydrocarbons) in order to keep cylinder pressures down below the threshold where knock can occur. Contact your OEM for more information on running an engine on wellhead gas.

DTC 1325 – Knock Retard at Limit

Verify that the engine is running at the proper load for your application at all times. Make sure that any required derates* for elevation, ambient temperature, and gas quality are applied to the maximum load. Verify all loads to be certain there isn't a situation that can cause load to suddenly spike above the limit, e.g. motors starting simultaneously. Consider using VFDs (Variable Frequency Drivers) if there are cumulative inrush currents that could be overloading your engine.

Higher intake and coolant temperatures and excessive exhaust back pressure can lead to higher in-cylinder temperatures, which will contribute to the likelihood of knock.

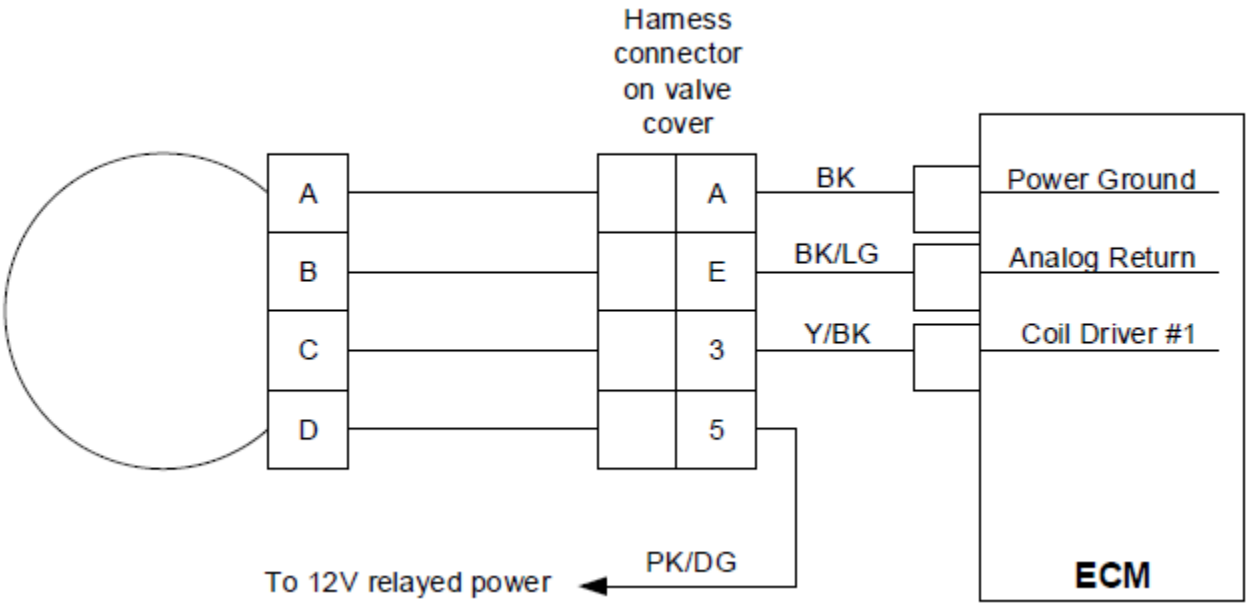
- Make sure the engine is receiving intake air that is as cool as possible. Elevated intake air temperatures can be caused by exhaust leaks near the intake, blocked or closed intake louvers on an enclosure, or air circulating over hot engine components.
- The cooling system should also be checked. Clogged radiator/CAC cores, low coolant level, loose, slipping or broken fan and/or water pump belts can all lead to elevated engine coolant temperatures.
- Check the exhaust system for proper flow. Make sure there are no obstructions in the piping, catalysts, or muffler (if equipped).

If the engine is thoroughly inspected and found to not be experiencing any knock, there are other factors that can sometimes cause the knock sensors to detect vibrations that the ECM will interpret as knock:

- Check the engine and all attached components for any loose nuts, bolts, or brackets that could be vibrating.
- Check to make sure there is nothing coming in contact with any of the knock sensors.
- Verify that the knock sensors are properly secured to the engine and the nut/bolt is correctly torqued:
    - Nut: 18 lb/ft
    - Bolt: 20 lb/ft
- Check the spark plugs, ignition coils, and coil boots on all cylinders to make sure the ignition system is performing properly and there is no misfire. Make sure spark plugs are the correct type as recommended by the manufacturer.
- Check and adjust engine valve lash as necessary. Loose valve lash can cause vibrations in the engine that is picked up by the knock sensors and could be interpreted by the ECM as knock.

*For information on derates consult PSI Heavy-Duty Technical Standard 56300003 – PSI HD Derate Specification

DTC 1351 – Spark Plug or Coil Failure



Conditions for setting the DTC

- Key on, Engine on
- Fault conditions: Ignition/spark drive circuitry (internal to the ECM) is overheating.
- MIL: ON
- Engine Shutdown

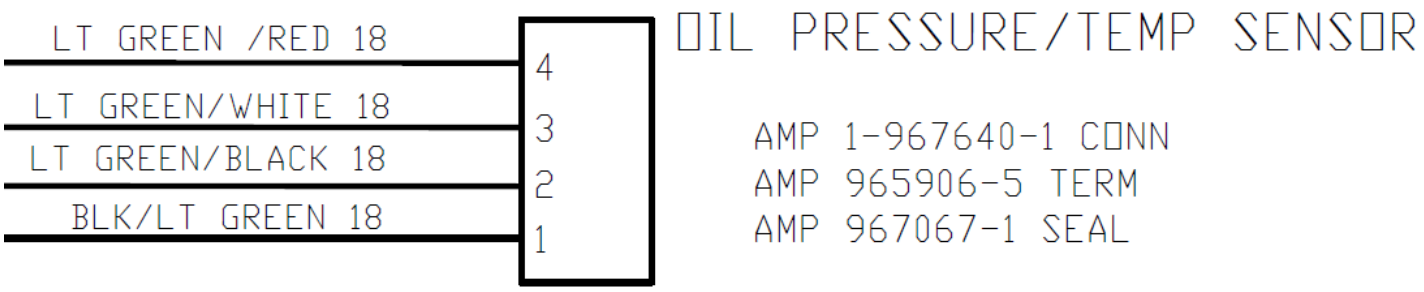
Fault Description

Coil driver #1 (correlates to DTC 1351) fires either the 1st cylinder in the firing order or the 1st cylinder in the block order depending on the configuration of the 'Injector/Spark Diagnostic Numbering' scheme as set in calibration. Drivers 2-10 (correlating to DTCs 1352-1360) follow in-kind.

Diagnostic Aids:

- Check plug gap on the cylinder associated with the fault.
- Check for loose connections at the coil and spark plugs. Look for evidence of charring or arcing around the spark plugs.
- Check coil resistance and verify that it is within specifications. Look for a short internal to the coil.
- Ensure the use of high-quality coils without a history of internal arcing or other failures.
- Verify that ambient conditions are not exceeding 85C on a continuous basis or 125C for short intervals. If so, verify that this fault stops occurring when ambient temperatures lower.
- Verify the dwell time set in the diagnostic calibration is not set too long and that adaptive dwell is enabled.

DTC 1439 – Engine Oil Temperature Sensor High



Conditions for setting the DTC

- Check Condition: Key On
- Fault condition: Temperature exceeds 235°F for over 3 seconds
- MIL: ON
- Engine Shutdown

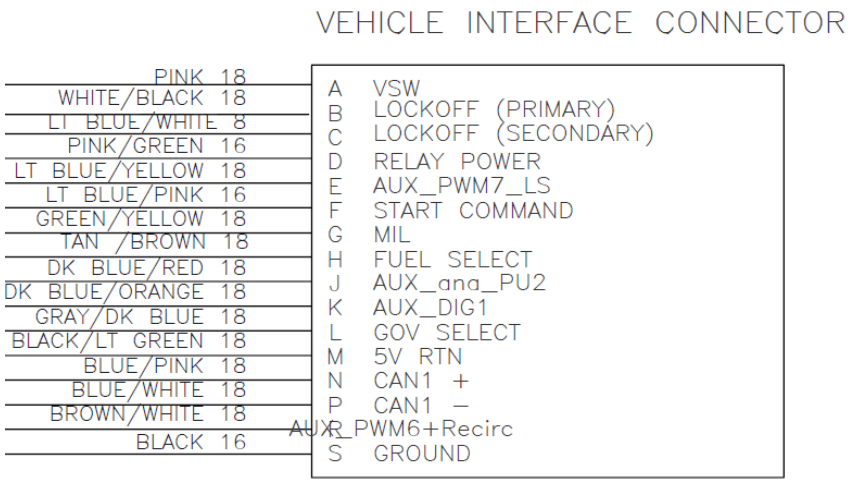
Fault Description

The engine oil temperature sensor determines if the engine oil temperature is operating at normal operating temperatures given known air temperature and engine loads. Sensor allows for continuous monitoring after startup conditions are achieved.

Diagnostic Aid

- Check the engine oil level and refill if necessary.
- If the oil level is full, check the function of the switch. Disconnect the switch, clear the fault and try running the engine again. If the fault does not come back, check the oil temperature sensor switch.
- If the fault is still active with the switch disconnected, check the wiring for the switch to make sure it is not shorted to ground. The wiring originates at the Vehicle Interface Connector on the engine at terminal K. Disconnect the VIC and use an ohmmeter to check for a short to ground from pin K on the engine side of the VIC and on the OEM side of the VIC. Once you have determined whether the short is on the engine or in the OEM wiring you can begin searching for the short and repair it.
- Check for containment buildup or other non-leak-based failures that reduce the efficiency of the oil cooler.
- Check for damages in the rotating assembly that is causing excessive heat buildup, extra friction is going to be transferred into the oil in either loaded prime or continues applications, this will not be enough additional load and will come up as an increase in power output.

DTC 1552 – Coolant Level Low Voltage



Conditions for Setting the DTC

- Check Condition: Key On
- Fault Condition: Low coolant level switch circuit (Aux_DIG1) voltage is less than 1.25V while the engine is running and coolant temperature is above 70°F
- MIL: ON during active fault
- Engine Shutdown

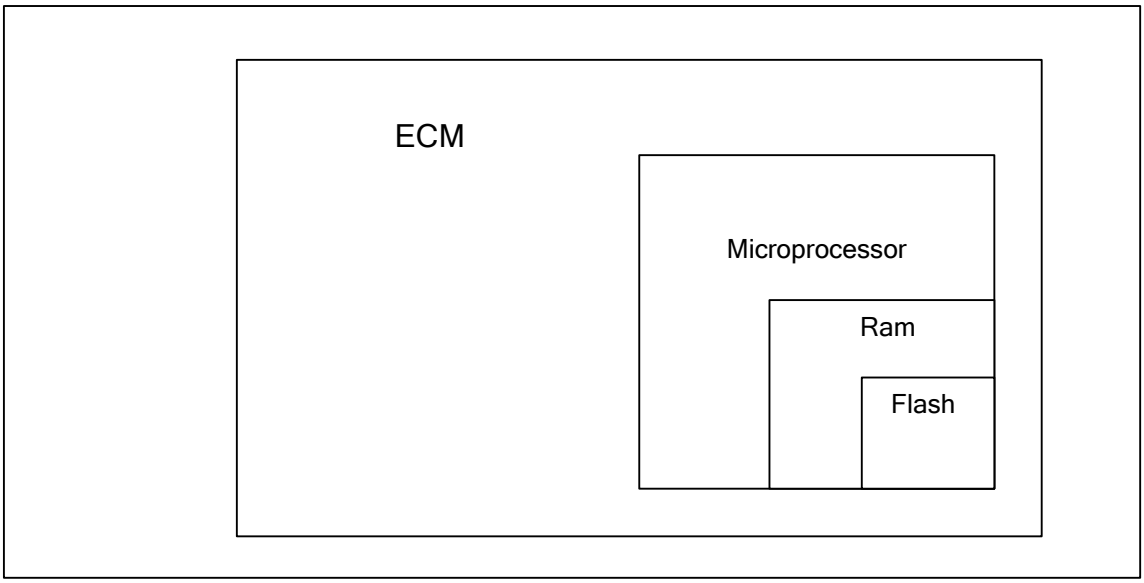
Fault Description

The coolant level switch is an optional switch installed by the OEM in the cooling circuit to detect a loss of engine coolant and shut the engine down. The switch is normally open and shorts the AUX_DIG1 wire to ground when closed, triggering the fault. The MIL will light and the engine will shut down.

Diagnostic Aids

- Check the engine coolant level and refill if necessary.
- If the coolant level is full, check the function of the switch. Disconnect the switch, clear the fault, and try running the engine again. If the fault does not come back, check the coolant level switch.
- If the fault is still active with the switch disconnected, check the wiring for the switch to make sure it is not shorted to ground. The wiring originates at the Vehicle Interface Connector on the engine at terminal K. Disconnect the VIC and use an ohmmeter to check for a short to ground from pin K on the engine side of the VIC and on the OEM side of the VIC. Once you have determined whether the short is on the engine or in the OEM wiring you can begin searching for the short and repair it.

DTC 1612-RTI 1 Loss



Conditions for Setting the DTC

- Check Condition: Key on
- Fault Condition: Internal microprocessor error
- MIL: ON
- Adaptive: Disabled for the remainder of the key-ON cycle
- Engine shutdown will occur

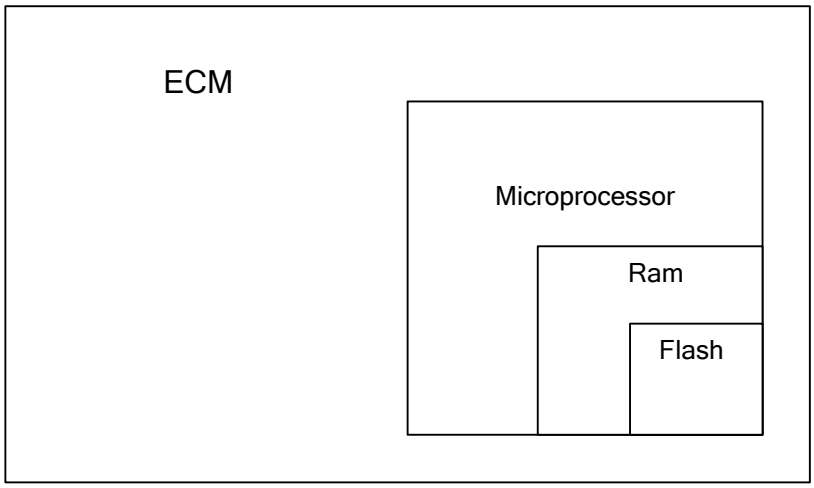
Circuit Description

The ECM has several internal checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will attempt to reset itself in the event this fault is set. The MIL command is on and will remain on until the code is cleared using the DST. The engine will shut down if this code occurs.

DTC 1612-RT 1 Loss

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	Key ON, Engine Running DST (Diagnostic Scan Tool) connected in System Data Mode Clear system fault code Does DTC 1612 reset with the engine idling?		Go to Step (3)	Intermittent problem Go to Intermittent section
3	Check ECM power and ground circuits Did the power and ground circuits check OK?		Go to Step (4)	Repair the circuit as necessary. Refer to Wiring Repairs in Engine Electrical.
4	Replace ECM Is the replacement complete?		Go to Step (5)	-
5	Remove all test equipment except the DST. Connect any disconnected components, fuses, etc. Using the DST clear DTC information from the ECM. Turn the ignition OFF and wait 30 seconds. Start the engine and operate the vehicle to full operating temperature Observe the MIL Observe engine performance and drivability After operating the engine within the test parameters of DTC-1612 check for any stored codes. Does the engine operate normally with no stored codes?		System OK	Go to OBD System Check

DTC 1613-RTI 2 Loss



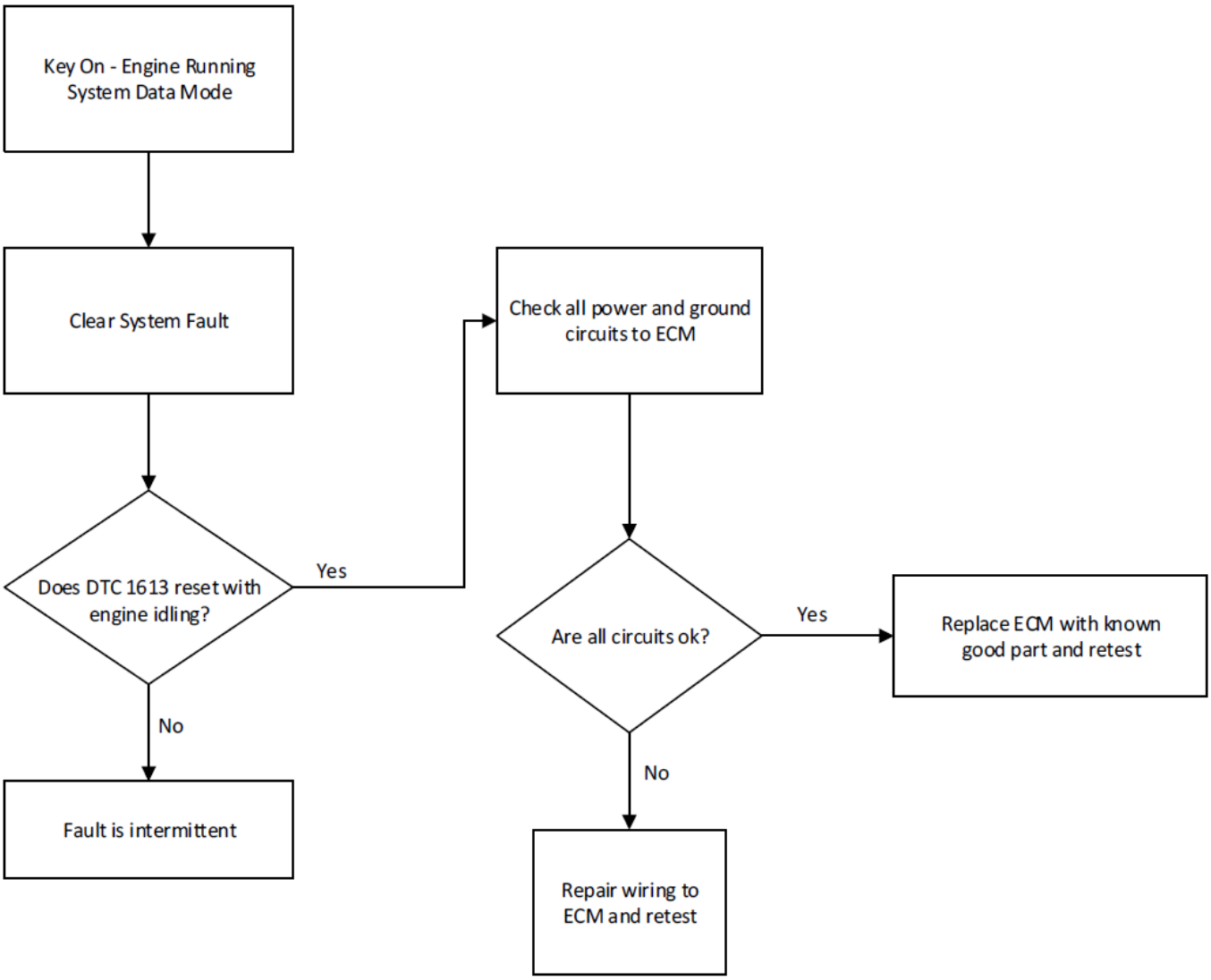
Conditions for Setting the DTC

- Check Condition: Key on
- Fault Condition: Internal microprocessor error
- MIL: ON
- Adaptive: Disabled for the remainder of the key-ON cycle
- Engine shutdown will occur

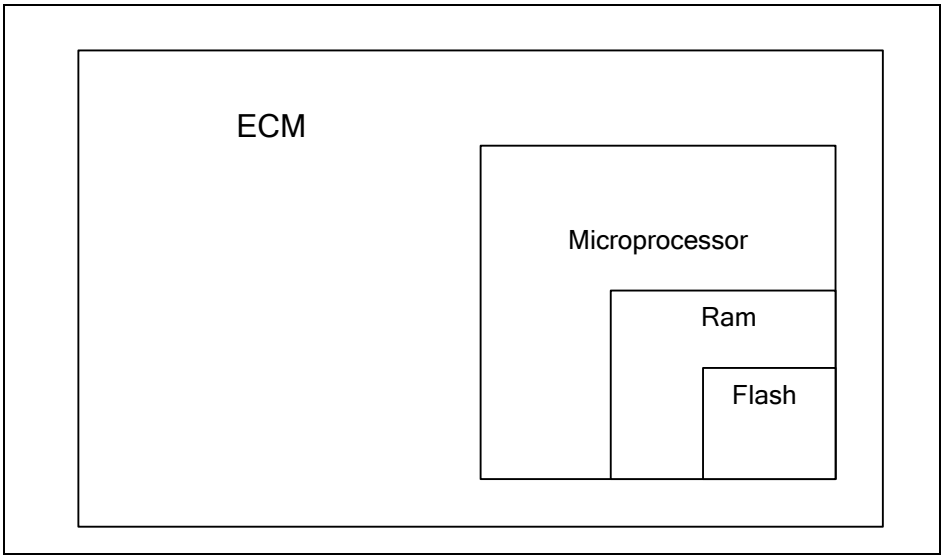
Circuit Description

The ECM has several internal checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will attempt to reset itself in the event this fault is set. The MIL command is on and will remain on until the code is cleared using the DST. The engine will shut down if this code occurs.

DTC 1613-RTI 2 Loss



DTC 1614-RTI 3 Loss



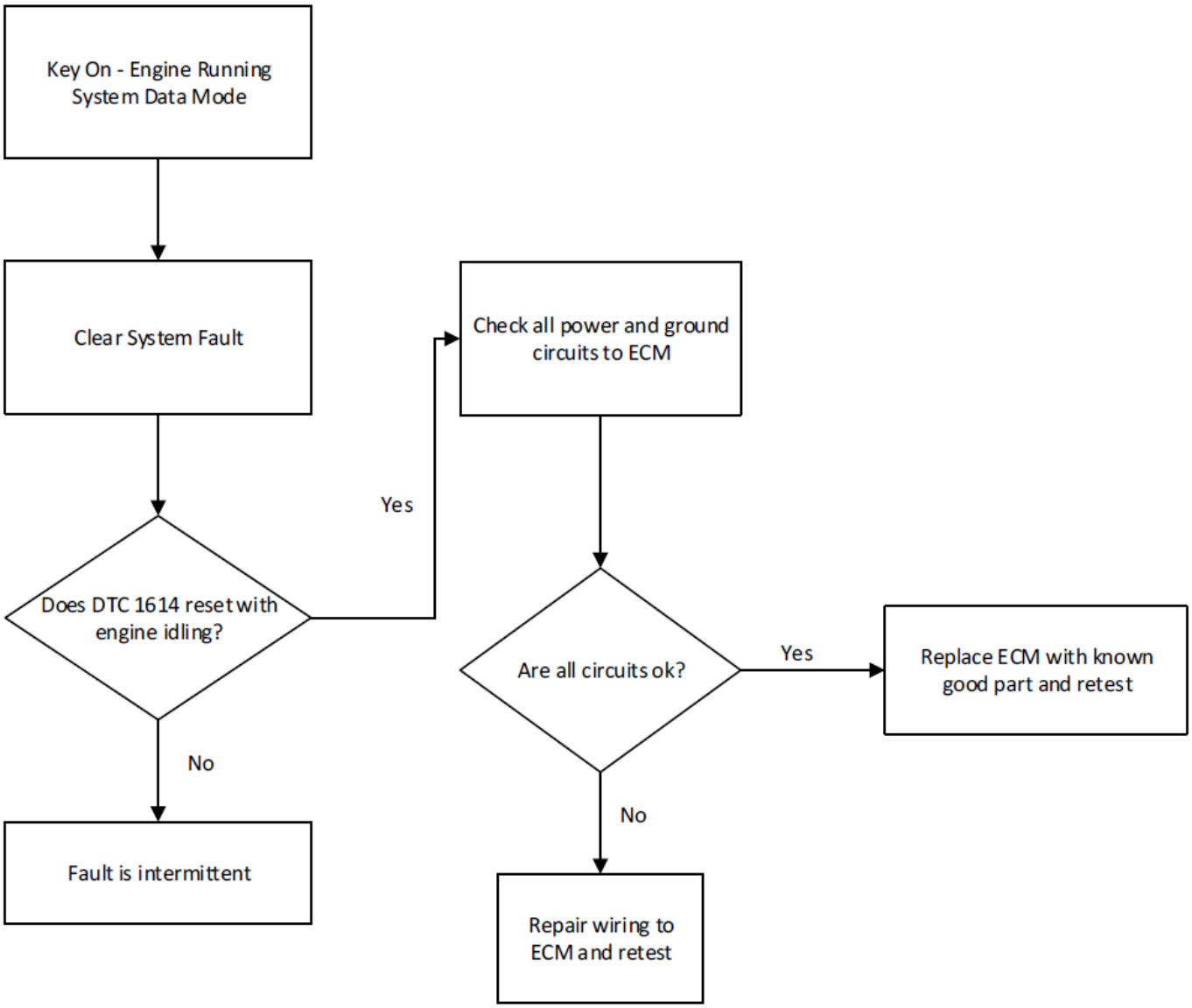
Conditions for Setting the DTC

- Check Condition: Key on
- Fault Condition: Internal microprocessor error
- MIL: ON
- Adaptive disabled for the remainder of the key-ON cycle
- Engine shutdown will occur

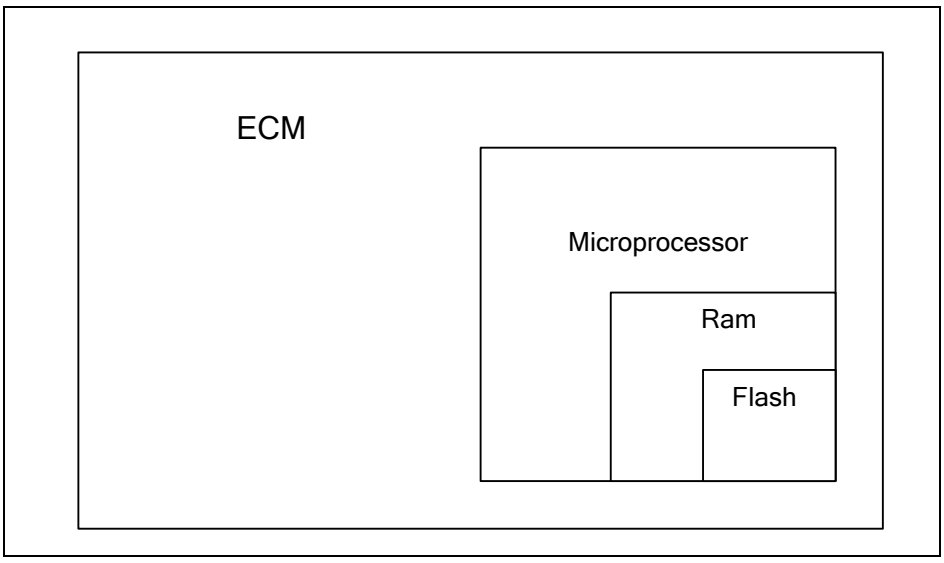
Circuit Description

The ECM has several internal checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will attempt to reset itself in the event this fault is set. The MIL command is on and will remain on until the code is cleared using the DST. The engine will shut down if this code occurs.

DTC 1614-RTI 3 Loss



DTC 1615-A/D Loss



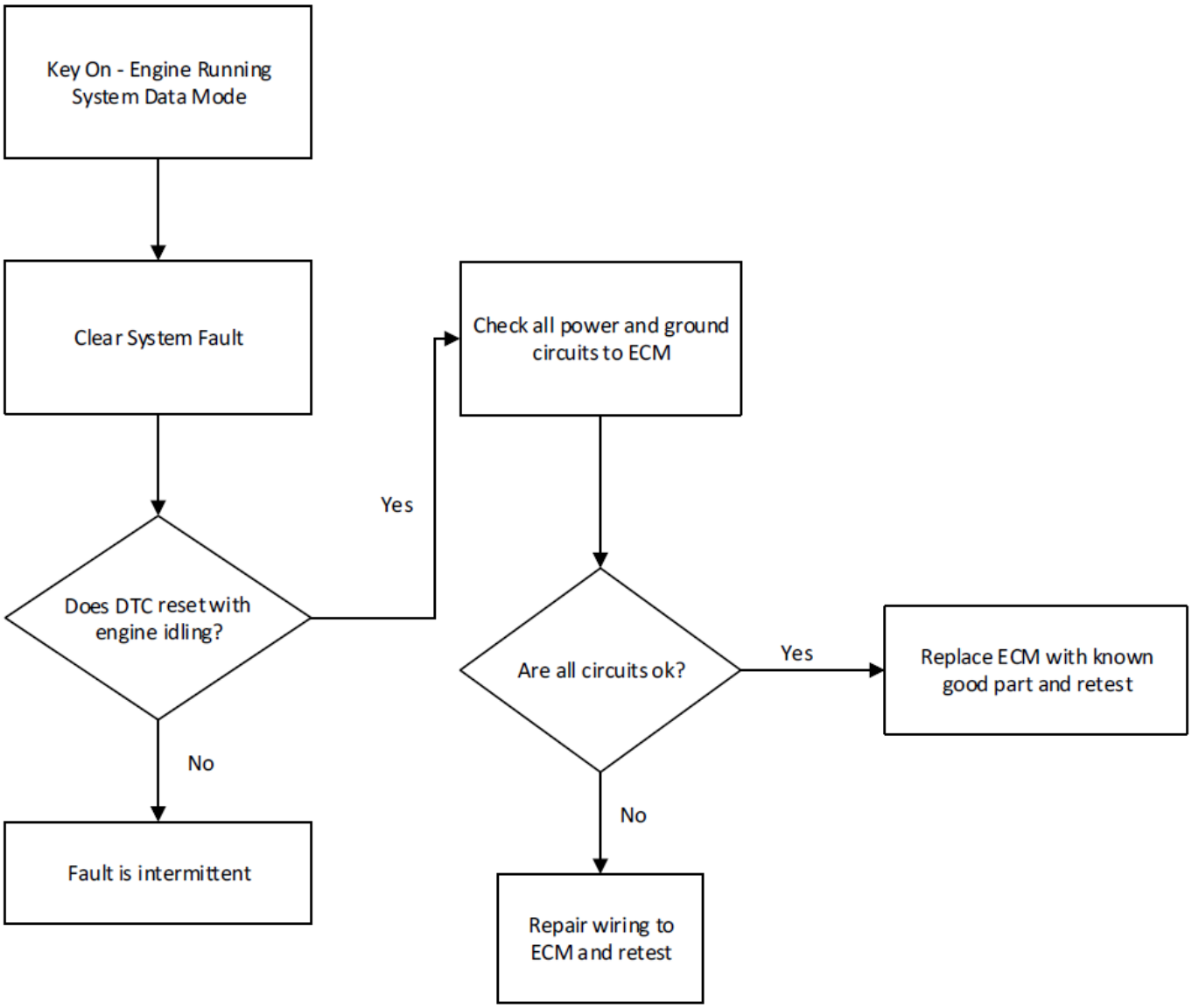
Conditions for Setting the DTC

- Check Condition: Key on
- Fault Condition: Internal microprocessor error
- MIL: ON
- Adaptive disabled for the remainder of the key-ON cycle
- Engine shutdown will occur

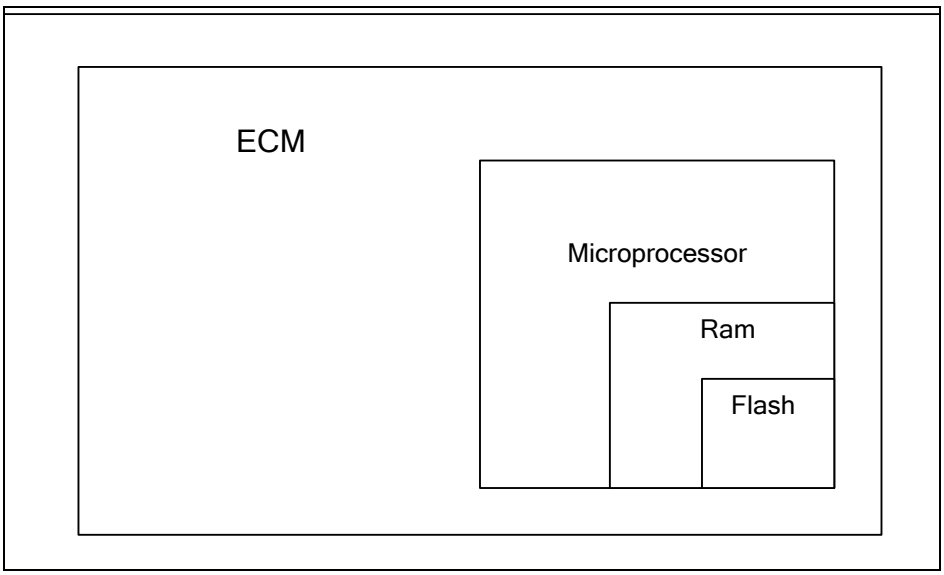
Circuit Description

The ECM has several internal checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will attempt to reset itself in the event this fault is set. The MIL command is on and will remain on until the code is cleared using the DST. The engine will shut down if this code occurs.

DTC 1615-A/D Loss



DTC 1616-Invalid Interrupt



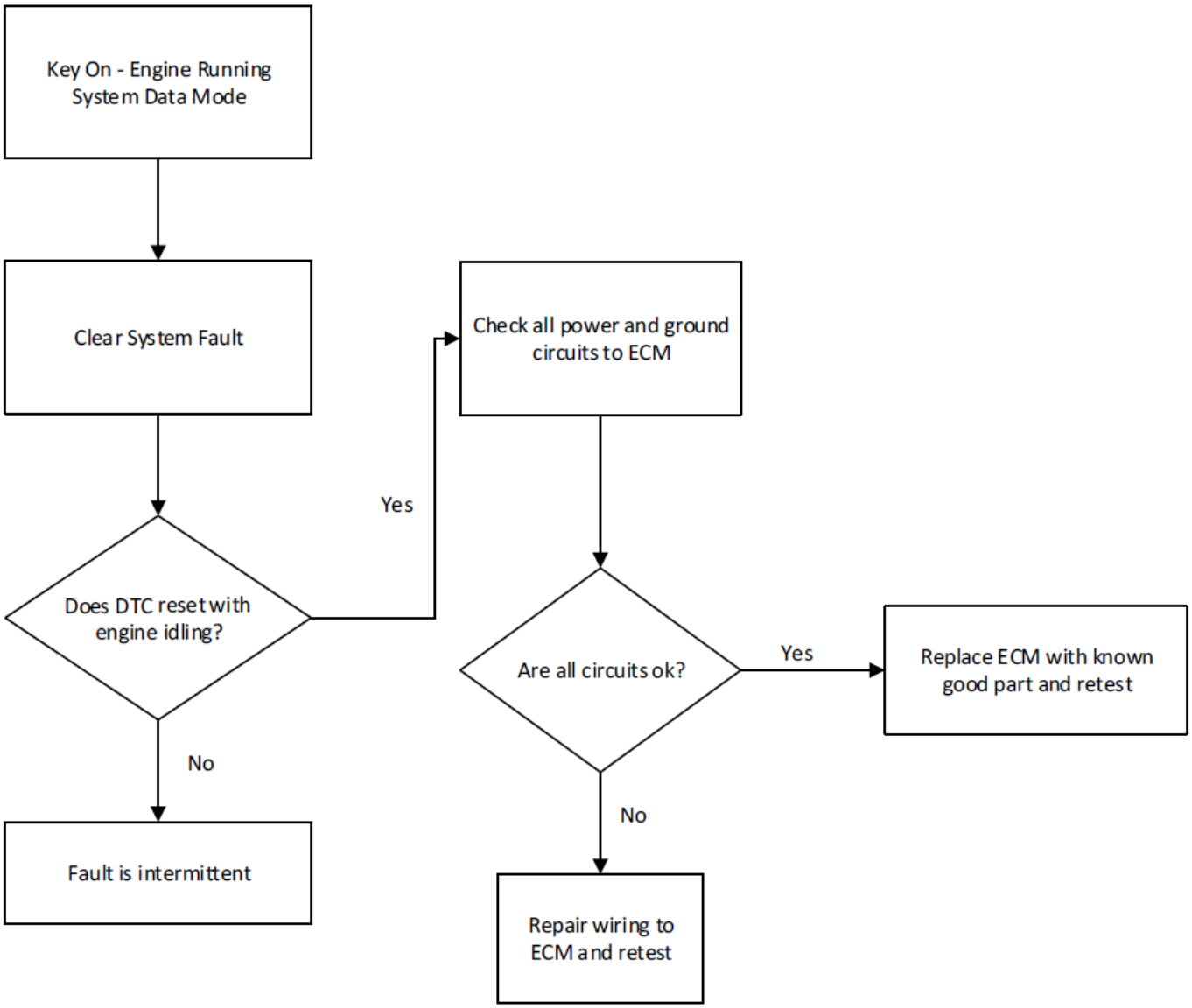
Conditions for Setting the DTC

- Check Condition: Key on
- Fault Condition: Internal microprocessor error
- MIL: ON
- Adaptive disabled for the remainder of the key-ON cycle
- Engine Shutdown will occur

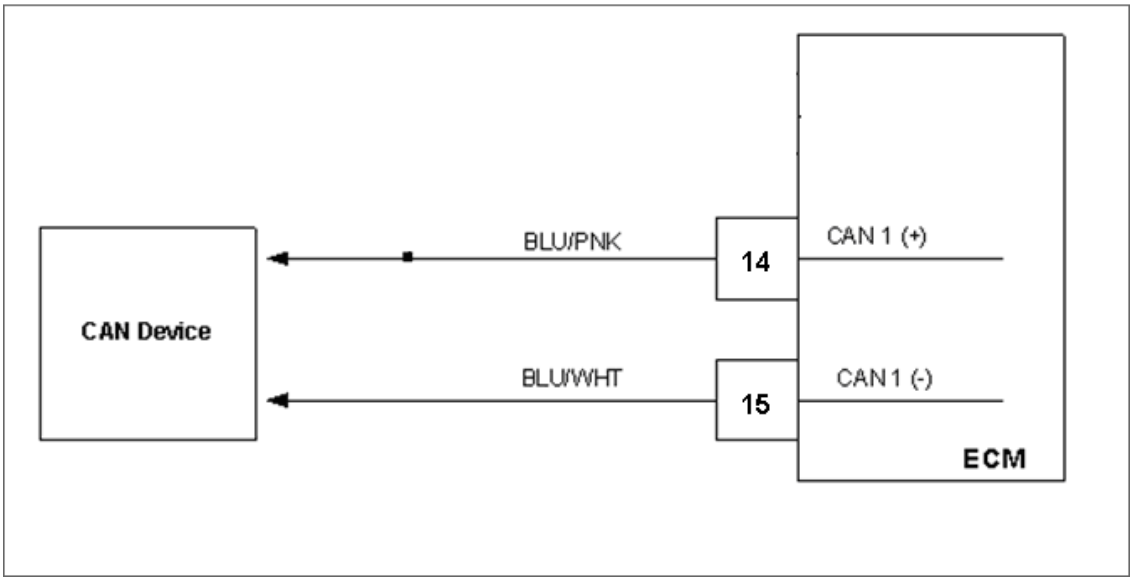
Circuit Description

The ECM has several internal checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will attempt to reset itself in the event this fault is set. The MIL command is on and will remain on until the code is cleared using the DST. The engine will shut down if this code occurs.

DTC 1616-Invalid Interrupt



DTC 1625 – J1939 Shutdown Request



Conditions for Setting the DTC

- Check Condition: Key On
- Fault Condition: Master ECM receives a shutdown request over the CAN network
- MIL: ON during active fault
- Engine Shutdown

Fault Description

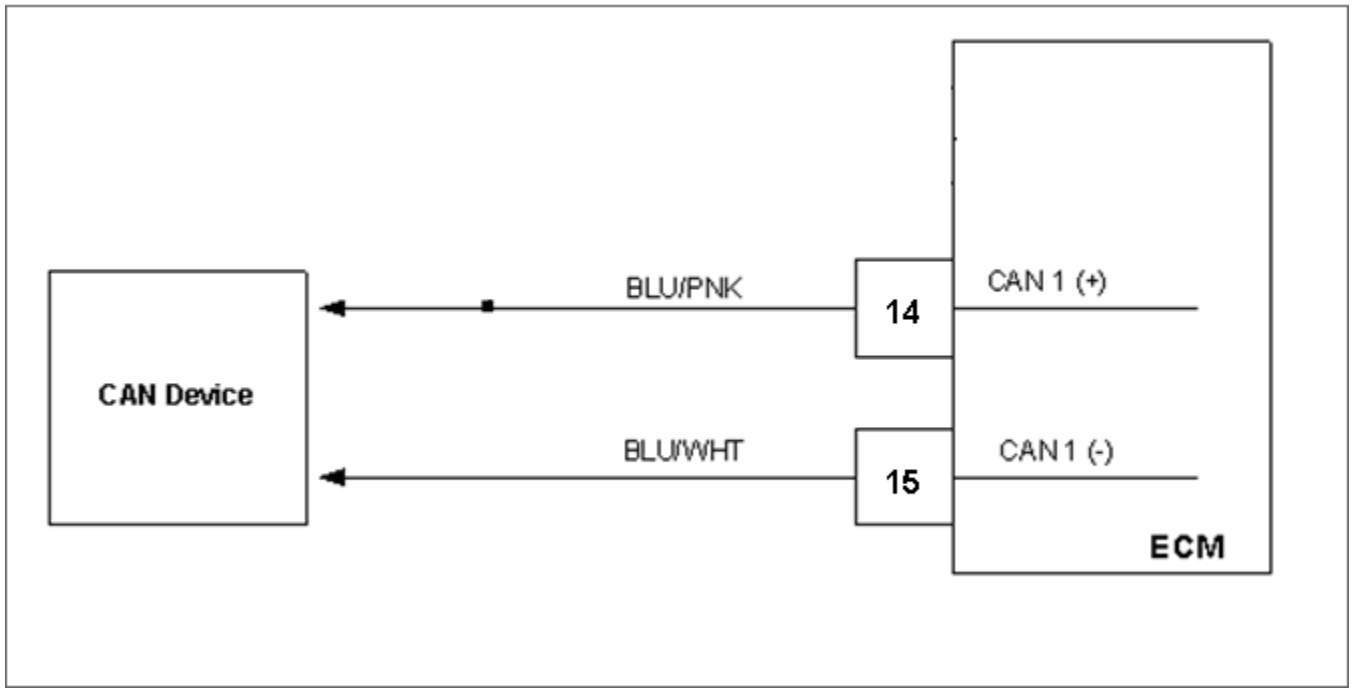
This fault is triggered when a device connected to the CAN network triggers an engine shutdown. The MIL will light and the engine will shut down.

Diagnostic Aids

This fault is triggered in the master ECM whenever there is a fault in the slave ECM that requires the engine to shut down. The slave ECM doesn't have the authority to shut down the engine on its own, so it sends a shutdown request over the CAN network to the master ECM to get the engine to shut down. Connect to the slave ECU and check all stored fault codes to find the fault that triggered the shutdown on the master side.

If there are no stored faults on the slave ECM, check any other devices connected to the CAN network that are capable of triggering an engine shutdown, such as genset controllers or pump controllers.

DTC 1626-CAN1 Tx Failure



Conditions for Setting the DTC

- Check Condition: Engine running
- Fault Condition: CAN Tx error 120 packets lost within 1 second
- MIL: ON

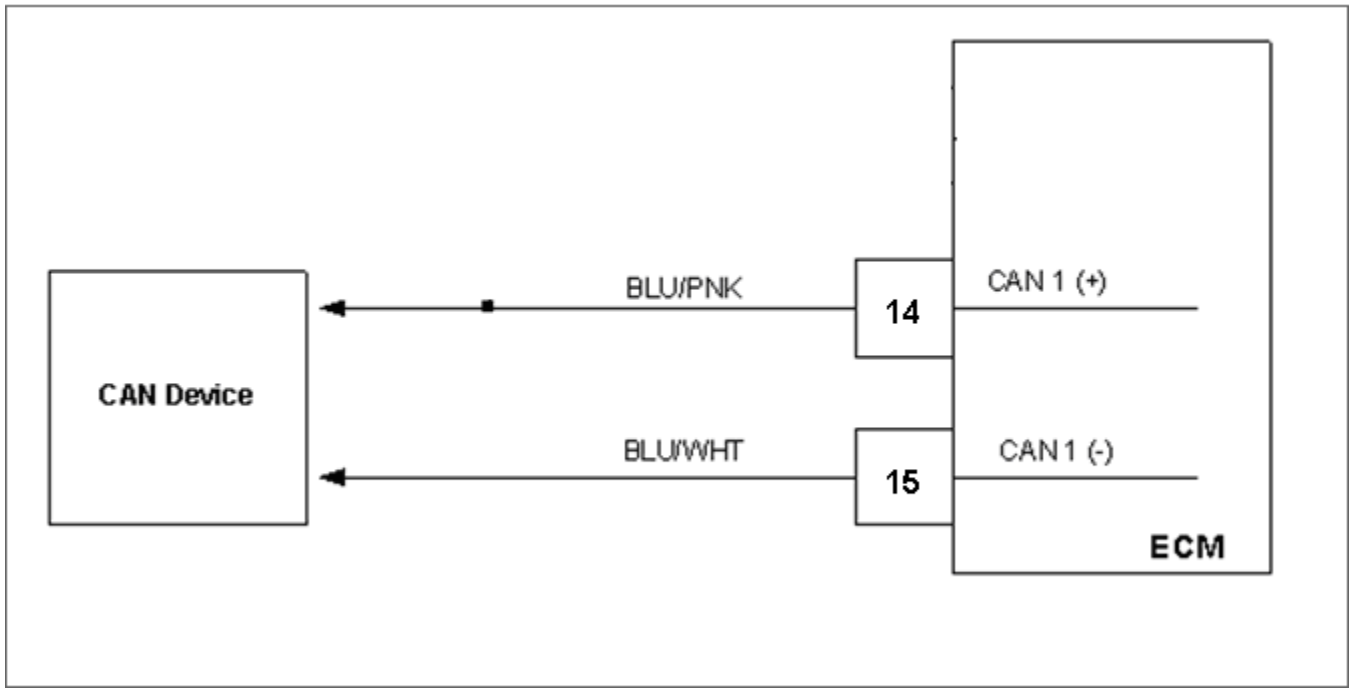
Circuit description

The CAN bus (controller area network) is used by the ECM to communicate with other digital devices used throughout the fuel system. Information is sent over the CAN bus in digital information “packets” that contain information for various control functions. This fault will set if the ECM broadcasts 120 packets to the network that are not received within a one second time period. The MIL command is ON.

Diagnostic Aides

- Verify that all CAN devices are powered and properly grounded
- Verify that the CAN1 network is properly terminated
- Check CAN1 wire routing with respect to noise sources (ignition coils, spark plug coil wires, etc.) and shield if necessary
- Check CAN1 (+) and (-) wires for short circuits

DTC 1627-CAN1 Rx Failure



Conditions for Setting the DTC

- Check Condition: Engine running
- Fault Condition: CAN1 Rx error 120 packets lost within 1 second
- MIL: ON

Circuit description

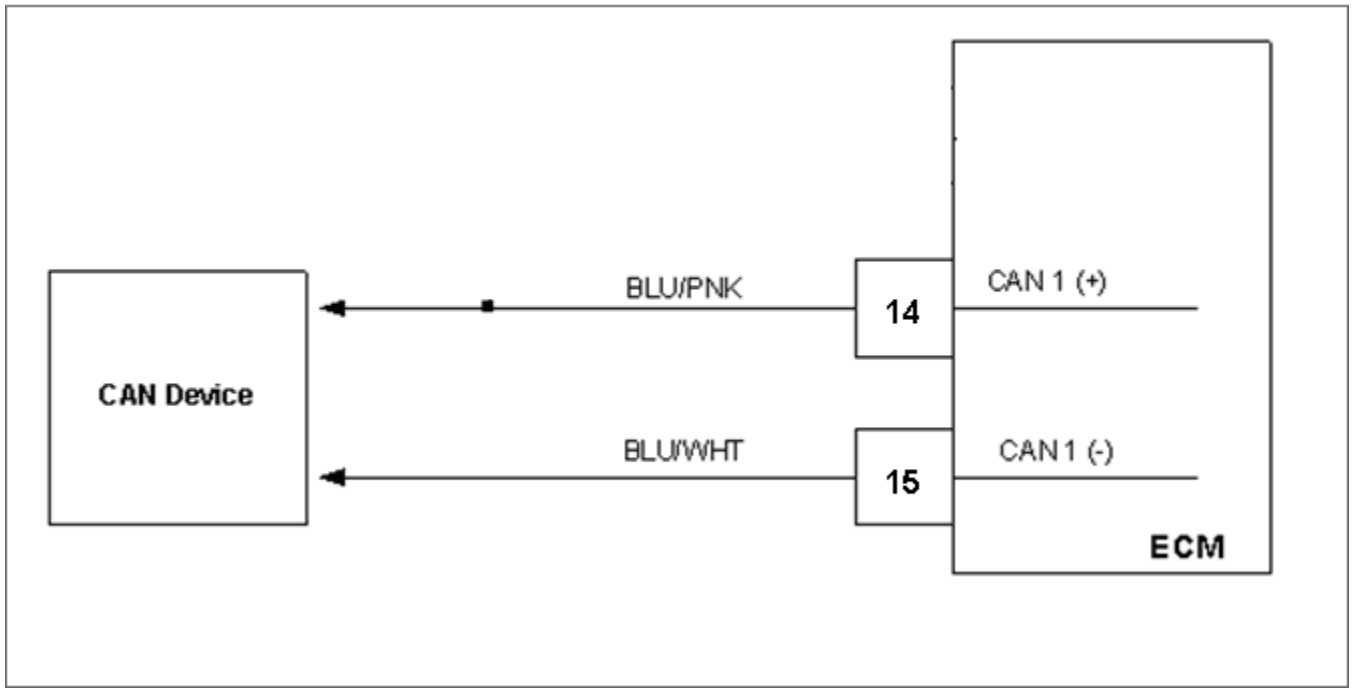
The CAN bus (controller area network) is used by the ECM to communicate with other digital devices used throughout the fuel system. Information is sent over the CAN bus in digital information “packets” that contain information for various control functions. This fault will set if the ECM detects 120 packets lost within a one second time period. The MIL command is ON.

DTC 1627-CAN1 Rx Failure

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	Key ON, Engine Running DST (Diagnostic Scan Tool) connected in System Data Mode Clear system fault code Does DTC1627 reset with the engine idling?		Go to Step (3)	Intermittent problem Go to Intermittent section
3	Check that the ECM power connection C019 is clean, tight and in the proper location. Check that the ECM ground connection C010 is clean, tight and in the proper location. Are the power and ground circuits OK?		Go to Step (4)	Repair the circuit as necessary. Refer to Wiring Repairs in Engine Electrical.
4	Using a DVOM check for continuity between ECM pins 14 and 15 Do you have continuity between them?		Repair the shorted circuit as necessary. Refer to Wiring Repairs in Engine Electrical.	Go to Step (5)
5	Using a DVOM check for continuity to engine ground on pin 15. Do have continuity to engine ground?		Repair the shorted to ground circuit as necessary. Refer to Wiring Repairs in Engine Electrical.	Go to Step (6)
6	Using a DVOM check for continuity to battery positive on pin 15. Do have continuity between them?		Repair the shorted to ground circuit as necessary. Refer to Wiring Repairs in Engine Electrical.	Go to Step (7)
7	Replace the ECM Is the replacement complete?		Go to Step (8)	_

Step	Action	Value(s)	Yes	No
8	Remove all test equipment except the DST. Connect any disconnected components, fuses, etc. Using the DST clear DTC information from the ECM. Turn the ignition OFF and wait 30 seconds. Start the engine and operate the vehicle to full operating temperature Observe the MIL Observe engine performance and drivability After operating the engine within the test parameters of DTC-1627 check for any stored codes. Does the engine operate normally with no stored codes?		System OK	Go to OBD System Check

DTC 1628-CAN Address Conflict



Conditions for Setting the DTC

- Check Condition: Engine running
- Fault Condition: 5 or more address conflict errors
- MIL: ON

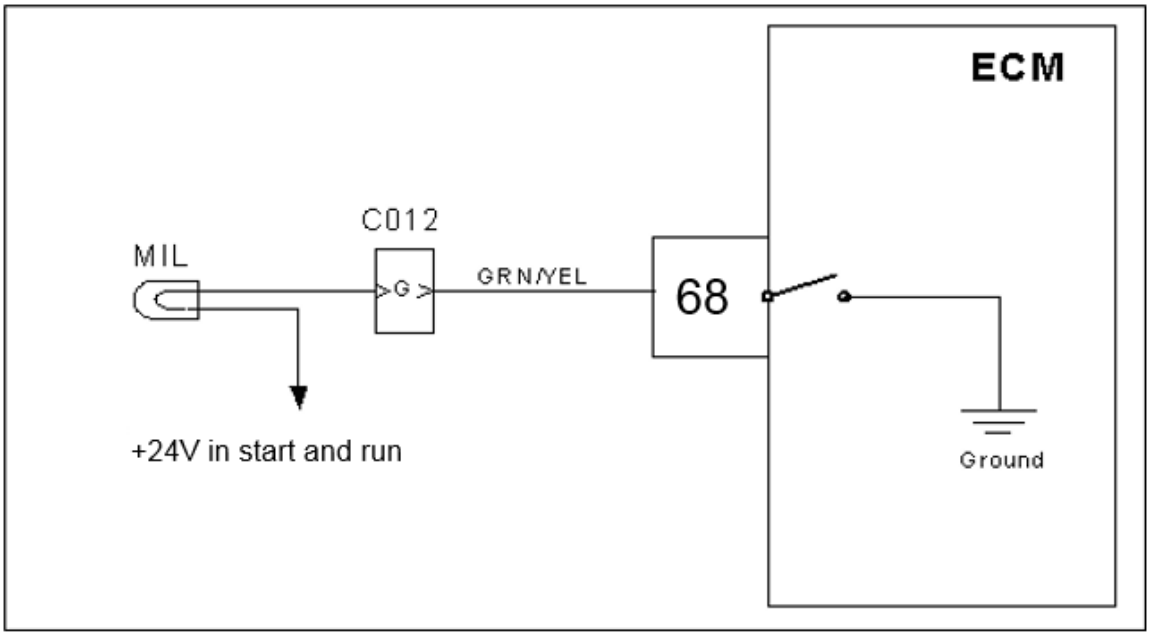
Circuit description

The CAN bus (controller area network) is used by the ECM to communicate with other digital devices used throughout the fuel system. Information is sent over the CAN bus in digital information “packets” that contain information for various control functions. Individual devices are assigned network addresses. This fault will set if the ECM detects an address conflict, such as two devices with the same address. This is usually not due to an in-field failure and may be the results of “add on” CAN devices

DTC 1628-CAN Address Conflict

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	Key ON, Engine Running DST (Diagnostic Scan Tool) connected in System Data Mode Clear system fault code Does DTC1628 reset with the engine idling?		Go to Step (3)	Intermittent problem Go to Intermittent section
3	Key OFF Disconnect one CAN device Clear DTC 1628 Key ON (start engine if possible if not continue cranking for at least 3 seconds) Wait 5 seconds Does DTC 1628 re-set?		Repeat step 3 until all CAN devices have been disconnected one at a time	Contact the CAN device manufacturer for additional CAN address information Go to Step (4)
4	Has the CAN device been replaced or address conflict resolved?		Go to Step (5)	–
5	Remove all test equipment except the DST. Connect any disconnected components, fuses, etc. Using the DST clear DTC information from the ECM. Turn the ignition OFF and wait 30 seconds. Start the engine and operate the vehicle to full operating temperature Observe the MIL Observe engine performance and drivability After operating the engine within the test parameters of DTC-1628 check for any stored codes. Does the engine operate normally with no stored codes?		System OK	Go to OBD System Check

DTC 1644-MIL Control Ground Short not enabled



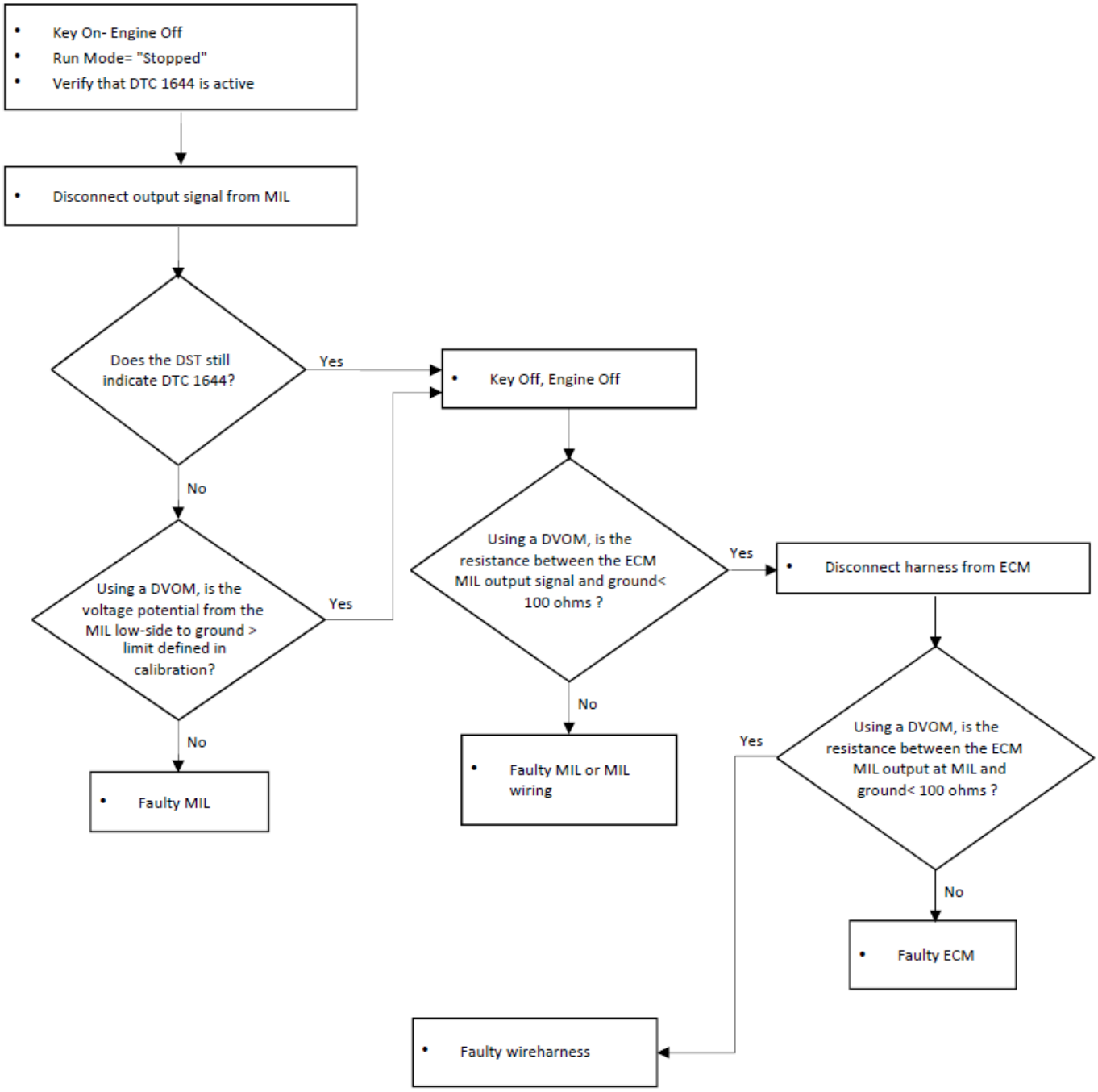
Conditions for setting the DTC

- Check Condition: Key ON engine OFF
- Fault Condition: ECM MIL output shorted to ground
- MIL Command: ON

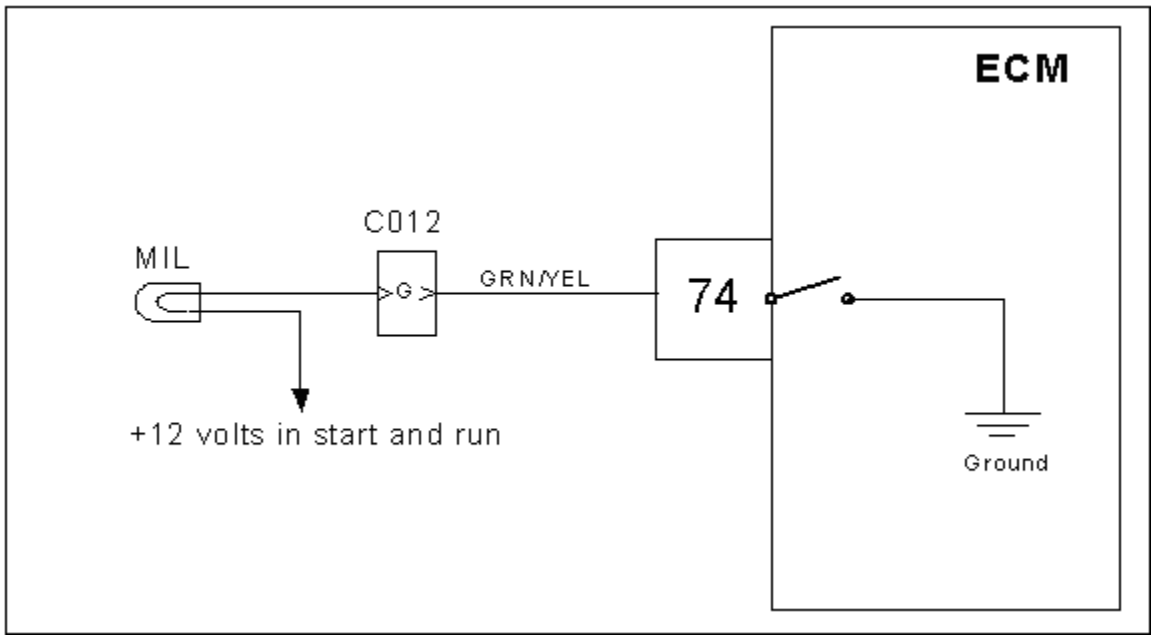
Circuit Description

This ECM output is used to provide a low-side switch to a MIL that is used to indicate that an emission related fault has been set. This fault will set if the ECM detects that there is a ground short of the MIL output.

DTC 1644-MIL Control Ground Short not enabled



DTC 1645-MIL Control Ground Short To Power not enabled



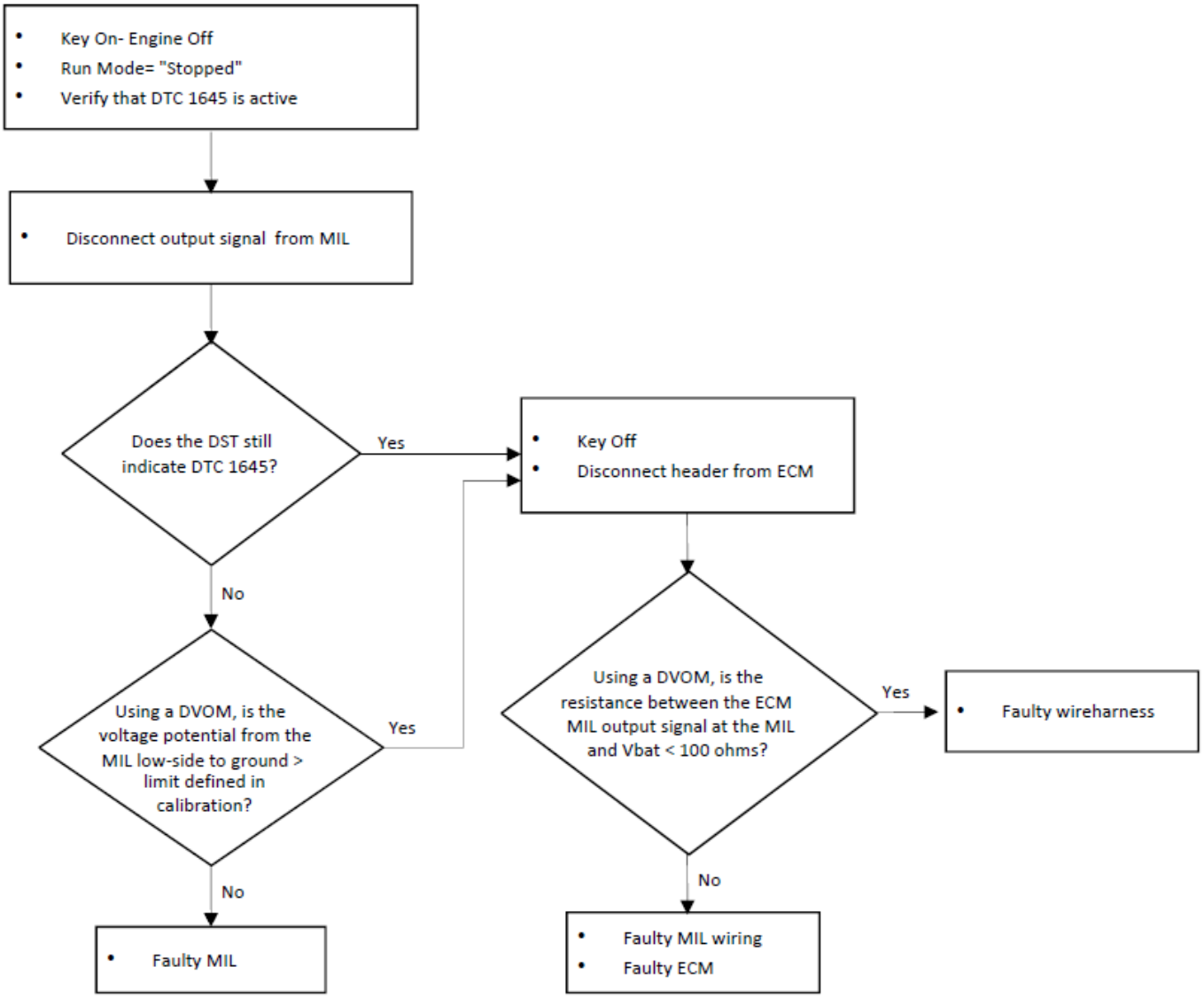
Conditions for setting the DTC

- MIL check
- Check Condition-Key ON engine OFF
- Fault Condition-ECM MIL output shorted to voltage
- MIL Command-ON

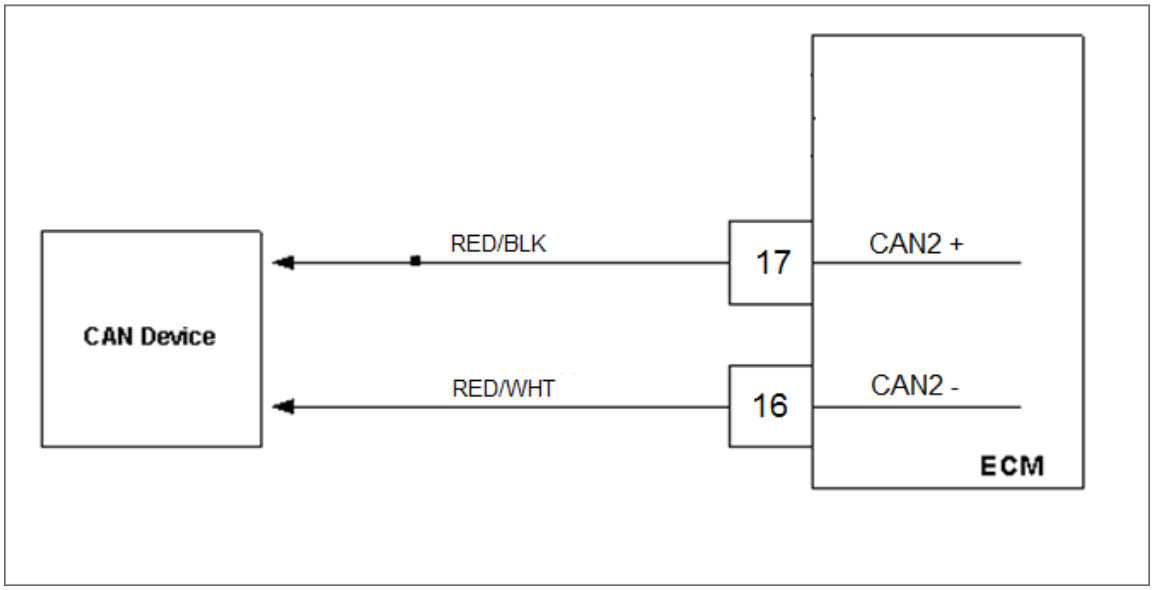
Circuit Description

This ECM output is used to provide a low-side switch to a MIL that is used to indicate that an emission related fault has been set. This fault will set if the ECM detects that the ECM MIL output is shorted to power.

DTC 1645-MIL Control Short to Power



DTC 1646-CAN2 Tx Failure



Conditions for Setting the DTC

- Check Condition: Engine running
- Fault Condition: CAN Tx error 120 packets lost within 1 second
- MIL: ON

Circuit description

The CAN bus (controller area network) is used by the ECM to communicate with other digital devices used throughout the fuel system. Information is sent over the CAN bus in digital information “packets” that contain information for various control functions. This fault will set if the ECM broadcasts 120 packets to the network that are not received within a one second time period. The MIL command is ON.

Diagnostic Aides

- Verify that all CAN devices are powered and properly grounded
- Verify that the CAN2 network is properly terminated
- Check CAN2 wire routing with respect to noise sources (ignition coils, spark plug coil wires, etc.) and shield if necessary
- Check CAN2 (+) and (-) wires for short circuits

DTC 1647 – CAN3 Tx Failure

Conditions for Setting the DTC

- Check Condition: Engine running
- Fault Condition: CAN Tx error 120 packets lost within 1 second
- MIL: ON

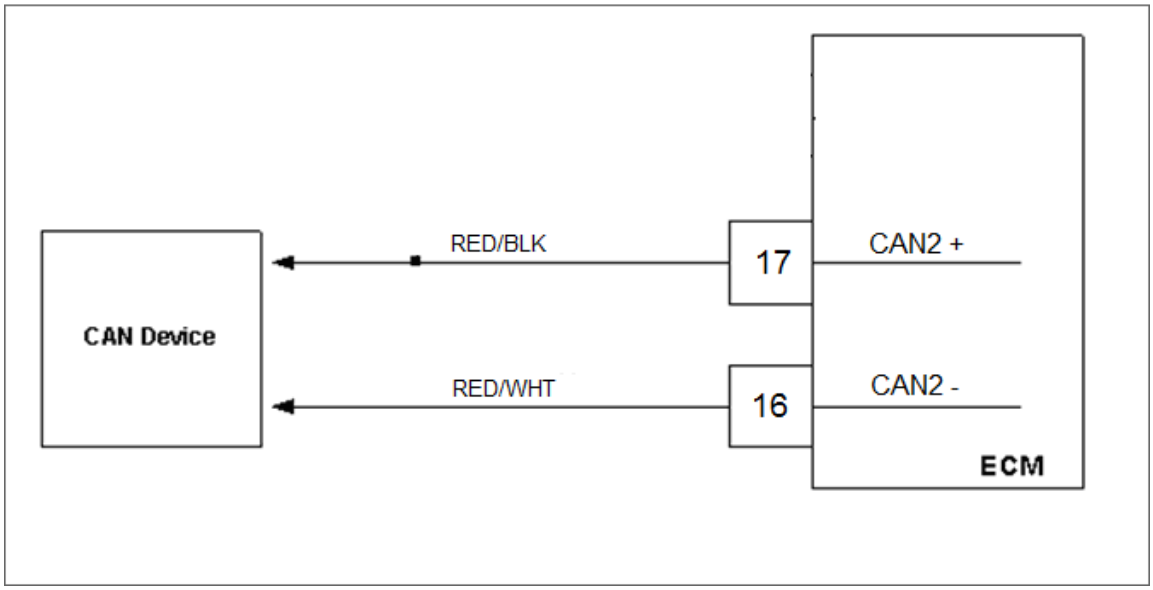
Circuit description

The CAN bus (controller area network) is used by the ECM to communicate with other digital devices used throughout the fuel system. Information is sent over the CAN bus in digital information “packets” that contain information for various control functions. This fault will set if the ECM broadcasts 120 packets to the network that are not received within a one second time period. The MIL command is ON.

Diagnostic Aides

- Verify that all CAN devices are powered and properly grounded
- Verify that the CAN3 network is properly terminated
- Check CAN3 wire routing with respect to noise sources (ignition coils, spark plug coil wires, etc.) and shield if necessary
- Check CAN3 (+) and (-) wires for short circuits

DTC 1648-CAN2 Rx Failure



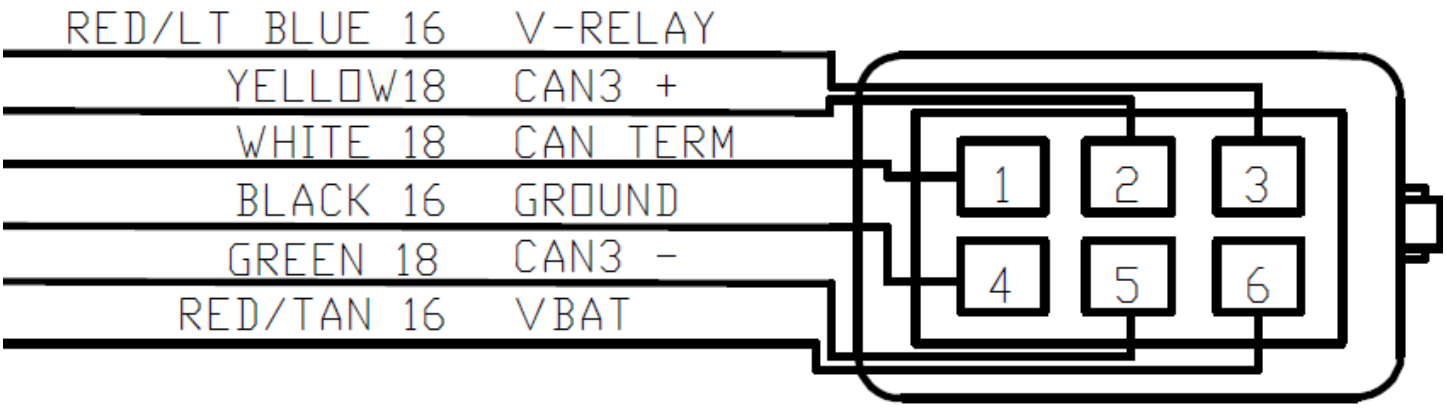
Conditions for Setting the DTC

- Check Condition: Engine running
- Fault Condition: CAN2 Rx error 120 packets lost within 1 second
- MIL: ON

Circuit description

The CAN bus (controller area network) is used by the ECM to communicate with other digital devices used throughout the fuel system. Information is sent over the CAN bus in digital information “packets” that contain information for various control functions. This fault will set if the ECM detects 120 packets lost within a one second time period. The MIL command is ON.

DTC 1649 CAN3 Rx Failure



Conditions for Setting the DTC

- Check Condition: Engine running
- Fault Condition: CAN3 Rx error 120 packets lost within 1 second
- MIL: ON

Circuit description

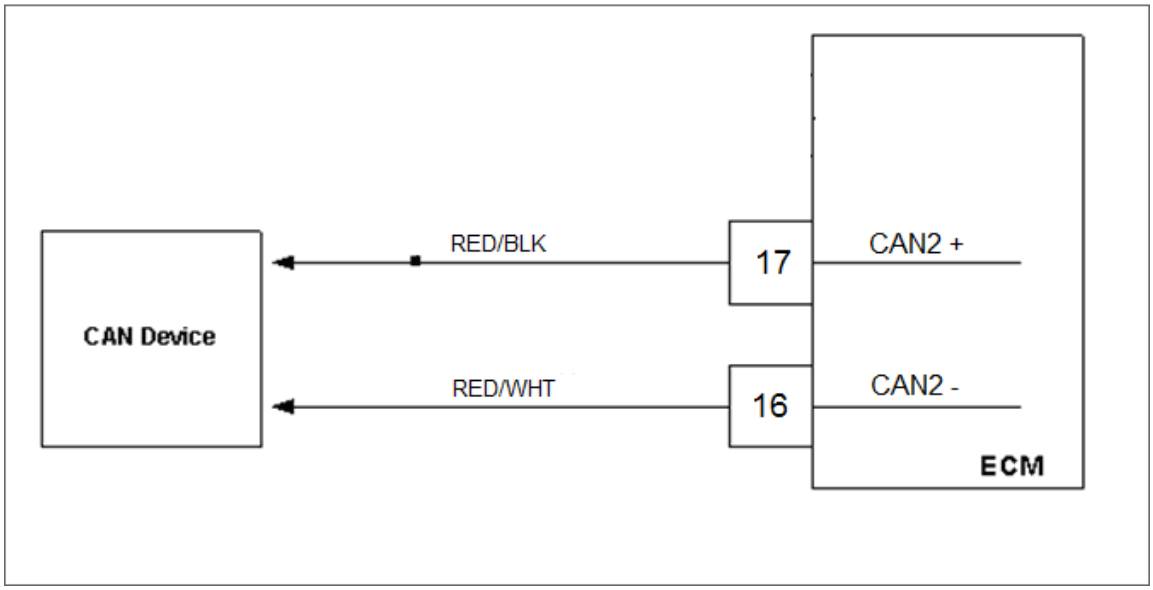
The CAN bus (controller area network) is used by the ECM to communicate with other digital devices used throughout the fuel system. Information is sent over the CAN bus in digital information “packets” that contain information for various control functions. This fault will set if the ECM detects 120 packets lost within a one second time period. The MIL command is ON.

DTC 1627-CAN1 Rx Failure

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	Key ON, Engine Running DST (Diagnostic Scan Tool) connected in System Data Mode Clear system fault code Does DTC1627 reset with the engine idling?		Go to Step (3)	Intermittent problem Go to Intermittent section
3	Check that the ECM power connection C019 is clean, tight and in the proper location. Check that the ECM ground connection C010 is clean, tight and in the proper location. Are the power and ground circuits OK?		Go to Step (4)	Repair the circuit as necessary. Refer to Wiring Repairs in Engine Electrical.
4	Using a DVOM check for continuity between ECM pins 16 and 17 Do you have continuity between them?		Repair the shorted circuit as necessary. Refer to Wiring Repairs in Engine Electrical.	Go to Step (5)
5	Using a DVOM check for continuity to engine ground on pins 16 and 17. Do have continuity to engine ground?		Repair the shorted to ground circuit as necessary. Refer to Wiring Repairs in Engine Electrical.	Go to Step (6)
6	Using a DVOM check for continuity to battery positive on pins 16 and 17. Do have continuity between them?		Repair the shorted to ground circuit as necessary. Refer to Wiring Repairs in Engine Electrical.	Go to Step (7)
7	Replace the ECM Is the replacement complete?		Go to Step (8)	_

Step	Action	Value(s)	Yes	No
8	Remove all test equipment except the DST. Connect any disconnected components, fuses, etc. Using the DST clear DTC information from the ECM. Turn the ignition OFF and wait 30 seconds. Start the engine and operate the vehicle to full operating temperature Observe the MIL Observe engine performance and drivability After operating the engine within the test parameters of DTC-1627 check for any stored codes. Does the engine operate normally with no stored codes?		System OK	Go to OBD System Check

DTC 1650 – CAN2 Rx Failure



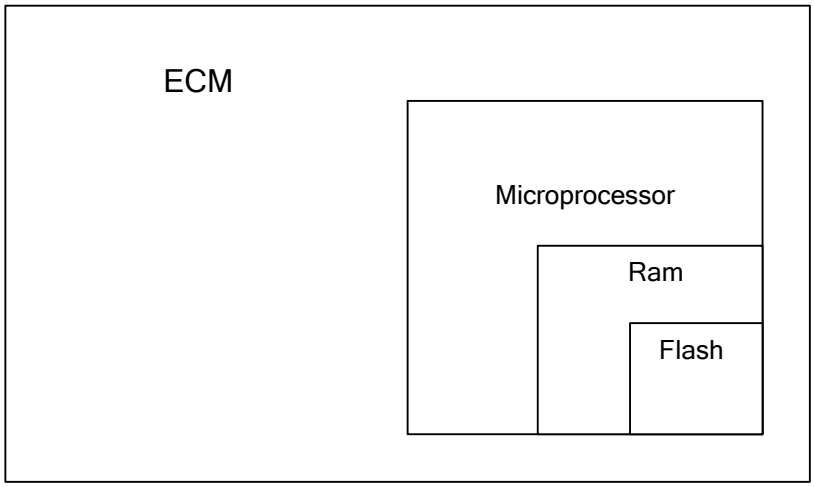
Conditions for Setting the DTC

- Check Condition: Engine running
- Fault Condition: 5 or more address conflict errors
- MIL: ON

Circuit description

The CAN bus (controller area network) is used by the ECM to communicate with other digital devices used throughout the fuel system. Information is sent over the CAN bus in digital information “packets” that contain information for various control functions. Individual devices are assigned network addresses. This fault will set if the ECM detects an address conflict, such as two devices with the same address. This is usually not due to an in-field failure and may be the results of “add on” CAN devices

DTC 1673 – Calibration Configuration Error



Conditions for Setting the DTC

- Check Condition: Engine running
- Fault Condition: Specific calibration variable checks do not return expected results
- MIL: ON
- Adaptive disabled, engine derated

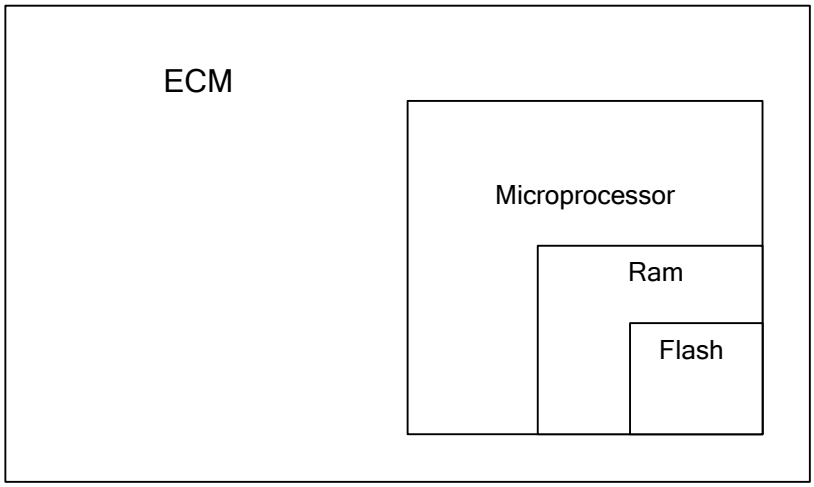
Circuit description

The ECM checks certain safety-related calibration variables for acceptable values or ranges. This fault becomes active when these variable checks do not return the expected results.

Diagnostic Aids

Clear the fault and run the engine again. If the fault returns, contact PSI.

DTC 1674 – Hardware ID Failure



Conditions for Setting the DTC

- Check Condition: Key On
- Fault Condition: MOT file is too old for the given hardware revision level
- MIL: ON
- Adaptive disabled, engine derated

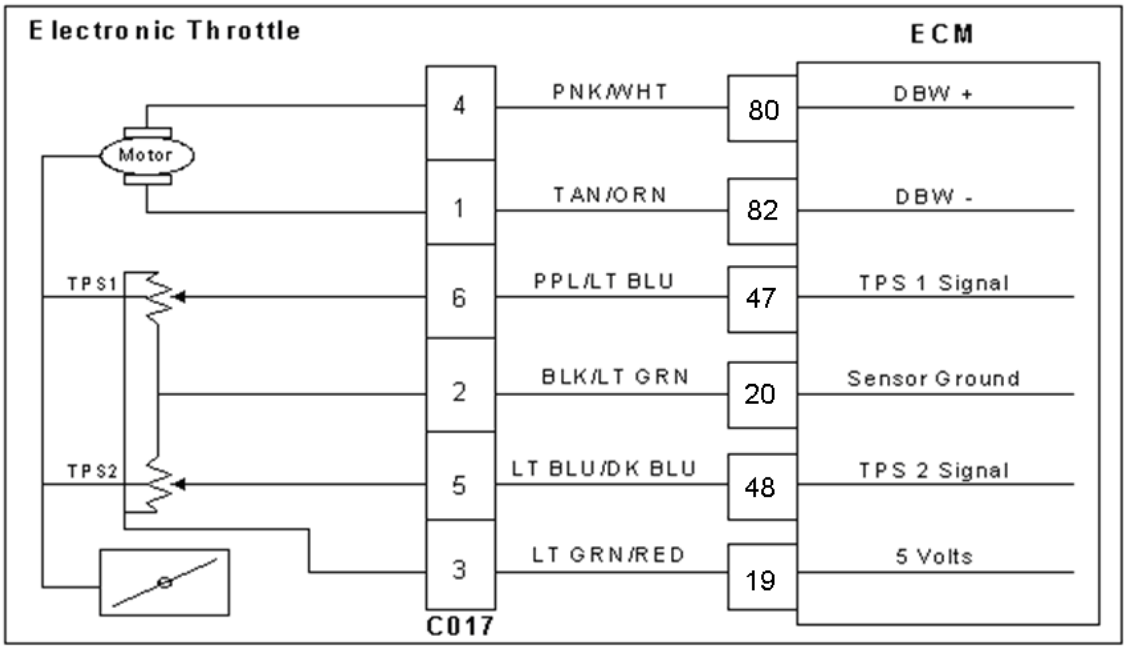
Circuit description

The ECM checks the MOT file against hardware ID tags that indicate the current ECM hardware revision level. This fault will set when programming the ECM with a MOT file that is too old for the given hardware and revision level

Diagnostic Aids

Clear the fault and run the engine again. If the fault returns, contact PSI.

DTC 2111-Unable To Reach Lower TPS



Conditions for Setting the DTC

- Check Condition: Cranking or Running
- Fault Condition: Actual throttle position is 20% greater than the throttle command
- MIL: ON during active fault
- Engine shutdown

Circuit Description

Dual throttle position sensors are used within the throttle that use variable resistors to determine signal voltage based on throttle plate position. When the throttle is closed TPS1 will read low voltage and TPS2 will read high voltage. The TPS 1 and TPS 2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded. This fault will set if the actual throttle position is 20% greater than the throttle command. During this active fault the MIL command is ON and the engine will shut down.

Diagnostic Aid

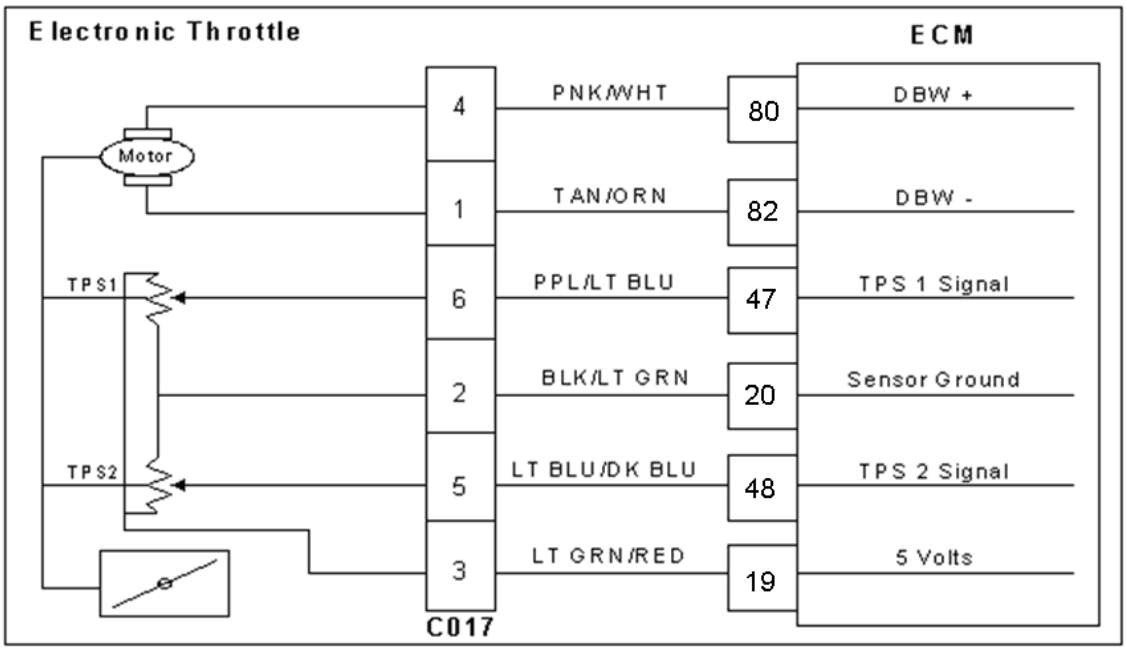
This fault is most often caused by a mechanical problem with the throttle. As the gears inside the throttle wear they have a tendency to bind on each other and cause the throttle to get stuck. Testing the engine with a known good throttle or swapping the throttles side to side on a V-series engine and seeing if the problem moves are good ways to diagnose a stuck throttle.

DTC 2111 Unable To Reach Lower TPS

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	Key ON, Engine OFF DST (Diagnostic Scan Tool) connected in DBW (Drive By Wire) test mode Depress foot pedal until the throttle command is between 63%-68% Is the TPS 1 voltage greater than 2.0 volts?		Go to Step (3)	Intermittent problem Go to Intermittent section
3	Key OFF Disconnect electronic throttle connector C017 Probe TPS 1 signal pin 6 with a test light connected to battery voltage Key ON Does DST display TPS 1 voltage less than 0.2 volts?		Go to Step (6)	Go to Step (4)
4	Key OFF Disconnect ECM wire harness connector C001 Key ON Using a DVOM check for voltage between throttle connector TPS 1signal pin 6 and engine ground Do you have voltage?		Repair the circuit as necessary. Refer to Wiring Repairs in Engine Electrical.	*Go to Step (5)*
5	Replace ECM Is the replacement complete?		Go to Step (13)	-
6	Probe sensor ground circuit at ECM connector C001 with a test light connected to battery voltage Does the test light come on?		Go to Step (9)	Go to Step (7)
7	Key OFF Disconnect ECM wire harness connector C001 Using a DVOM check for continuity between throttle connector signal ground pin 2 and ECM signal ground circuit pin 20 Do you have continuity between them?		Go to Step (8)	Repair the circuit as necessary. Refer to Wiring Repairs in Engine Electrical.
8	Replace ECM Is the replacement complete?		Go to Step (13)	-
9	Check throttle for foreign object in bore Did you find a foreign object in the bore?		Go to Step (10)	Go to Step (11)
10	Remove foreign object Is the removal complete?		Go to Step (13)	-
11	Inspect the throttle wire harness connector terminals for damage, corrosion or contamination Did you find the problem?		Repair the circuit as necessary. Refer to Wiring Repairs in Engine Electrical.	Go to Step (12)

Step	Action	Value(s)	Yes	No
12	Replace throttle Is the replacement complete?		Go to Step (13)	-
13	Remove all test equipment except the DST. Connect any disconnected components, fuses, etc. Using the DST clear DTC information from the ECM. Turn the ignition OFF and wait 30 seconds. Start the engine and operate the vehicle to full operating temperature Observe the MIL Observe engine performance and drivability After operating the engine within the test parameters of DTC-2111 check for any stored codes. Does the engine operate normally with no stored codes?		System OK	Go to OBD System Check

DTC 2112-Unable To Reach Higher TPS



Conditions for Setting the DTC

- Check Condition: Cranking or Running
- Fault Condition: Actual throttle position is 20% less than the throttle command
- MIL: ON during active fault
- Engine shutdown

Circuit Description

Dual throttle position sensors are used within the throttle that use variable resistors to determine signal voltage based on throttle plate position. TPS 1 will read low voltage when closed and TPS 2 will read high voltage when closed. The TPS 1 and TPS 2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded. This fault will set if the actual throttle position is 20% less than the throttle command. The MIL command is ON and the engine will shut down.

Diagnostic Aid

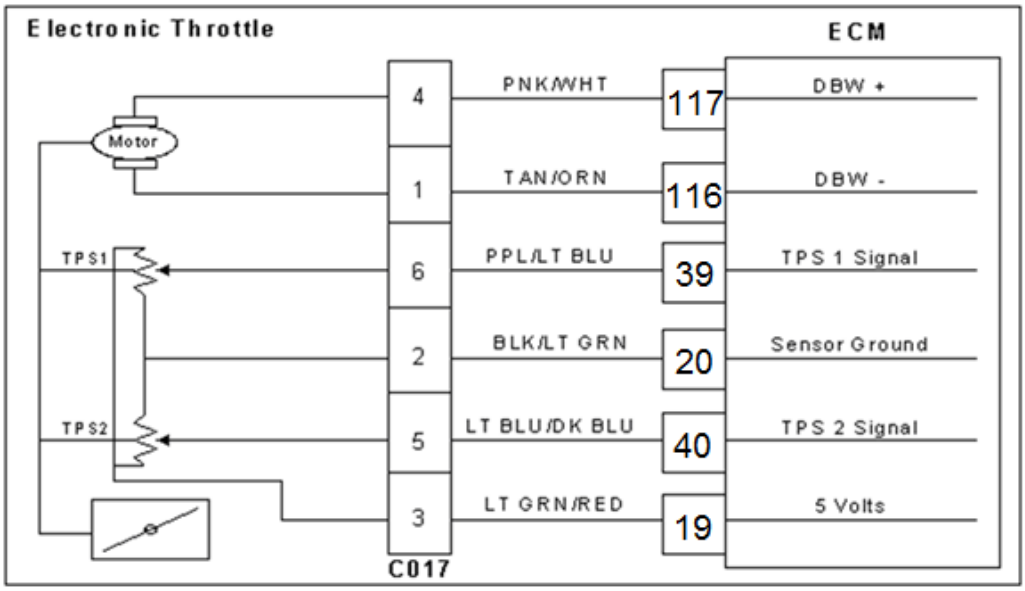
This fault is most often caused by a mechanical problem with the throttle. As the gears inside the throttle wear they have a tendency to bind on each other and cause the throttle to get stuck. Testing the engine with a known good throttle or swapping the throttles side to side on a V-series engine and seeing if the problem moves are good ways to diagnose a stuck throttle.

DTC 2112-Unable To Reach Higher TPS

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	Key ON, Engine OFF DST (Diagnostic Scan Tool) connected in DBW (Drive By Wire) test mode Depress foot pedal until the throttle command is 63%-68% Is the TPS voltage less than 2.0 volts?		Go to Step (3)	Intermittent problem Go to Intermit-tent section
3	Key OFF Disconnect electronic throttle connector C017 Probe TPS 1 signal circuit pin 6 with test light connected to battery voltage Key ON Is TPS voltage 4.0 volts or greater?		Go to Step (4)	Go to Step (8)
4	Check throttle bore for foreign object Did you find a problem?		Go to Step (5)	*Go to Step (6)*
5	Remove the foreign object Has the object been removed?		Go to Step (11)	-
6	Check the electronic throttle connector terminals for damage corrosion or contamination Did you find a problem?		Repair the circuit as nec-essary. Refer to Wiring Re-pairs in Engine Elec-trical.	Go to Step (7)
7	Replace throttle Is the replacement complete?		Go to Step (11)	-
8	Key OFF Disconnect ECM wire harness connector C001 Using a DVOM check for continuity between throttle connector TPS 1 signal pin 6 and ECM TPS 1 signal pin 47 Do you have continuity between them?		Go to Step (9)	Repair the cir-cuit as necessary. Refer to Wir-ing Repairs in Engine Elec-trical.
9	Using a DVOM check for continuity between throttle connector TPS 1 signal pin 6 and engine ground Do you have continuity between them?		Repair the shorted to ground circuit as necessary. Refer to Wir-ing Repairs in Engine Elec-trical.	Go to Step (10)
10	Replace ECM Is the replacement complete?		Go to Step (11)	-

Step	Action	Value(s)	Yes	No
11	Remove all test equipment except the DST. Connect any disconnected components, fuses, etc. Using the DST clear DTC information from the ECM. Turn the ignition OFF and wait 30 seconds. Start the engine and operate the vehicle to full operating temperature Observe the MIL Observe engine performance and drivability After operating the engine within the test parameters of DTC-2112 check for any stored codes. Does the engine operate normally with no stored codes?		System OK	Go to OBD System Check

DTC 2135 – TPS1/2 Simultaneous Voltages Out of Range



Conditions for Setting the DTC

- Check Condition: Key On, Engine running
- Fault Condition: TPS1 voltage is greater than 4.8V or less than 0.2V AND TPS2 voltage is greater than 4.8V or less than 0.2V
- MIL: ON during active fault
- Engine Shutdown

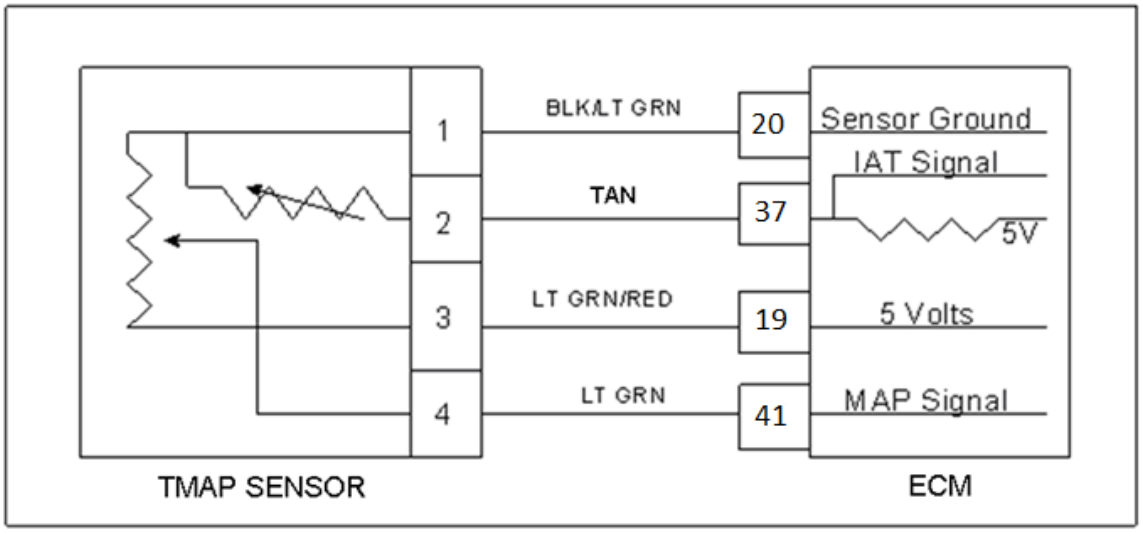
Fault Description

Dual throttle position sensors are used within the throttle that use variable resistors to determine signal voltage based on throttle plate position. TPS1 will read lower voltage when closed and TPS2 will read higher voltage when closed. The TPS1 and TPS2 percentages are calculated from these voltages. Although the voltages are different, the calculated values for the throttle position percentages should be very close to the same. The TPS values are used by the ECM to determine if the throttle is opening as commanded. The TPS is not serviceable and in the event of a failure the electronic throttle assembly must be replaced. This fault will set if there are simultaneous voltage out-of-range faults for both TPS 1 and TPS2.

Diagnostic Aids

- Troubleshoot according to TPS1 voltage out-of-range following DTC 122 and 123 procedures.
- Troubleshoot according to TPS2 voltage out-of-range following DTC 222 and 223 procedures.

DTC 2229-BP High Pressure



Conditions for Setting the DTC

- Check Condition: Key ON
- Fault Condition: BP greater than 16 psia
- MIL: ON for active fault
- Adaptive: Disabled

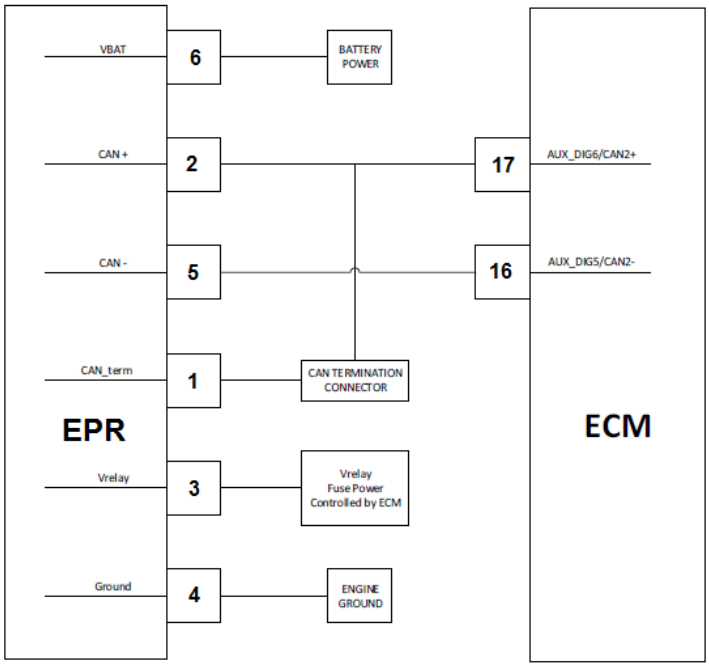
Circuit Description

The BP (Barometric Pressure) is estimated from the TMAP sensor. The barometric pressure value is used for fuel and airflow calculations. This fault sets in the event the BP value is out of the normal range.

DTC 2229-BP High Pressure

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	Key ON DST (Diagnostic Scan Tool) connected in System Data Mode Does DST display MAP pressure of 16 psia or greater?		Go to Step (3)	Intermittent problem Go to Intermittent section
3	Replace TMAP sensor. Is the repair complete?		Go to Step 4	-
4	Remove all test equipment except the DST. Connect any disconnected components, fuses, etc. Using the DST clear DTC information from the ECM. Turn the ignition OFF and wait 30 seconds. Start the engine and operate the vehicle to full operating temperature Observe the MIL Observe engine performance and drivability After operating the engine within the test parameters of DTC-2229 check for any stored codes. Does the engine operate normally with no stored codes?		System OK	Go to OBD System Check

DTC 3031 – UEGO1 Heater Open/Ground Short



Conditions for Setting the DTC

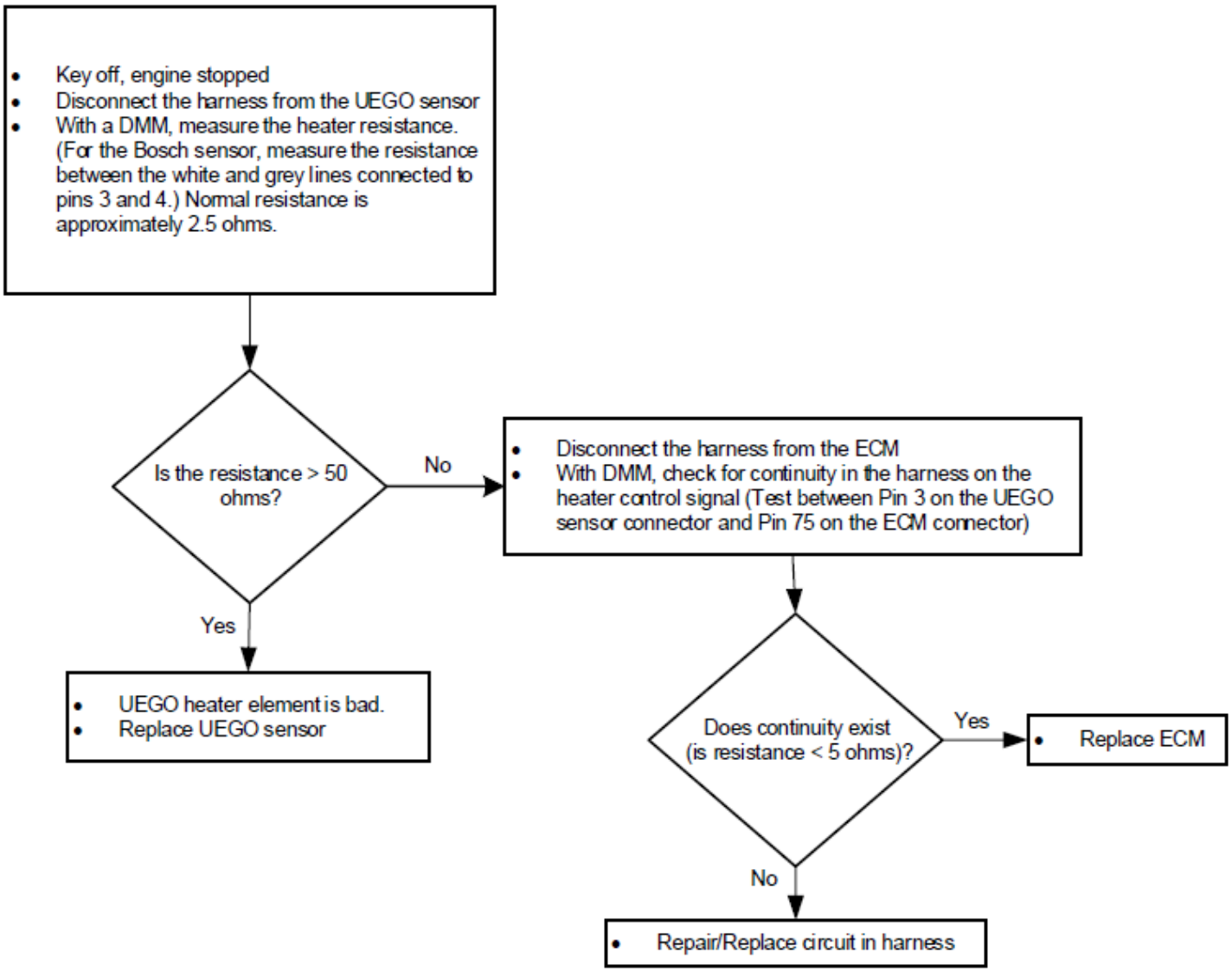
- Check Condition: Key On
- Fault Condition: UEGO heater low-side feedback < 5% of Vbattery for 2 seconds and PWM duty cycle < 5%
- MIL: ON during active fault
- Closed Loop Disabled

Fault Description

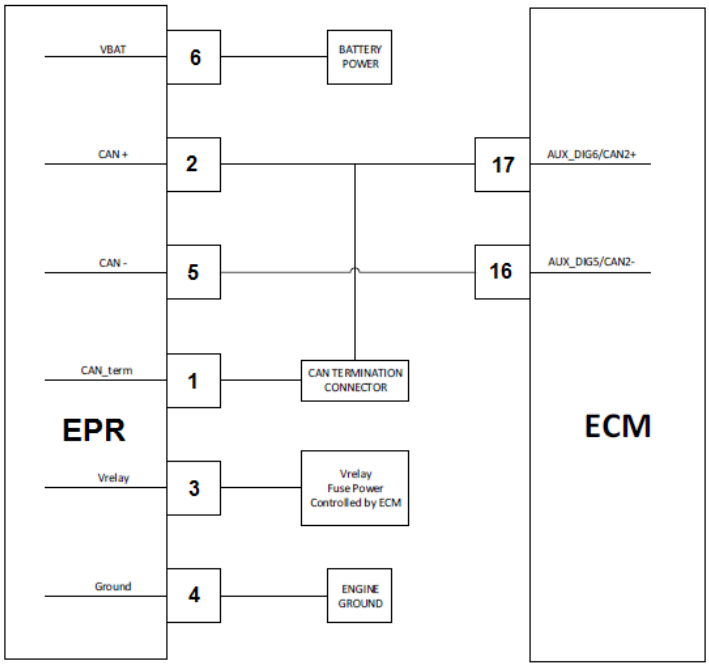
A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear output proportional to lambda/equivalence ratio/air-fuel ratio. The sensor is heated with an internal resistive element that is supplied by the battery voltage and switched on/off by the ECM. The ECM will pull the heater control signal to ground when turning on the heater. The ECM monitors the heater control signal for a short to ground. If the control signal is not equal to Vbattery with the heater is turned off, then the circuit is not functioning properly. The UEGO heater circuit must always be functioning for proper emissions control.

This fault will set when the UEGO heater control signal does not achieve Vbattery when the heater is switched off. This may be caused by a bad heater element un the UEGO sensor, a break in the wire harness on the heater supply or control circuits, or fault within the ECM.

DTC 3031 – UEGO1 Heater Open/Ground Short



DTC 3032 – UEGO1 Heater Short to Power



Conditions for Setting the DTC

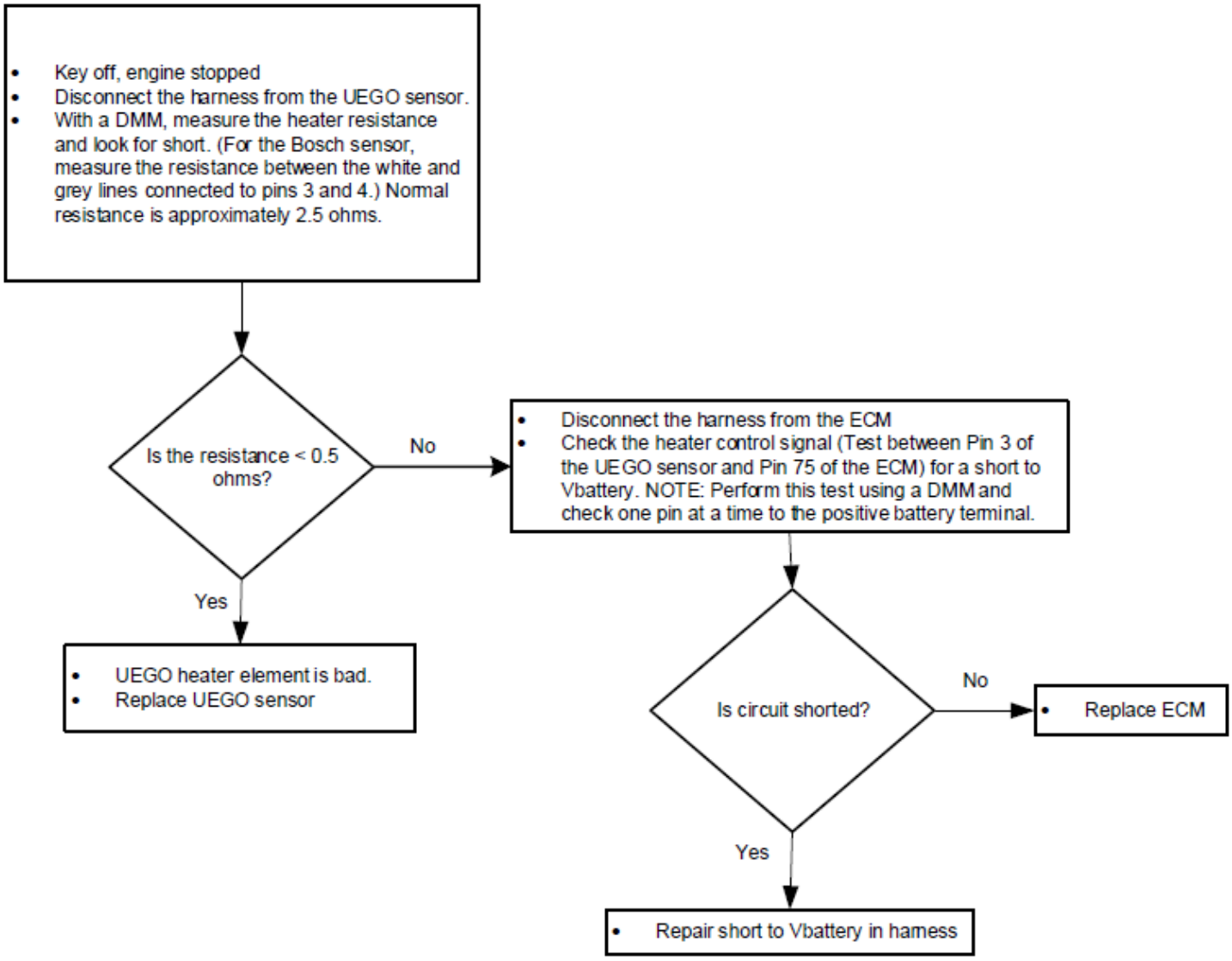
- Check Condition: Key On
- Fault Condition: UEGO heater low-side feedback < 90% of Vbattery for 2 seconds and PWM duty cycle < 90%
- MIL: ON during active fault
- Closed Loop Disabled

Fault Description

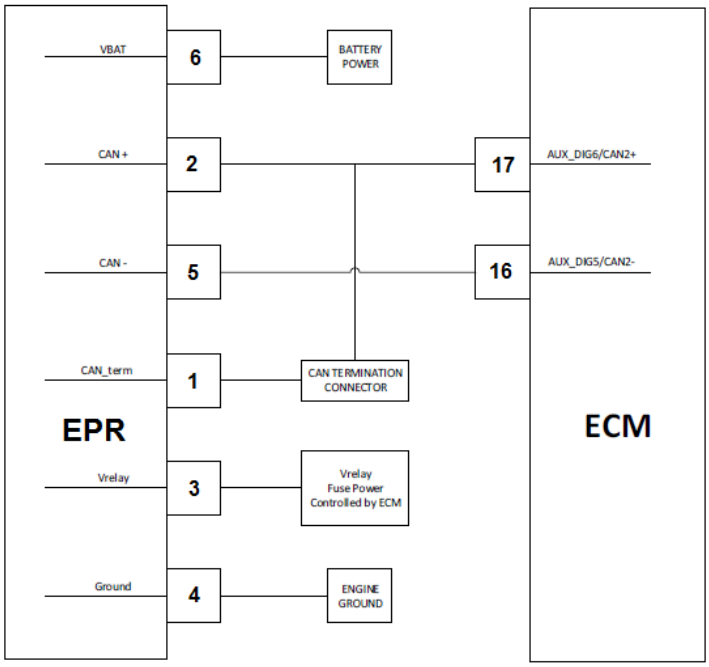
A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear output proportional to lambda/equivalence ratio/air-fuel ratio. The sensor is heated with an internal resistive element that is supplied by the battery voltage and switched on/off by the ECM. The ECM will pull the heater control signal to ground when turning on the heater. The ECM monitors the heater control signal for a short to ground. If the control signal is not equal to Vbattery with the heater is turned off, then the circuit is not functioning properly. The UEGO heater circuit must always be functioning for proper emissions control.

This fault will set when the UEGO heater control signal does not achieve zero volts when the heater is switched on. This may be caused by an internal fault within the ECU.

DTC 3032 – UEGO1 Heater Short to Power



DTC 8901 – UEGO1 Internal Processor Fault



Conditions for Setting the DTC

- Check Condition: Key On
- MIL: ON during active fault
- Closed Loop and Adaptive Learn Disabled

Fault Description

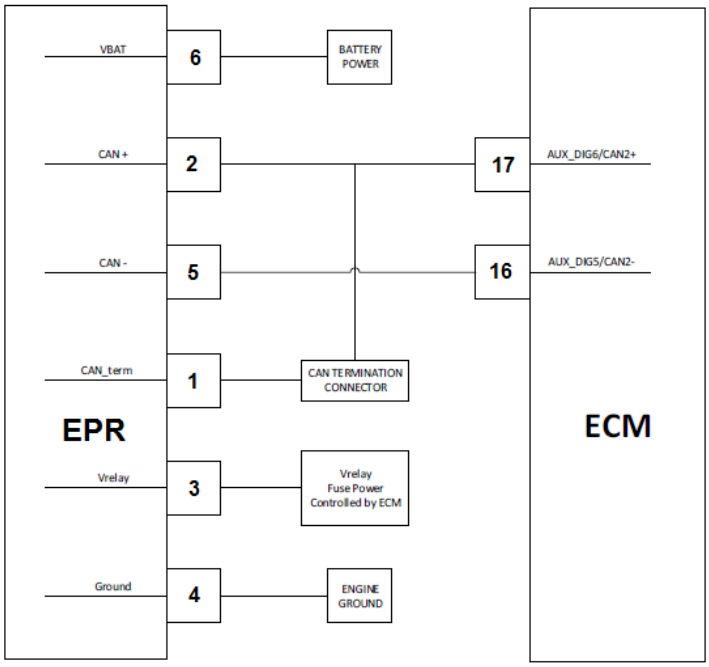
A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear output proportional to lambda/equivalence ratio/air-fuel ratio. Internal to the ECM there is an application specific integrated circuit/controller that controls the sensor. The UEGO controller communicates internally within the ECM to the main microcontroller. The UEGO controller must always be functioning and communicating with the main microcontroller for proper emissions control.

This fault may be set if the power supplied to the ECM (alternator or battery power) is excessively noisy and exhibits low voltage dips or dropouts. It may also indicate an internal failure within the ECM. The fault will disable closed loop and adaptive learn for the remainder of the key cycle.

Diagnostic Aids

- Verify that the alternator is working properly and there is not excessive noise on the alternator output or battery power from other loads. This fault may occur if power repeatedly dips but does not completely drop out to zero.
- Verify the ECM ground is sufficient (clean and tight to the engine block).
- Swap ECM with a known good part, run engine for 10 minutes, and then retest.

DTC 8902 – UEGO1 Heater Supply High Voltage



Conditions for Setting the DTC

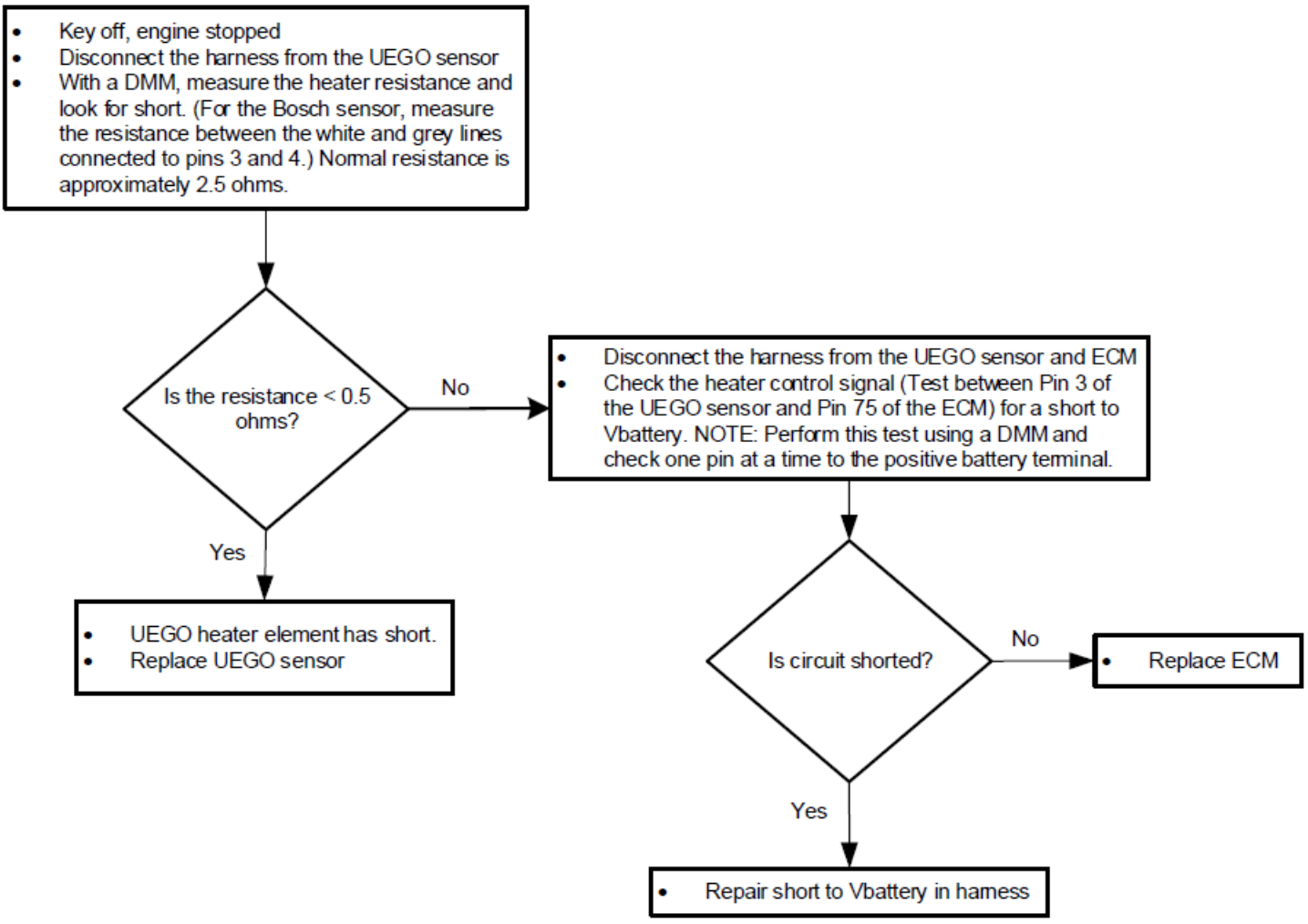
- Check Condition: Key On
- Fault Condition: UEGO heater supply voltage > 32V
- MIL: ON during active fault
- Adaptive Disabled

Fault Description

A UEGO sensor measures the exhaust content across a wide-range of air-fuel ratios with a linear output proportional to lambda/equivalence ratio/air-fuel ratio. The sensor is heated with an internal resistive element that is supplied by the battery voltage and switched on/off by the ECM. The ECM will pull the heater control signal to ground when turning on the heater. The ECM monitors the heater control signal for a short to ground. If the control signal is not equal to Vbattery with the heater is turned off, then the circuit is not functioning properly. The UEGO heater circuit must always be functioning for proper emissions control.

This fault will set when the UEGO heater control signal is greater than 32V when the heater is switched on. This may be caused by an internal fault within the ECM. This fault will disable adaptive learn and light the MIL.

DTC 8902 – UEGO1 Heater Supply High Voltage



Definitions

Air Valve Vacuum (AVV): The vacuum signal taken from below the air valve assembly and above the throttle butterfly valve.

ADP: Adaptive Digital Processor.

Air/Fuel Ratio: The amount or balance of air and fuel in the air fuel mixture that enters the engine.

Analog Voltmeter: A meter that uses a mechanical needle to point to a value on a scale of numbers. It is usually of the low impedance type and used to measure voltage and resistance.

Aromatics: Pertaining to or containing the six-carbon ring characteristic of the benzene series. Found in many petroleum distillates.

Backfire: Combustion of the air/fuel mixture in the intake or exhaust manifolds. A backfire can occur if the intake or exhaust valves are open when there is a mis-timed ignition spark.

Benzene: An aromatic (C_6H_6). Sometimes blended with gasoline to improve anti-knock value. Benzene is toxic and suspected of causing cancer.

Bi-Fueled: A vehicle equipped to run on two fuels.

Blow-By: Gases formed by the combustion of fuel and air, which ordinarily should exert pressure only against the piston crown and first compression ring. When rings do not seal, these gases escape or "blow by" the side of the piston into the crankcase.

BTU: British Thermal Unit. A measurement of the amount of heat required to raise the temperature of 1lb. of water 1 degree F.

Butane: An odorless, colorless gas, C_4H_{10} found in natural gas and petroleum. One of the five LP gases.

CAFE: Corporate Average Fuel Economy.

CARB: California Air Resources Board.

Carbon Monoxide (CO): A chemical compound of a highly toxic gas that is both odorless and colorless.

Carburetor: An apparatus for supplying an internal-combustion engine a mixture of vaporized fuel and air.

Cathode Ray Tube: A vacuum tube in which cathode rays usually in the form of a slender beam are projected on a fluorescent screen and produce a luminous spot.

Circuit: A path of conductors through which electricity flows.

Closed Loop Operation: Applies to systems utilizing an oxygen sensor. In this mode of operation, the system uses oxygen sensor information to determine air/fuel ratio. Adjustments are made accordingly and checked by comparing the new oxygen sensor to previous signals. No stored information is used.

CNG: Compressed Natural Gas.

CKP: Crankshaft Position Sensor

CMP: Camshaft Position Sensor

Conductor: A material, normally metallic, that permits easy passage of electricity.

Contaminants: Impurities or foreign material present in fuel.

Control Module: One of several informal names for a solid state microcomputer which monitors engine conditions and controls certain engine functions; i.e. air/fuel ratio, injection and ignition time, etc. The formal name and the one used throughout this manual is ECM, or Engine Control Module.

Converter: A LPG fuel system component containing varying stages of fuel pressure regulation combined with a vaporizer.

Cryogen: A refrigerant used to obtain very low temperatures.

Current: The volume or flow of electrons through a conductor. Measured in amperes or amps.

DBW: Drive By Wire

Dedicated Fuel System: A motor fuel system designed to operate on only one fuel type.

Diaphragm: A thin, flexible membrane that separates two chambers. When the pressure in one chamber is lower than in the other chamber, the diaphragm will move toward the side with the low pressure.

Diaphragm Port: The external port located at the fuel inlet assembly and connected to the vacuum chamber above the air valve diaphragm.

DLC: Data Link Connector.

DTC: Diagnostic Trouble Code

DST: Diagnostic Scan Tool.

DVOM: Digital Volt/ohm Meter**.** A meter that uses a numerical display in place of a gauge and is usually of the high impedance type.

ECT: Engine Coolant Temperature.

ECM: Electronic Control Module

ECOM: A DLC cable supporting CAN and serial communication with a NGE/EControls ECM.

EFI: Electronic Fuel Injection. A fuel injection system, which uses a microcomputer (ECM) to determine and control the amount of fuel, required by, and injected into, a particular engine.

EGO: Exhaust Gas Oxygen, used to describe a sensor. Also known as "HEGO" (Heat Exhaust Gas Oxygen) sensor, "O_2" or "Oxygen sensor.

EGR: Exhaust Gas Recirculation.

EPA: Environmental Protection Agency: A regulating agency of the Federal government which, among other duties, establishes and enforces automotive emissions standards.

Ethanol: Grain alcohol (C_2H_5OH), generally produced by fermenting starch or sugar.

Evaporative Emissions Controls: An automotive emission control system designed to reduce hydrocarbon emissions by trapping evaporated fuel vapors from the fuel system.

Excess Flow Valve: A check valve that is caused to close by the fuel when the flow exceeds a predetermined rate.

FTV: Fuel Trim Valve.

FFV: Flexible Fuel Vehicle.

Firing Line: The portion of an oscilloscope pattern that represents the total amount of voltage being expended through the secondary circuit.

FMVSS: Federal Motor Vehicle Safety Standards.

FPP: Foot Pedal Position Sensor

Fuel Injector: a spring loaded, electromagnetic valve which delivers fuel into the intake manifold, in response to an electrical input from the control module.

Fuel Lock: A solenoid-controlled valve located in the fuel line to stop the flow when the engine stops or the ignition switch is off.

Gasohol: 10 percent ethanol, 90 percent gasoline. Often referred to as E-10.

Gasoline: A motor vehicle fuel that is a complex blend of hydrocarbons and additives. Typical octane level is 89.

GCP: Spectrum III (90-pin) ECM.

Greenhouse Effect: A scientific theory suggesting that carbon dioxide from the burning of fossil fuels is causing the atmosphere to trap heat and cause global warming.

HC: Hydrocarbon. An organic chemical compound.

HD 10: A fuel of not less than 80% liquid volume propane and not more than 10% liquid volume propylene.

HD 5: A fuel of not less than 90% liquid volume propane and not more than 5% liquid volume propylene.

HDV: Heavy Duty Vehicle.

Heavy Ends: A term used to describe the buildup of wax-like impurities that fall out of LPG when vaporized.

HEGO: Heated Exhaust Gas Oxygen, used to describe a sensor. Also known as “EGO” (Exhaust Gas Oxygen sensor), “O_2” or “Oxygen sensor.

Hg: Chemical symbol for the element mercury. Used in reference to a measure of vacuum (inches of Hg).

Histogram: The graphical version of a table which shows what proportion of values fall into specific categories over a specific period of time.

Hydrocarbon: A chemical compound made up of hydrogen and carbon (HC). Gasoline and almost all other fuels are hydrocarbons.

Hydrostatic Relief Valve: A pressure relief device installed in the liquid LPG hose on a LPG fuel system.

IAT: Intake Air Temperature

Ideal Mixture: The air/fuel ratio at which the best compromise of engine performance to exhaust emissions is obtained. Typically 14.7:1.

Ignition Reserve: The difference between available voltage and the required voltage.

ILEV: Inherently Low Emission Vehicle.

Impedance: A form of opposition of AC electrical current flow (resistance) measured in ohms.

Insulation: A nonconductive material used to cover wires in electrical circuits to prevent the leakage of electricity and to protect the wire from corrosion.

Intercept: An electrical term for a type of splice where the original circuit is interrupted and redirected through another circuit.

Knock: Sound produced when an engine’s air/fuel mixture is ignited by something other than the spark plug, such as a hot spot in the combustion chamber. Also caused by a fuel with an octane rating that is too low and/or incorrect ignition timing. Also called detonation or ping.

Lambda Sensor: A feedback device, usually located in the exhaust manifold, which detects the amount of oxygen present in exhaust gases in relation to the surrounding atmosphere. (See HEGO).

LDV: Light Duty Vehicle.

Lean Mixture: An air to fuel ratio above the stoichiometric ratio; too much air.

LEV: Low Emission Vehicle.

Limp-in or Limp Home: A mode where the ECM or a component has failed, but the vehicle remains operational although the engine may operate minimally. This term may also describe the drivability characteristics of a failed computer system.

Liquid Petroleum Gas (LPG): A fuel commonly known as propane consisting mostly of propane (C_3H_8), derived from the liquid components of natural gas stripped out before the gas enters the pipeline, and the lightest hydrocarbons produced during petroleum refining. Octane level of LPG is 107.

LPG: Liquified Petroleum Gas.

M85: A blend of gasoline and methanol consisting of 85% methanol and 15% gasoline.

Measurements of Pressure: 1 PSI=2.06” Hg

(mercury) = 27.72" H_2O (water column). At sea level atmospheric pressure is 29.92" Hg.

Methanol: Known as wood alcohol (CH_3OH), a light, volatile, flammable alcohol commonly made from natural gas.

MIL: Malfunction Indicator Lamp.

Misfire: Failure of the air/fuel mixture to ignite during the power stroke.

Mixer: Fuel introduction device that does not include a throttle plate.

MFI: Multiport Fuel Injection. A fuel injection system that uses one injector per cylinder mounted on the engine to spray fuel near the intake valve area of combustion chamber.

MSV: Manual Shut-Off Valve. Refers to the manually operated valve on the LPG tank.

MTBE: Methyl Tertiary Butyl Ether. Oxygenate add to gasoline to reduce harmful emissions and to improve the octane rating.

Multi-fuel System: A motor fuel system designed to operate on two different fuels, such as LPG and gasoline.

Natural Gas: A gas formed naturally from buried organic material, composed of a mixture of hydrocarbons, with methane (CH_4) being the dominant component.

NGV: Natural Gas Vehicle.

NOX: See Oxides of Nitrogen.

OBD: On Board Diagnostic

Octane Rating: The measurement of the antiknock value of a motor fuel.

OEM: Original Equipment Manufacturer, the vehicle manufacturer.

Open-Loop: An operational mode during which control module memory information is used to determine air/fuel ratio, injection timing, etc., as opposed to actual oxygen sensor input.

Orifice: A port or passage with a calibrated opening designed to control or limit the amount of flow through it.

Oscilloscope: An instrument that converts voltage and frequency readings into traces on a cathode ray tube (also see Cathode Ray Tube).

Oxides of Nitrogen: Chemical compounds of nitrogen bonded to various amounts of oxygen (NOX). A chief smog forming-agent.

Oxygen Sensor: An automotive fuel system that produces a signal in accordance with the oxygen content of the exhaust gas. (See Lambda Sensor).

Oxygenate: Oxygenates (such as MTBE, ethanol and methanol) added to gasoline to increase the oxygen content and therefore reduce exhaust emissions.

Ozone: A radical oxygen module (O_3) that is found in the upper atmosphere and filters out ultraviolet radiation from the sun. Ground level ozone is formed by NOX, during the formation of photochemical smog.

Particulates: Microscopic pieces of solid or liquid substances such as lead and carbon that are discharged into the atmosphere by internal combustion engines.

Positive Crankcase Ventilation (PCV): An automotive emission control system designed to reduce hydrocarbon emissions by routing crankcase fumes into the intake manifold rather than to the atmosphere.

Power Derate: A mode of reduced engine power output for the purposes of protecting engine components during a failure or malfunction.

Pressure Differential: The differential between atmospheric pressure and intake manifold (referred to as vacuum) pressure.

Pressure Regulator: A device to control the pressure of fuel delivered to the fuel injector(s).

Primary Circuit: The low-voltage or input side of the ignition coil.

Propane: An odorless and colorless gas, C_3H_8, found in natural gas and petroleum.

PSIa: pounds per square inch absolute

PTV: Pressure Trim Valve

Reactivity: Refers to the tendency of an HC in the presence of NOX and sunlight to cause a smog-forming reaction. The lighter the HC, the lower reactivity tends to be.

Regulator: An assembly used to reduce and control the pressure of a liquid or vapor.

Resistance: The opposition to the flow of current in an electrical circuit. Measured in ohms.

Rest Pressure: Fuel pressure maintained within the system after engine shutdown.

Rich Mixture: An air to fuel ratio below the stoichiometric ratio; too much fuel.

SAE: Society of Automotive Engineers.

Secondary Circuit: The high-voltage output side of the ignition coil.

SEFI or SFI: Sequential Electronic Fuel Injection or Sequential Fuel Injection.

Sensors: Devices that provide the control module with engine information as needed to properly control engine function.

Spark Line: The portion of an oscilloscope pattern that represents the time during which the air/fuel mixture is being burned in the combustion chamber.

Splice: An electrical term for the joining of two or more conductors at a single point.

Stoichiometric Ratio: An ideal fuel/air ratio for combustion in which all of the fuel and most of the oxygen will be burned.

Sulfur Oxides: Chemical compounds where sulfur is bonded to oxygen produced by the combustion of gasoline or any other fuel that contains sulfur. As sulfur oxides combine with water in the atmosphere to form sulfuric acid.

System Pressure: The fuel pressure maintained in the system during normal engine operation.

Tap: An electrical term for a type of splice where the original circuit is not interrupted.

TBI: Throttle Body Injection. Any of several injection systems that have the fuel injector(s) mounted in a centrally located throttle body.

Throttle Body: Controls engine RPM by adjusting the engine manifold vacuum to the mixer. Consists of a housing shaft, throttle liner and butterfly valve.

TLEV: Transitional Low Emission Vehicle.

TMAP: Combined Air Inlet and Manifold Pressure Sensor.

Toluene: A liquid aromatic hydrocarbon C_7H_8.

TPS: Throttle Position Sensor.

TSB: Technical Service Bulletin.

ULEV: Ultra Low Emission Vehicle.

USB: Universal Serial Bus. A plug or interface supplied on most personal computers.

Vaporization: A process in which liquid changes states into gas.

Variable Frequency Driver (VFD): Allow electrical loads from motors to be applied gradually.

Venturi Air Valve Vacuum (VAVV): An amplified air valve vacuum signal coming from the venturi area of the mixer, directly exposed to airflow before the addition of vaporized LPG.

Volt/ohmmeter (VOM): A combination meter used to measure voltage and resistance in an electrical circuit. Available in both analog and digital types. May also referred to as AVOM and DVOM.

Voltage: The electrical pressure that causes current to flow in a circuit. Measured in volts.

Voltage Drop: A lowering of the voltage in a circuit when resistance or electrical load is added.

Voltmeter: A meter that uses a needle to point to a value on a scale of numbers usually of the low impedance type; used to measure voltage and resistance.

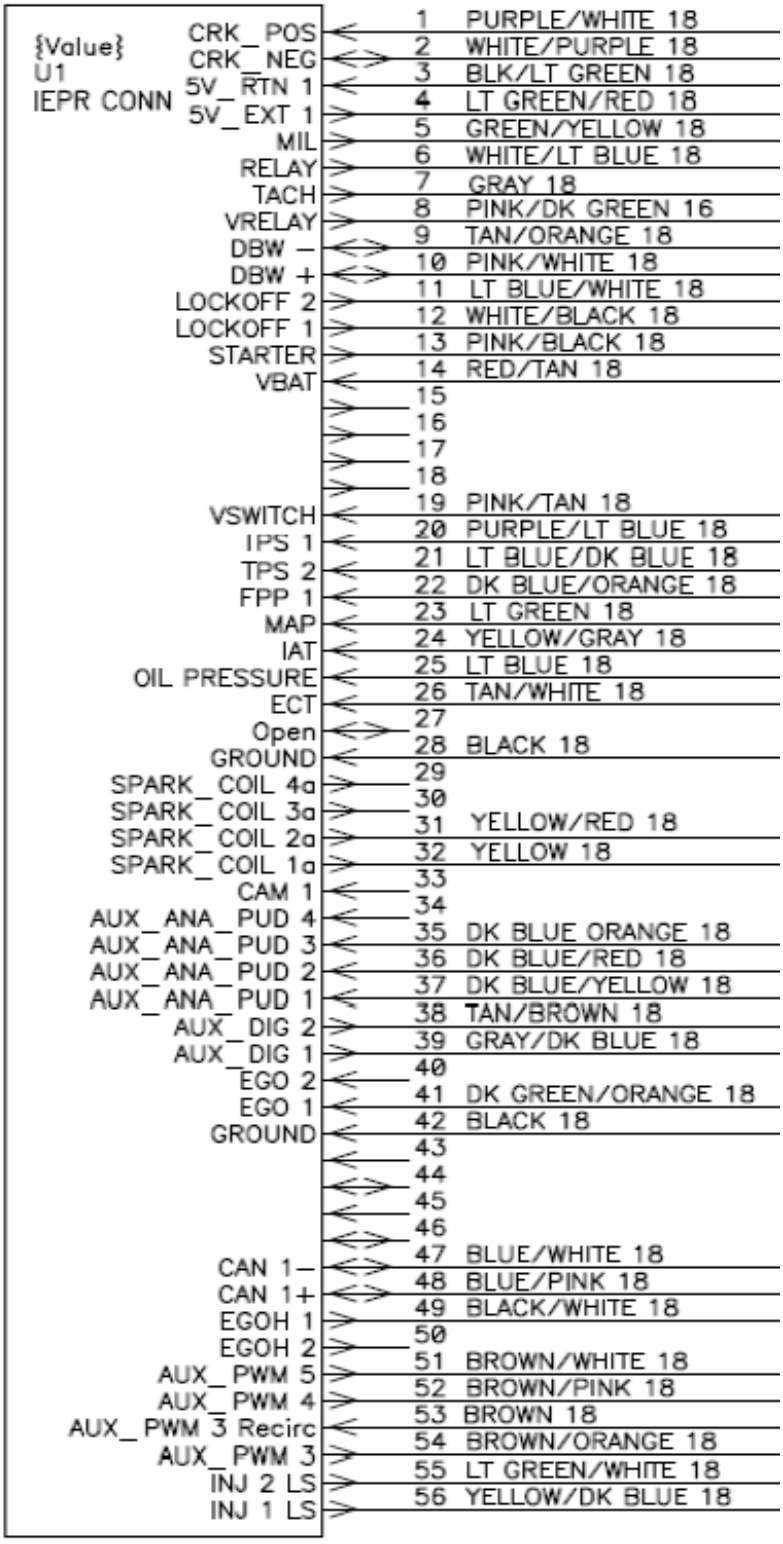
VSS: Vehicle Speed Sensor

Xylene: C_6H_4 $(CH_3)_2$. Any of three toxic, flammable, and oily isomeric aromatic hydrocarbons that are dimethyl homologues of benzene and usually obtained from petroleum or natural gas distillates.

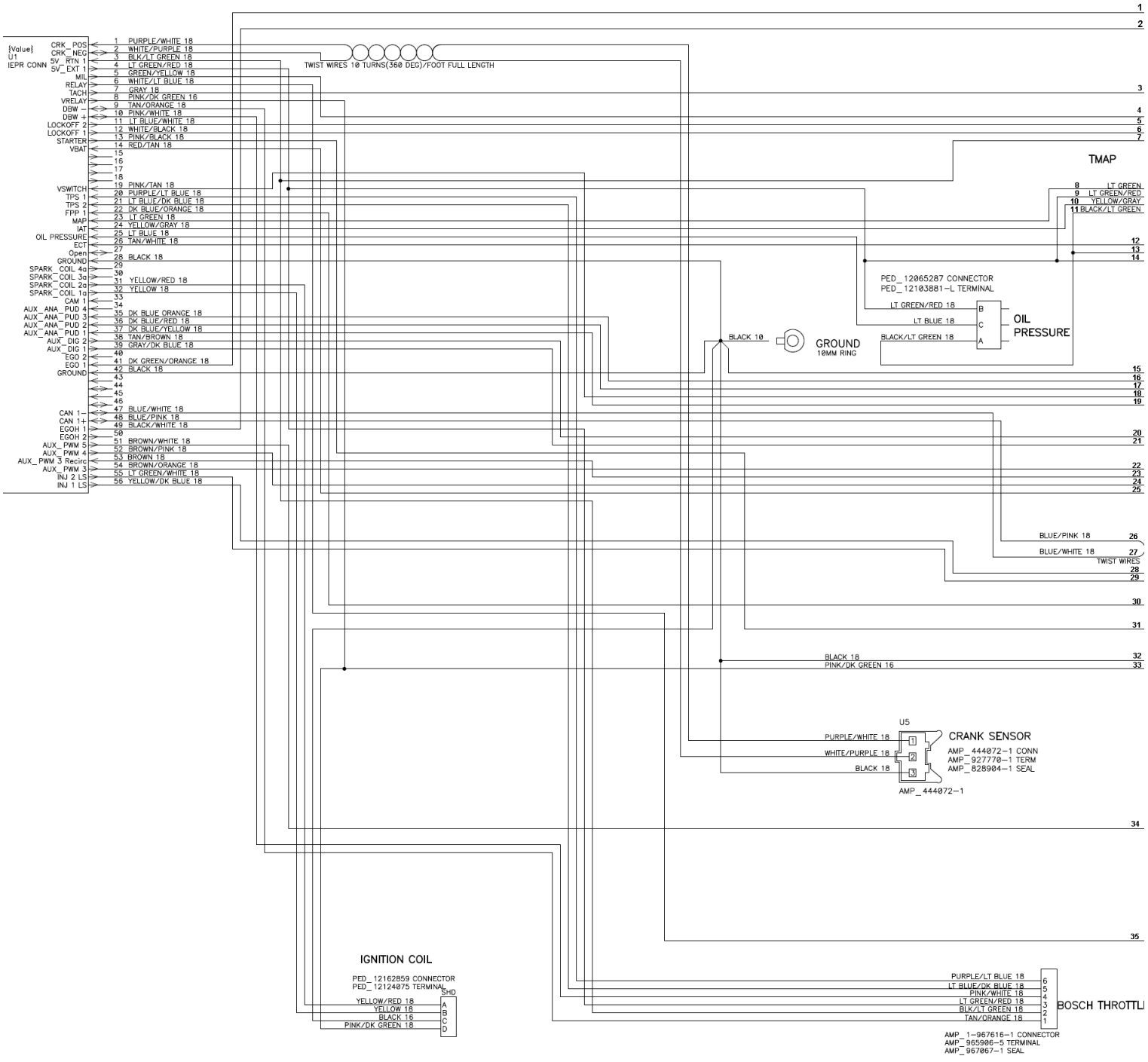
ZEV: Zero Emission Vehicle.

1.6L Wire Diagram

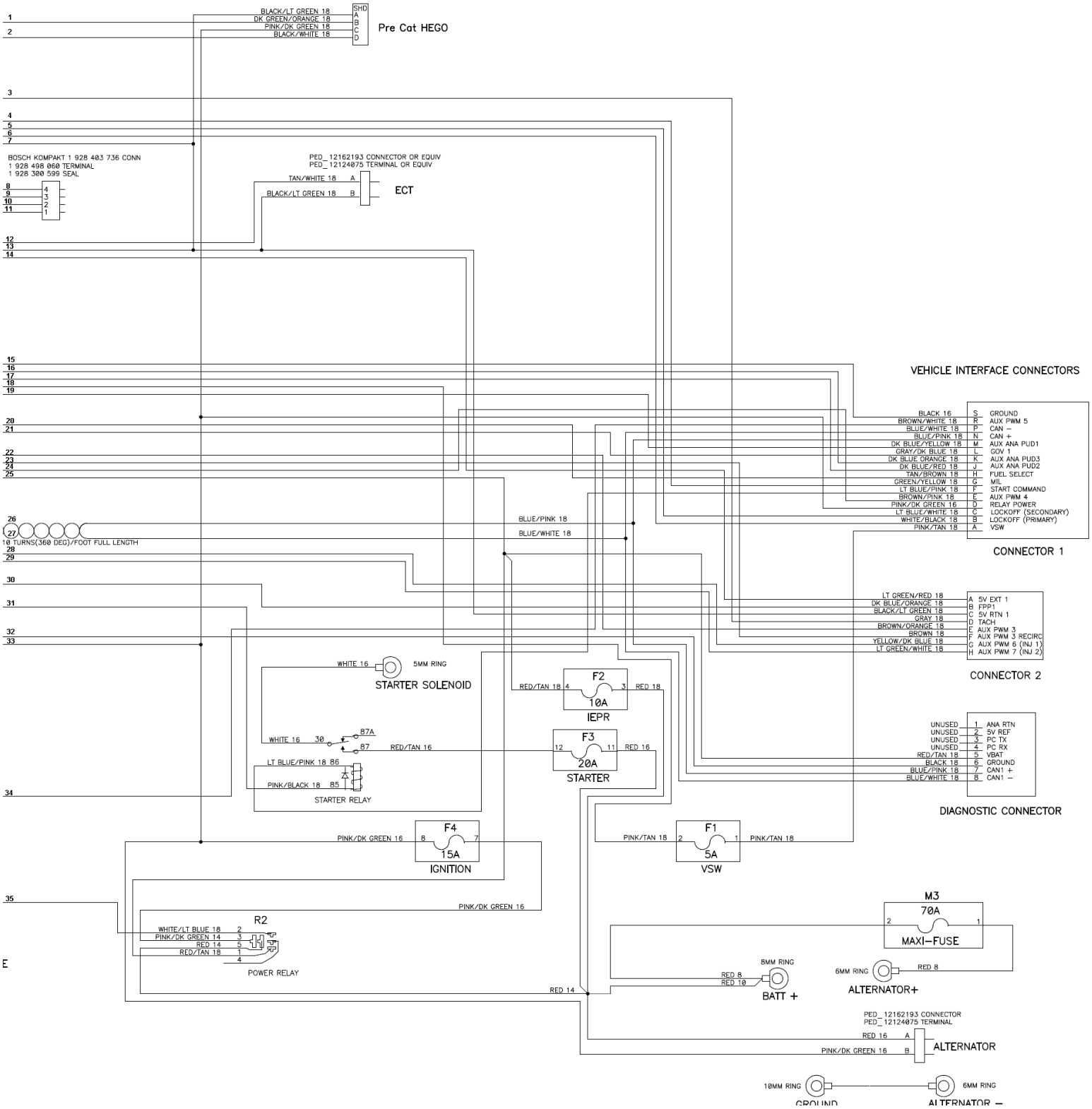
IEPR Header Connector



1.6L Engine Wire Harness (Part 1 of 2)

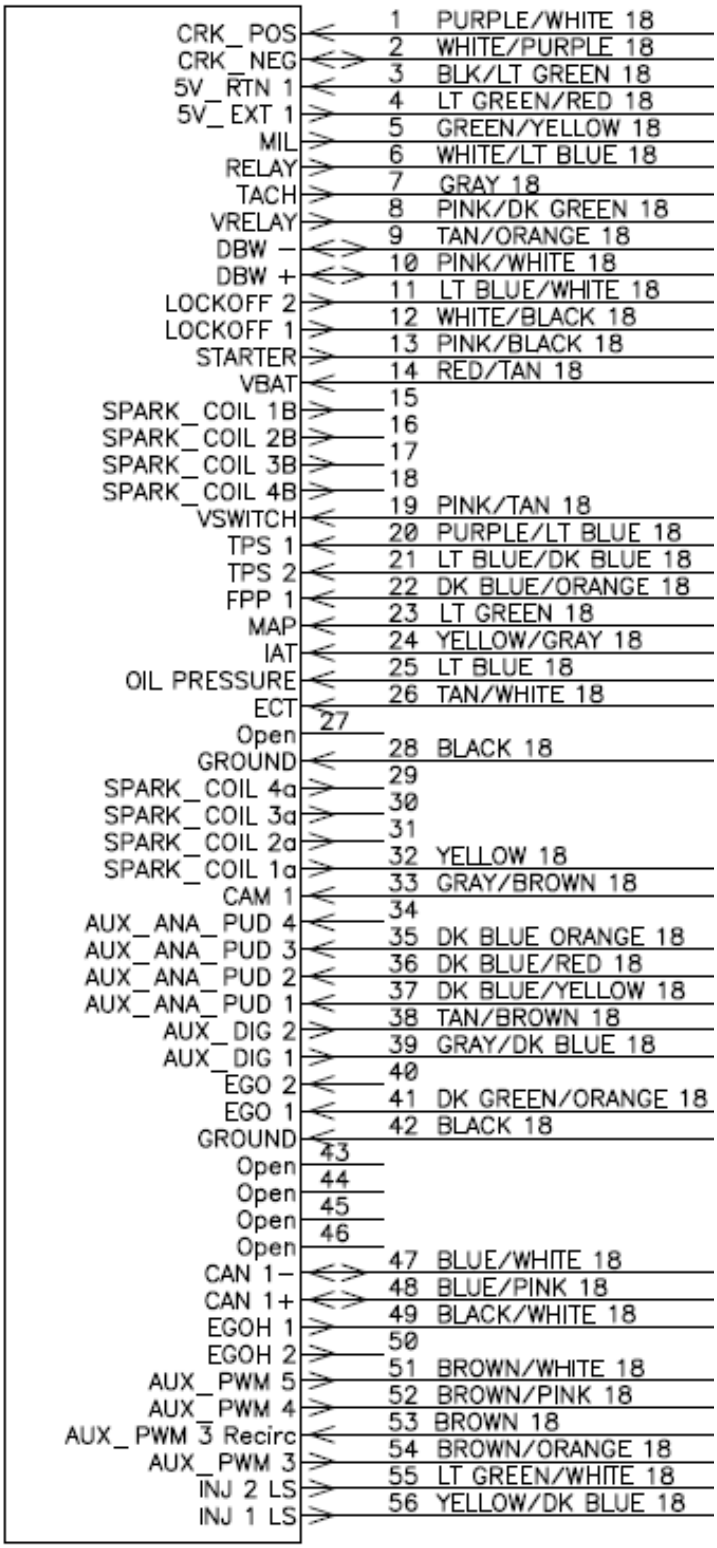


1.6L Engine Wire Harness (Part 2 of 2)

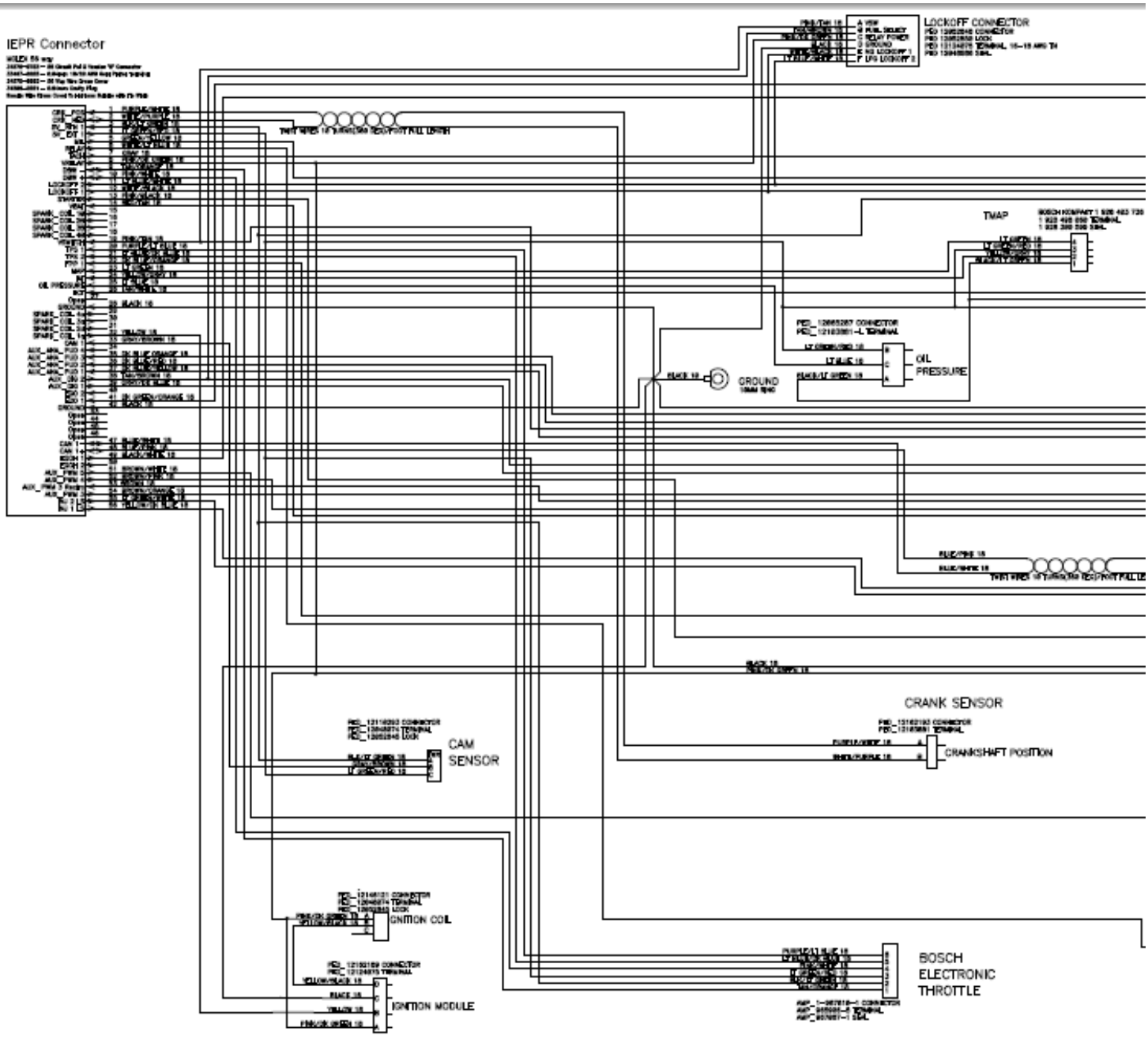


3.0L Wire Diagram

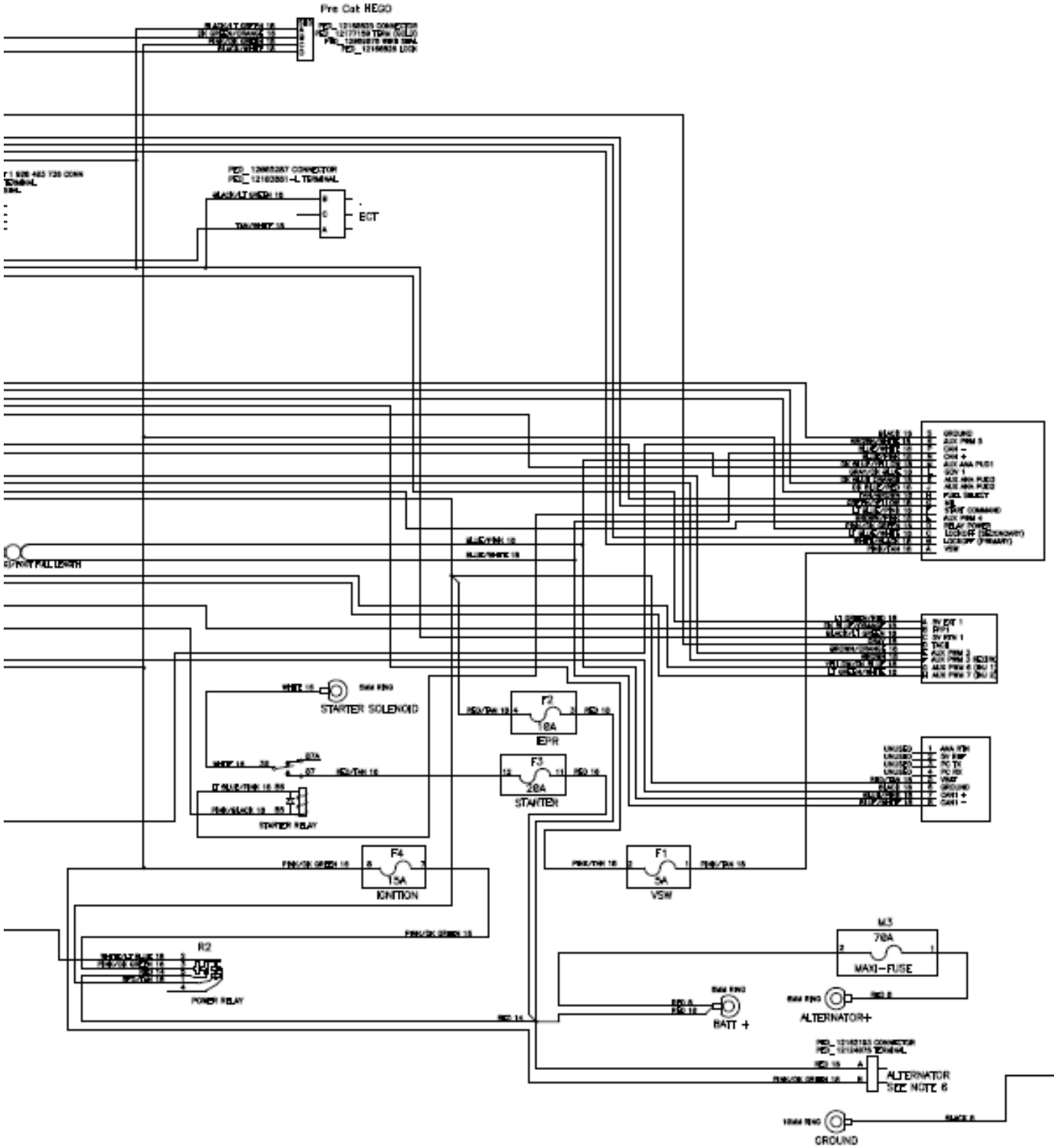
IEPR Header Connector



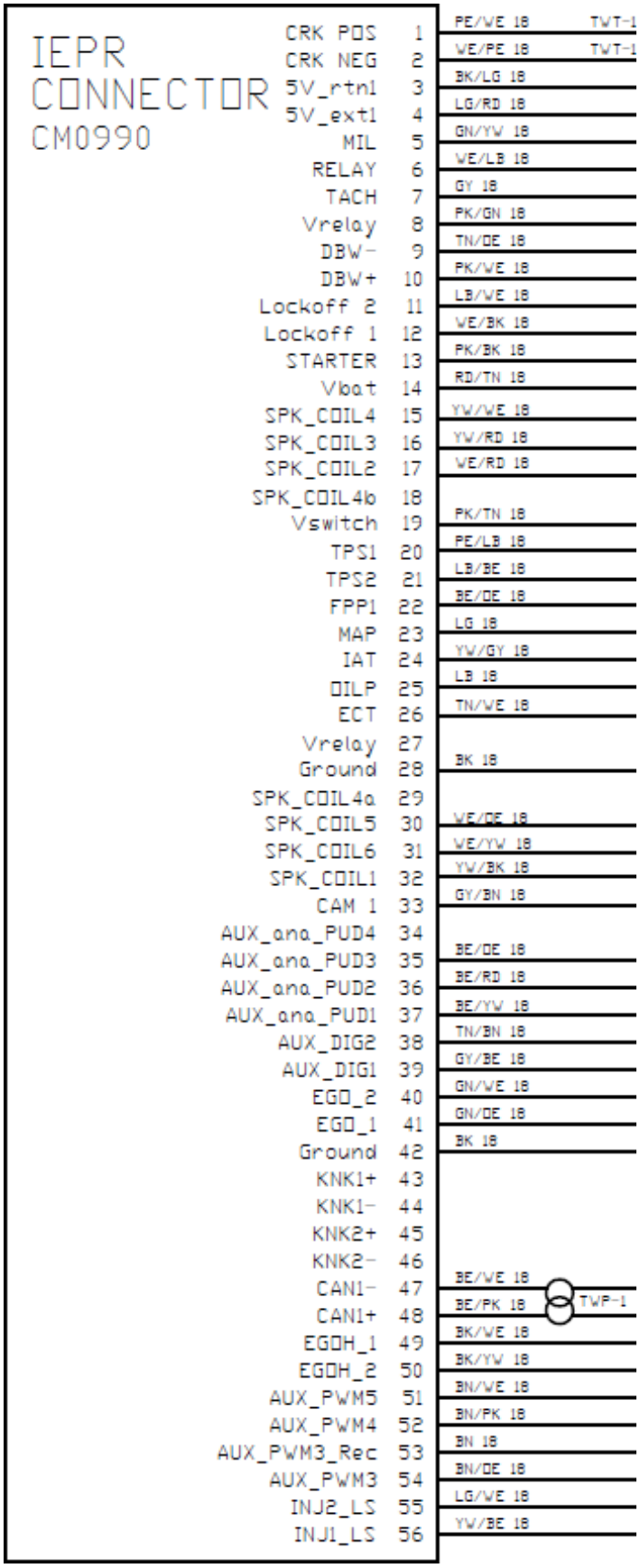
3.0L Engine Wire Harness (Part 1 of 2)



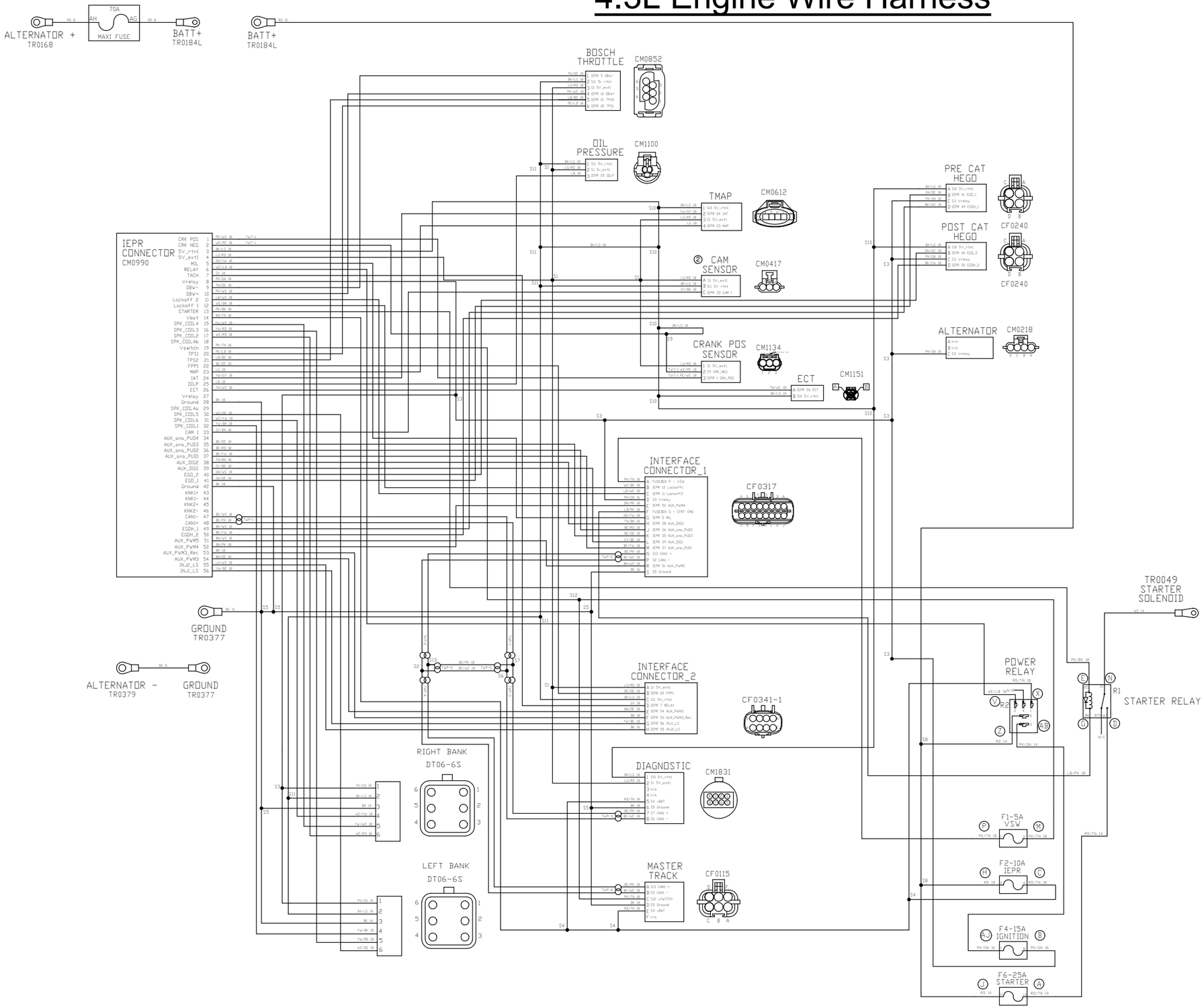
3.0L Engine Wire Harness (Part 2 of 2)



4.3L Wire Diagram

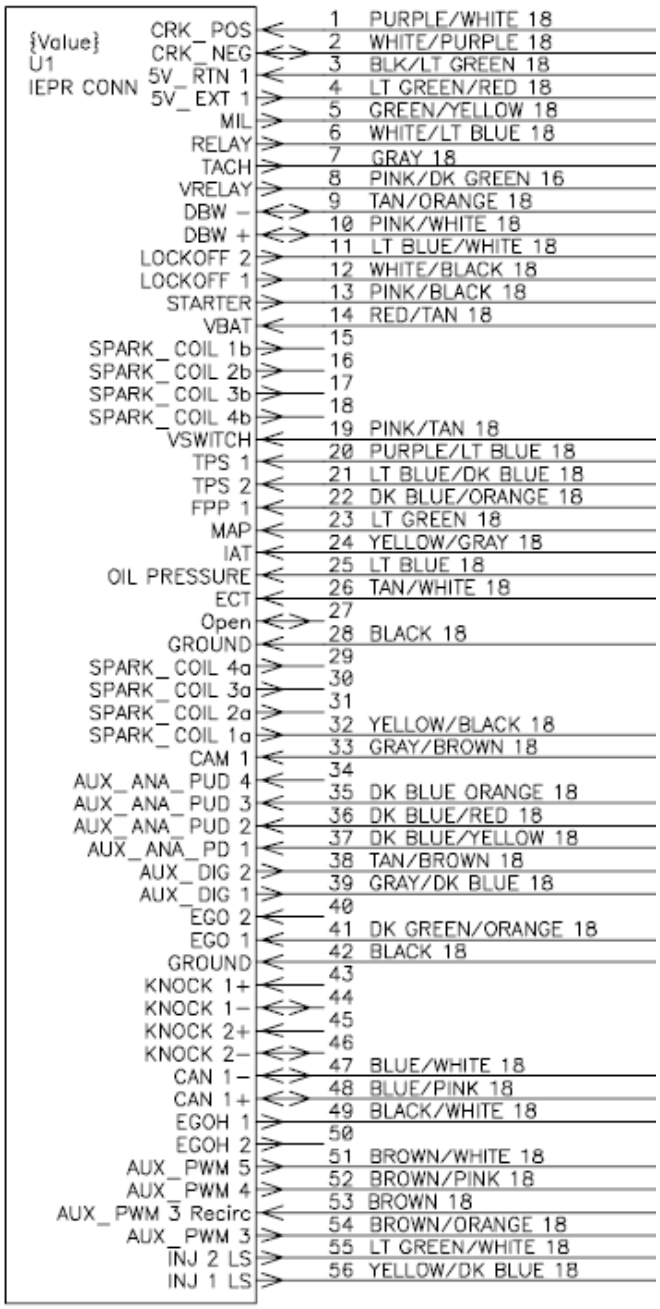


4.3L Engine Wire Harness

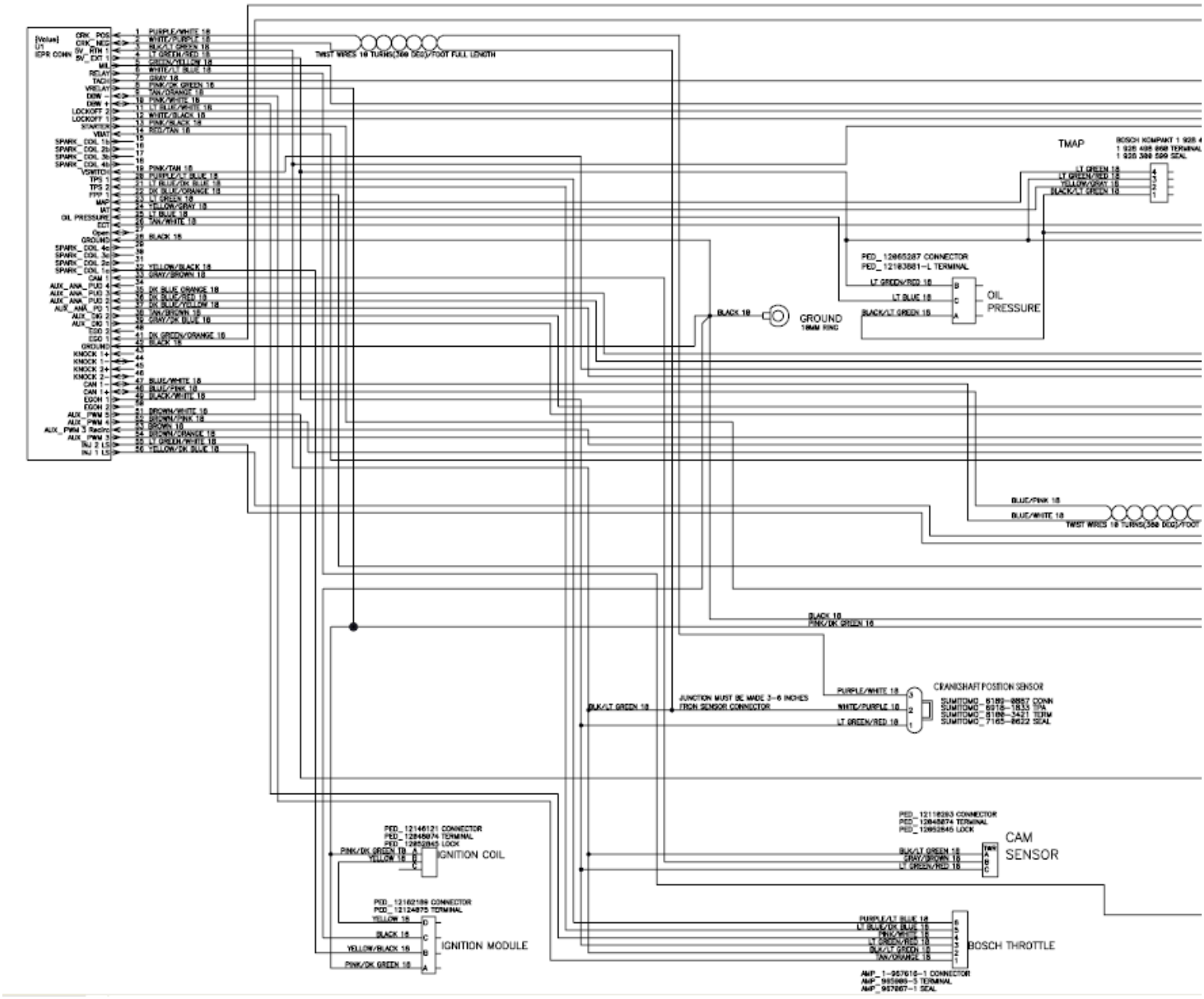


5.0L / 5.7L Wire Diagram

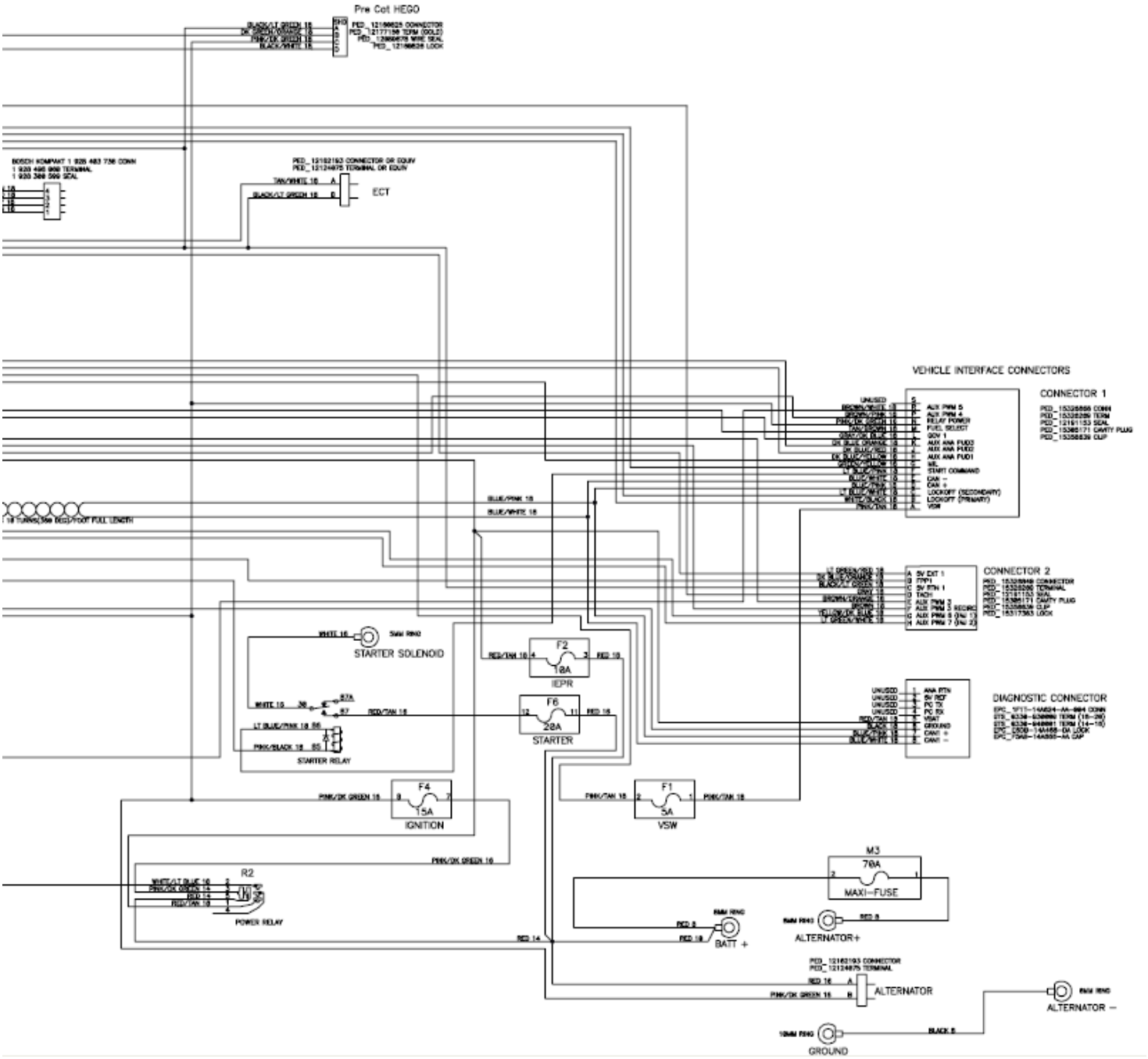
IEPR Connector



5.0L / 5.7L Engine Wire Harness (Part 1 of 2)

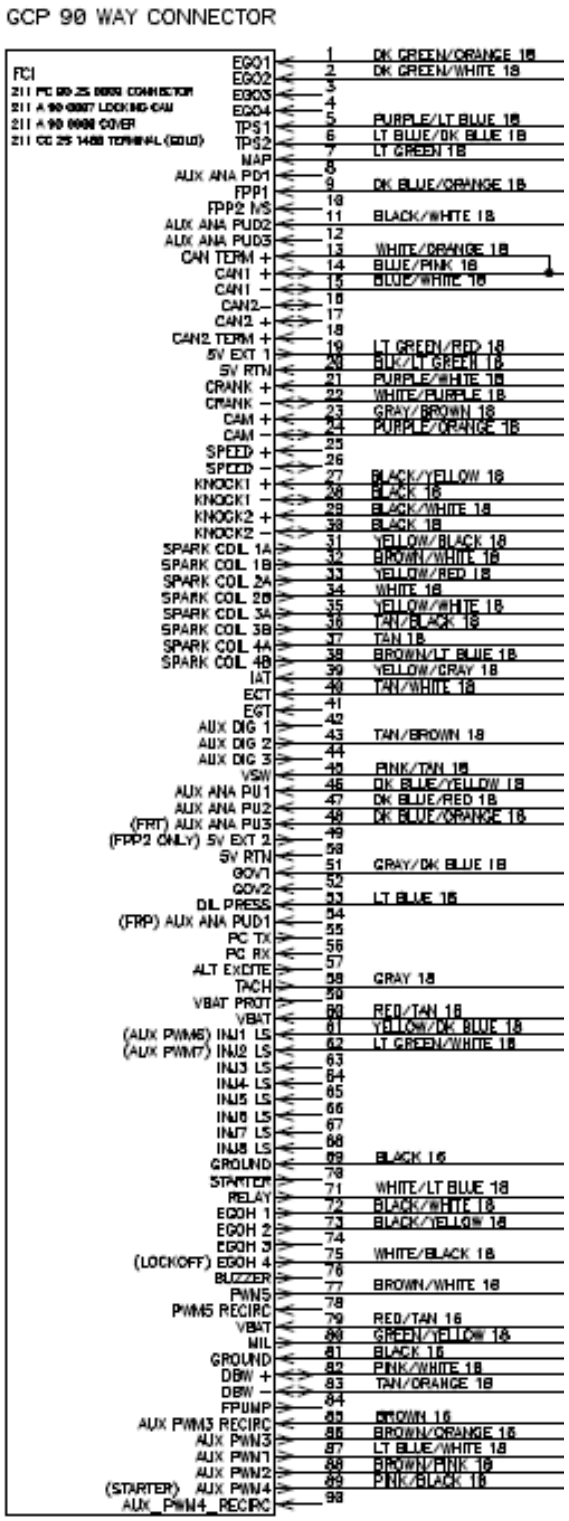


5.0L / 5.7L Engine Wire Harness (Part 2 of 2)

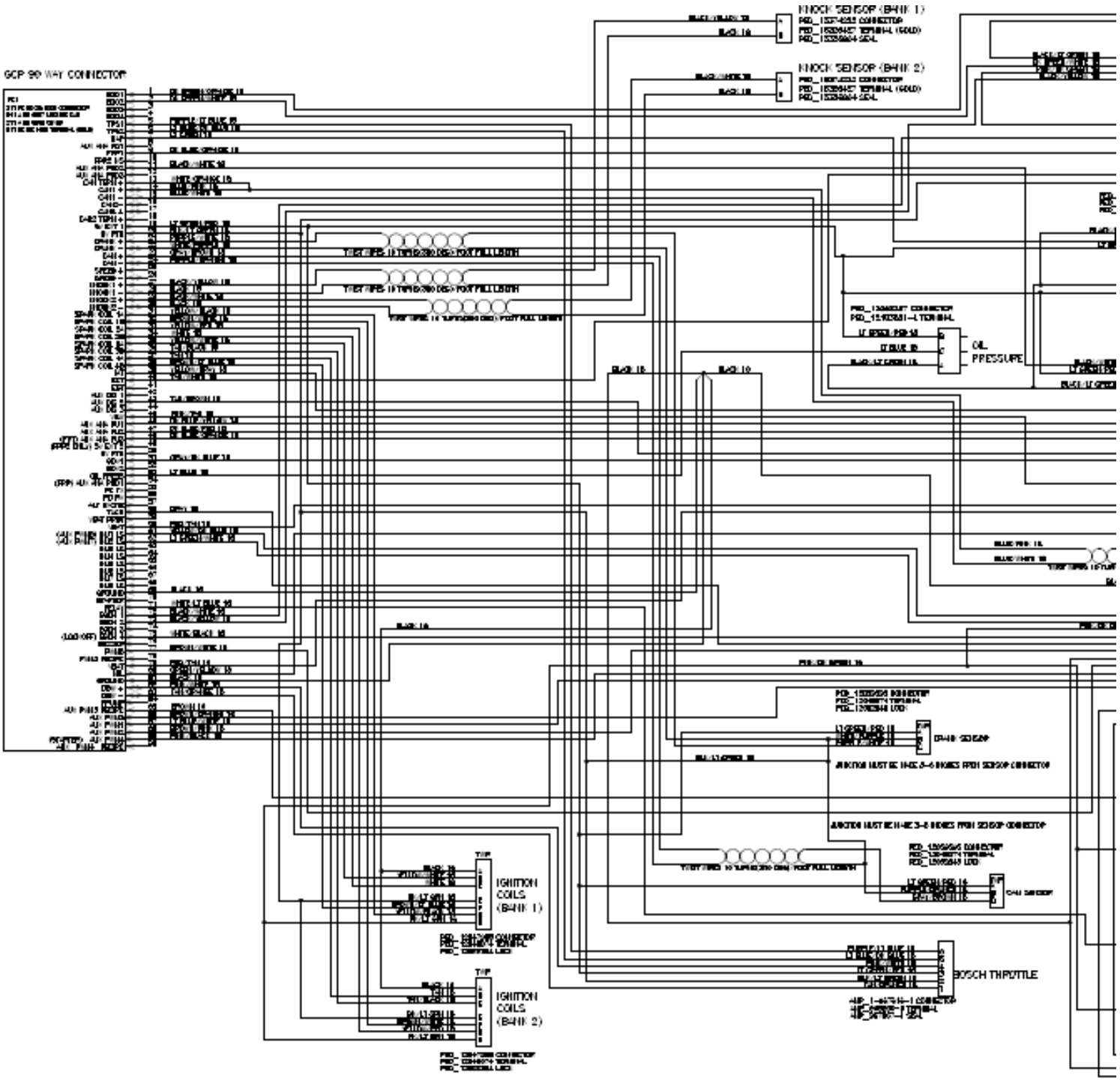


8.1L & 8.8L Naturally Aspirated Wire Diagram

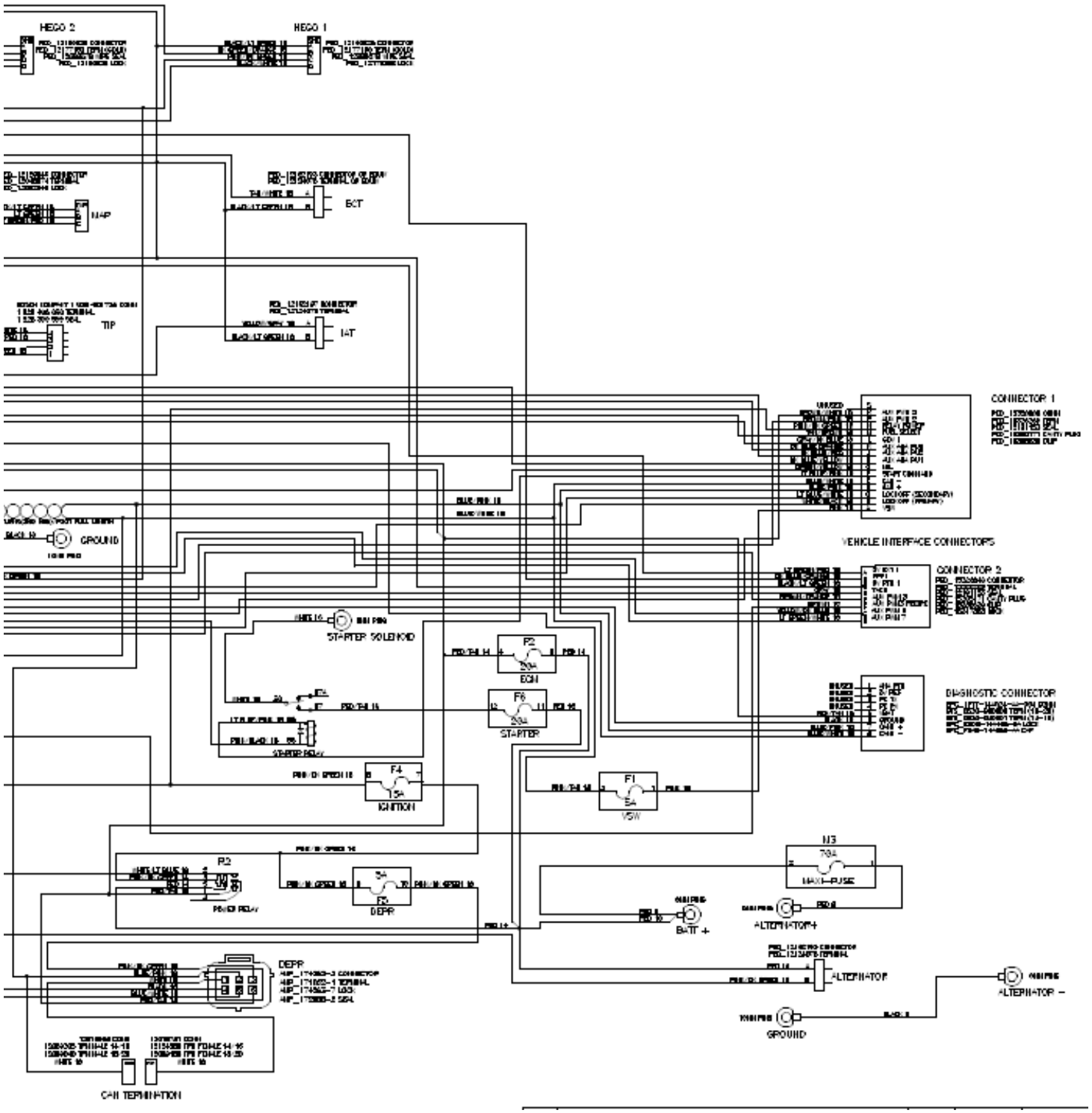
IEPR Connector



8.1L & 8.8L NA Engine Wire Harness (Part 1 of 2)

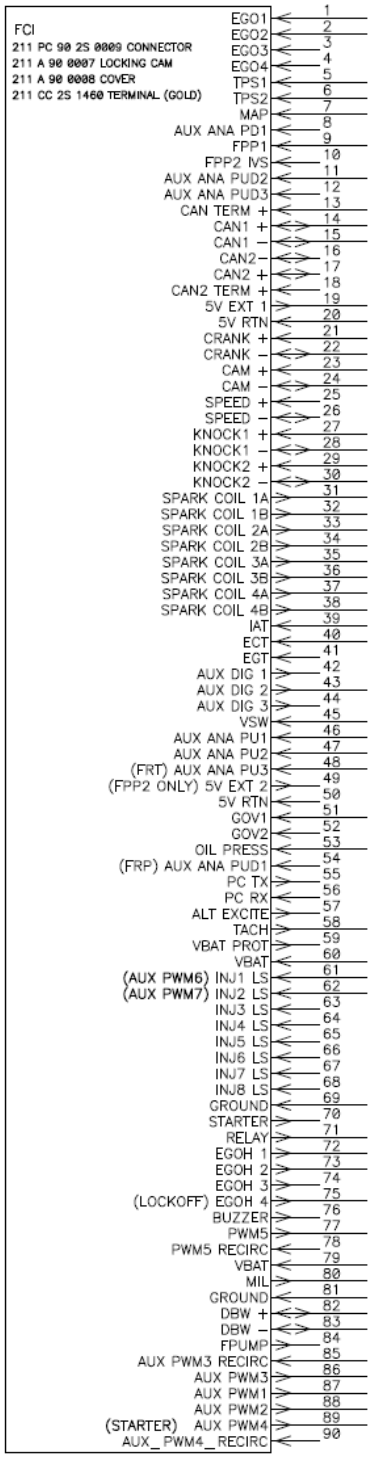


8.1L & 8.8L NA Engine Wire Harness (Part 2 of 2)

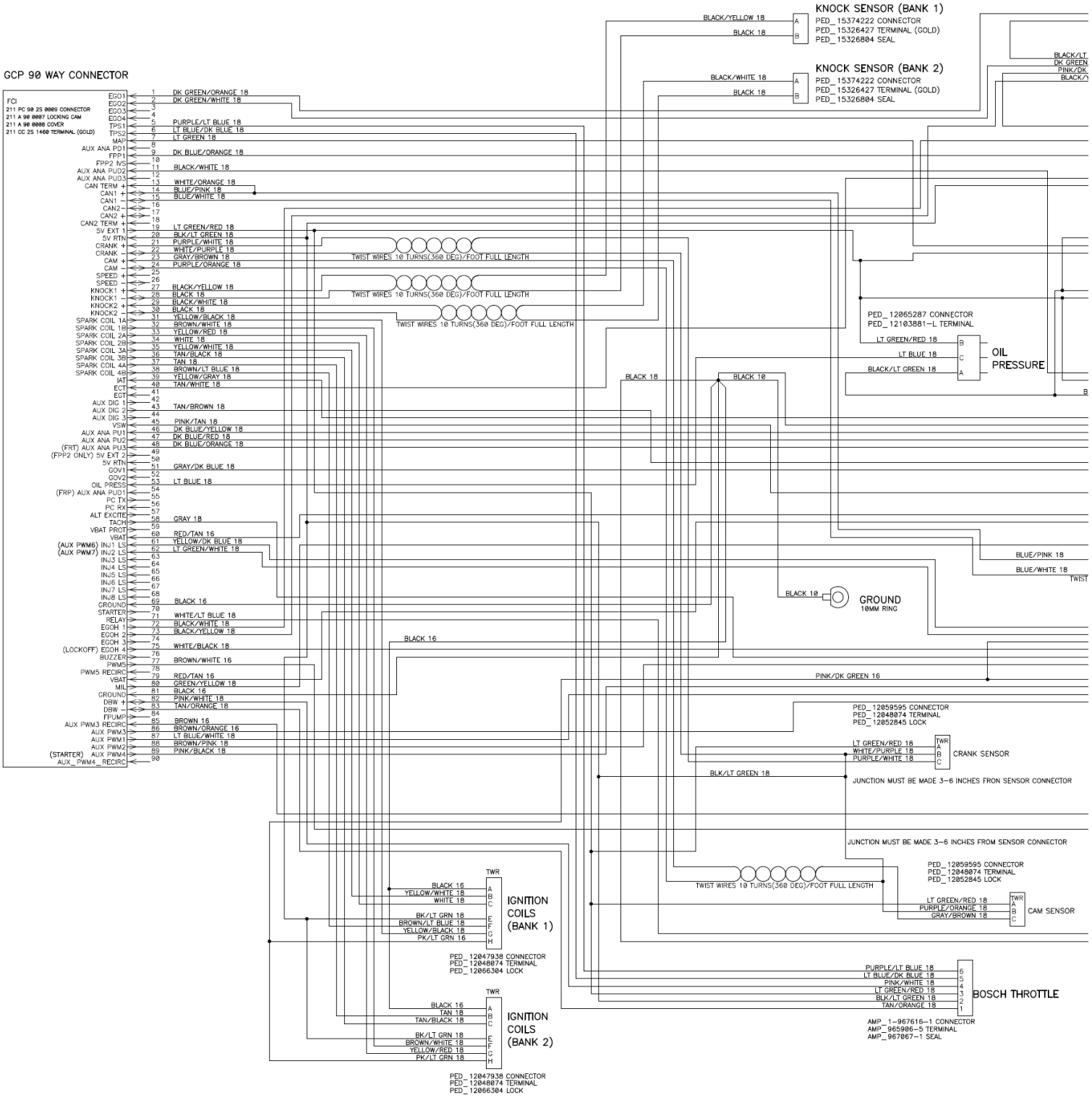


8.1L & 8.8L Turbo Wire Diagram

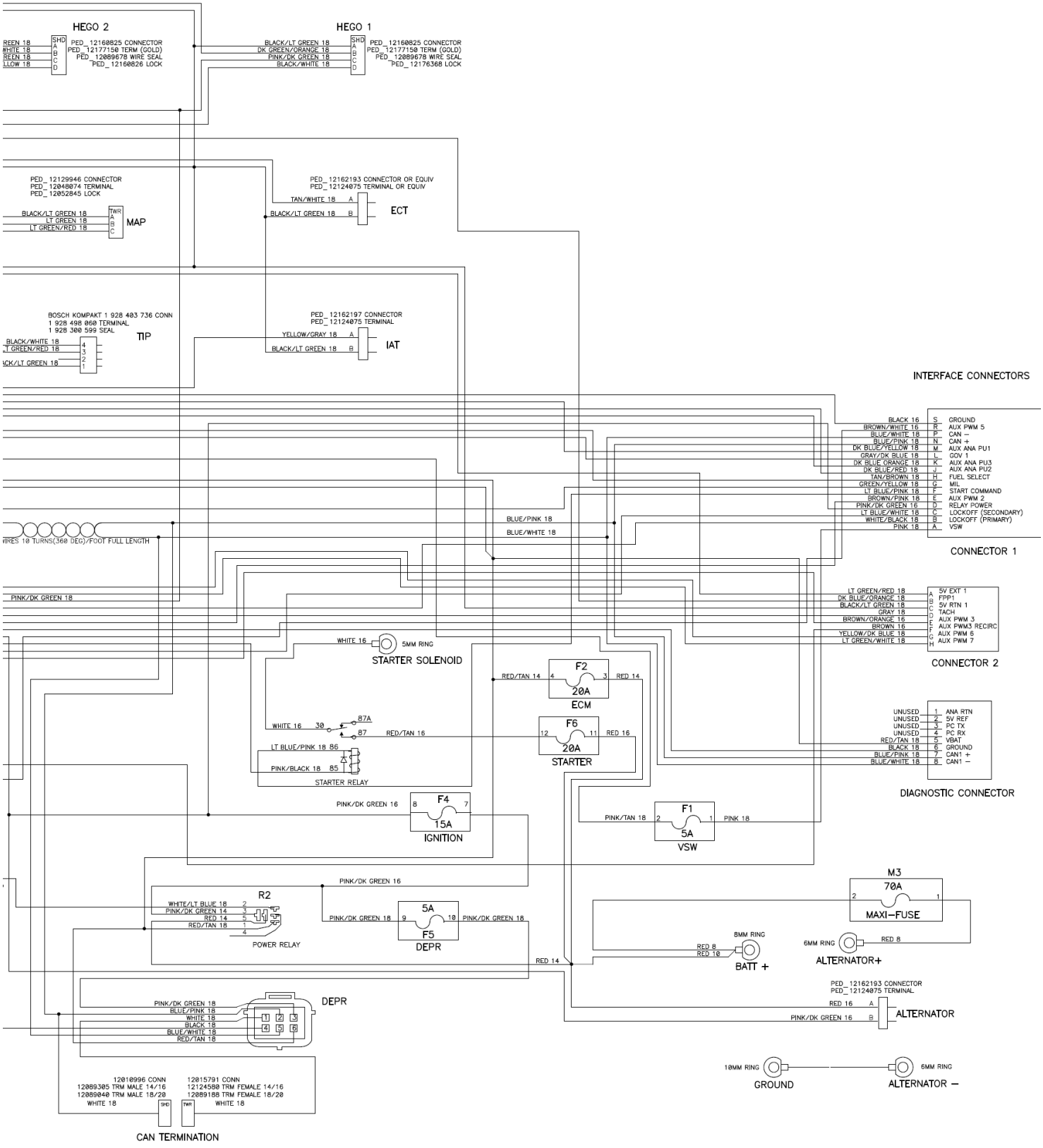
90 Pin GCP Header Connector



8.1L & 8.8L Turbo Engine Wire Harness (Part 1 of 2)



8.1L & 8.8L Turbo Engine Wire Harness (Part 2 of 2)



Connecting/Using the DST and Trouble Shooting

- Installation of the DST package to a personal computer (PC).
- Software login and password functionality.
- DST service pages.
- Updating the ECM calibration using a MOT file.
- DTC pages.

Examples and snapshots used in this manual are based off of the initial DST tool release as of July, 2007. This tool is frequently updated and the illustrations may vary depending on the changes included in any updated DST display Interface. For example, the Electronic Pressure Regulator (EPR) may be referred to as the "megajector." Terms, names and descriptions of parts and servicing procedures will be updated based on trade, brand, or common description to more accurately describe the part or service procedure.

DST INSTALLATION INSTRUCTIONS

Before installing the DST software, please be sure your computer meets the minimum system requirements.

Supported operating systems are:

- Windows Vista
- Windows XP
- Windows 2000

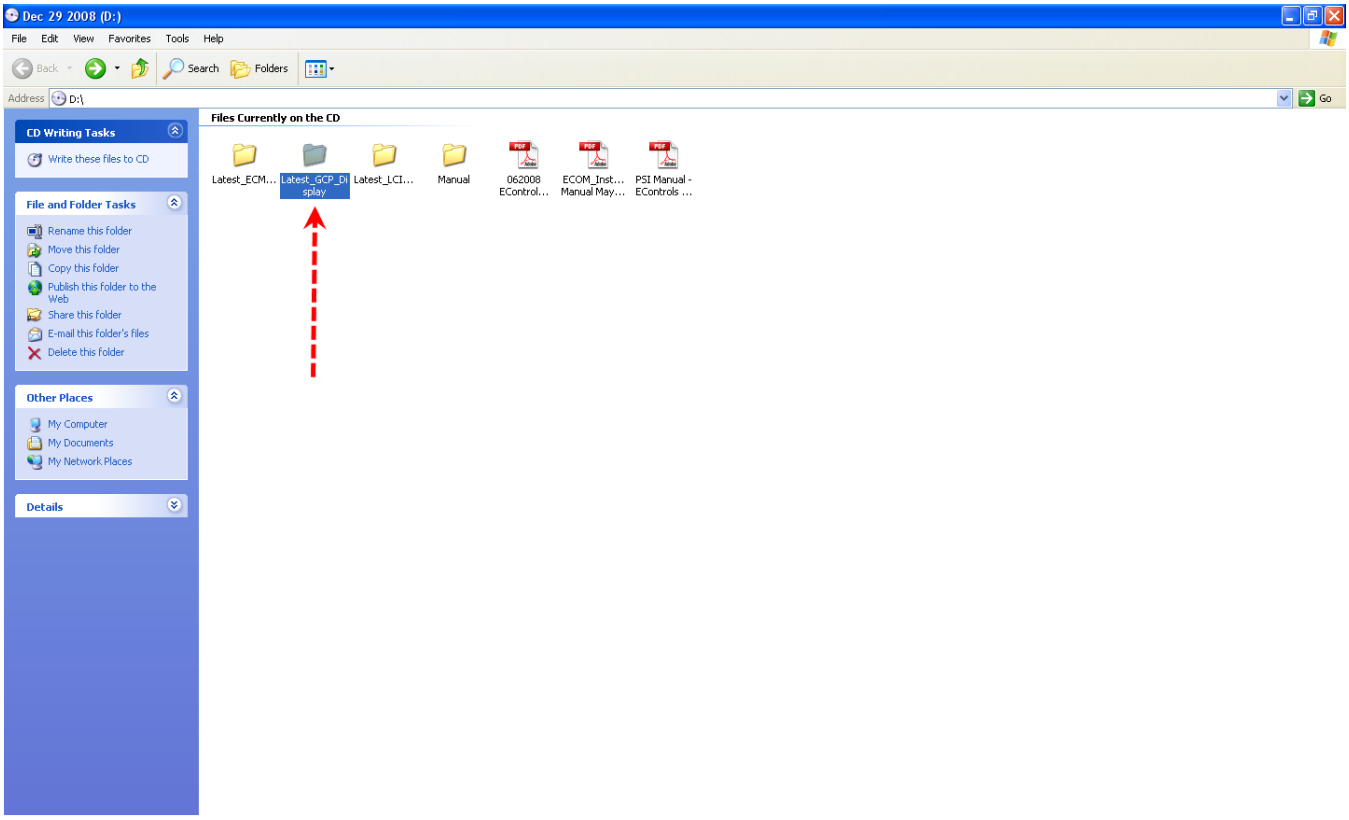
Minimum processor speed:

- Pentium II 450 MHz
- Pentium III 1.0 GHz for Windows Vista

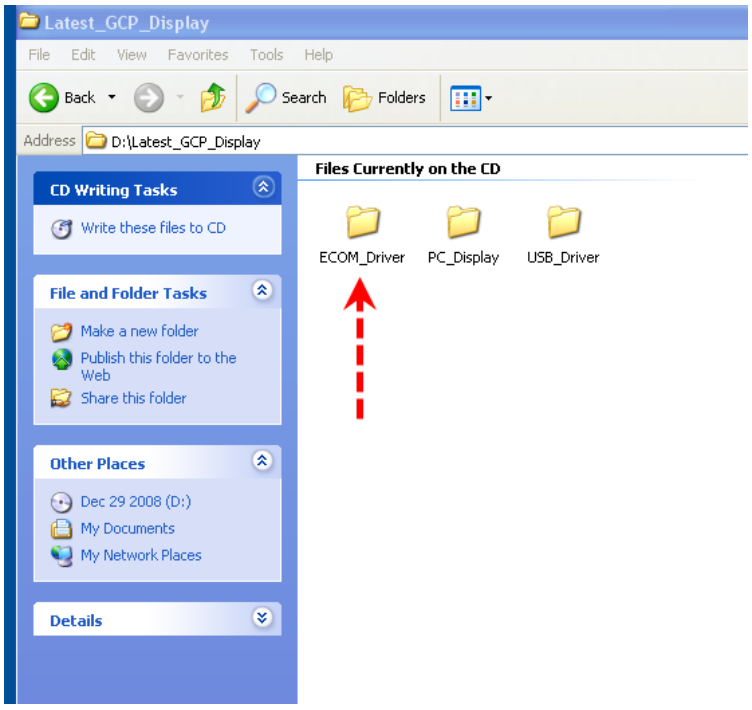
Minimum RAM requirement:

- Windows Vista 512 MB
- Windows XP 256 MB
- Windows 2000 128 MB

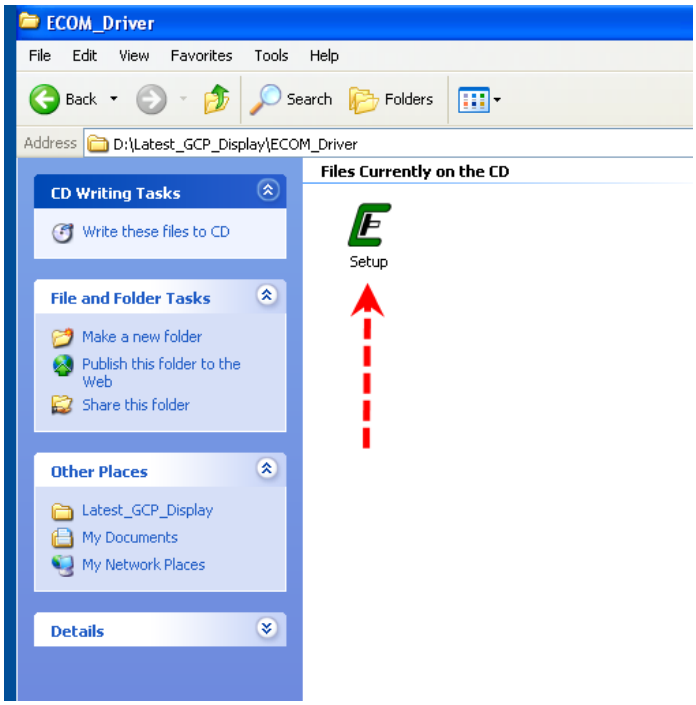
* At least one available RS232 serial or USB port.
* ECOM cable supports USB port only.



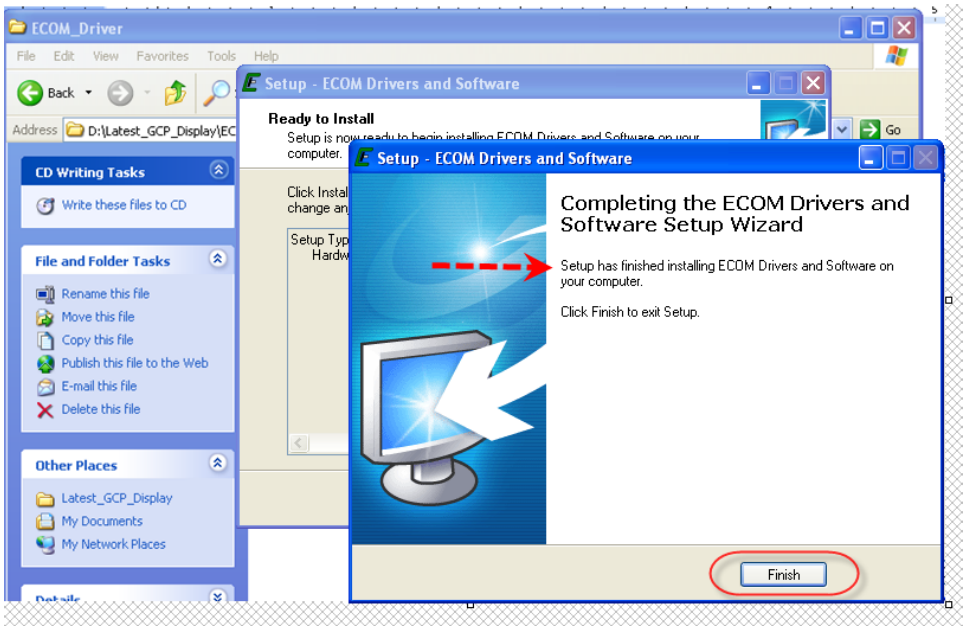
- Insert the CD into your computer and select **LATEST_GCP_DISPLAY**



- Open the **ECOM_Driver** Folder

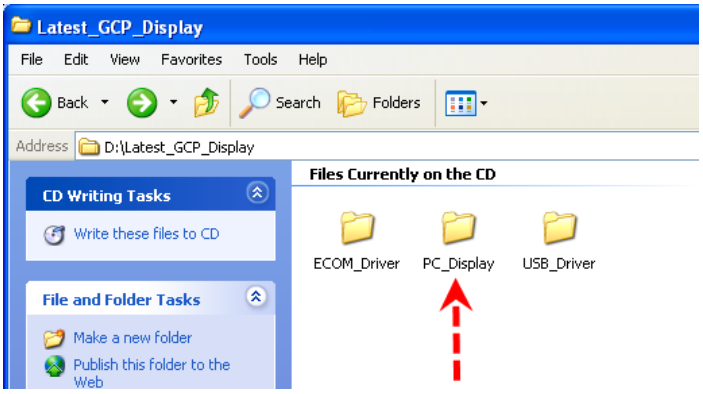


- Double Click the setup.exe file - - - > This will launch the installation wizard
- Select “NEXT” until you finish the installation as shown below

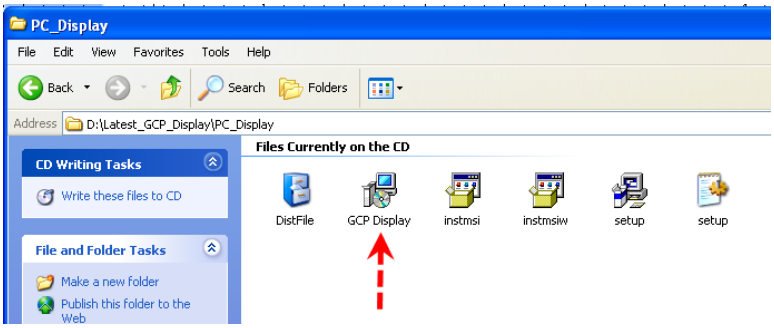


- Return to the **LATEST_GCP_DISPLAY** folder

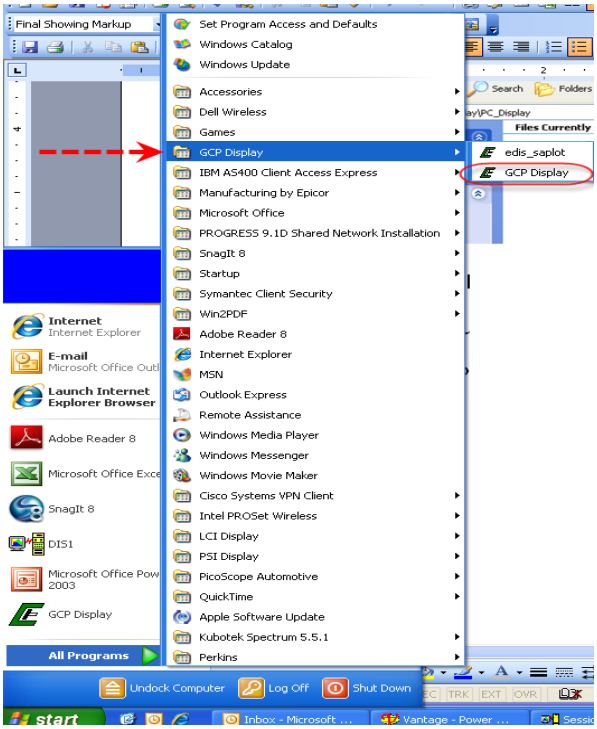
- Select the PC Display folder



- Select the GCP Display icon



- Select the GCP Display icon - - - > This will launch the installation wizard
- Select NEXT until it says you are finish
- Restart your PC
- Go to the START button on the lower left corner and find the GCP Display Program



PASSWORD LOGIN

Figure 1 shows the password dialog box, which is displayed when a software session begins. Login can be accomplished in two ways.

1. Enter an “All S/N Password” which is a password applicable to all ECMs of a given original equipment manufacture (OEM).

2. Enter a “Single S/N Password” and corresponding ECM serial number for a single ECM. A Single Serial Number password is unique to a specific ECM serial number and permits authorized service personnel to make changes or view information for a specific ECM.

3. In most instances the top “all” serial number boxes should be used for password entry. In this case, do not check the single serial number box. Each password is a 16-character alpha-numeric string specific to each Spectrum customer and determines which pages and variables are visible through the software. Passwords are assigned by the OEM support group and may change periodically. Check the “save password” box to automatically retain the password for future use.

Note: The password is printed on the CD disk. If it does not have a password or you have questions please contact the OEM.

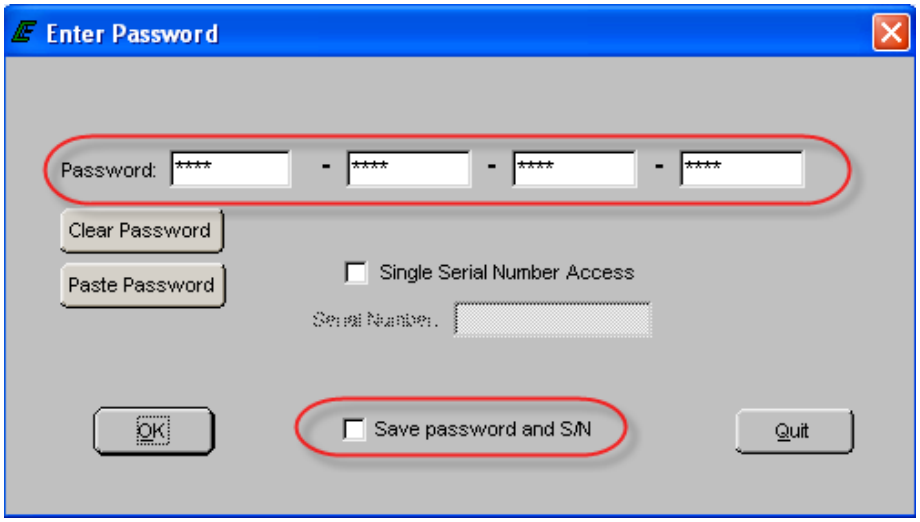


Figure 1: Populated Password Dialog Box

PASSWORD DIALOG BOX FUNCTIONS

- **Clear Password Button** Erases the current password from the password field.
- **Paste Password Button Allows** the user to copy a 16-character string from any word processor and paste the string in the password field.
- **Single Serial Number Access Checkbox** Tells the software that the password is applicable for single serial number access.
- **Serial Number Field** Only applicable when Single Serial Number Access Checkbox is checked. The entry field must be populated for the 6-digit serial number for which the Single Serial Number Access password applies (NOTE: Leading zeros included in the serial number are not required).
- **Save Password and S/N Checkbox** Retains the password, and serial number (if applicable) for the next software session.

Should an invalid password be entered, the error prompt shown in figure (2) will be displayed and the software will not load. This prompt signifies the following:

- The All S/N password is invalid.
- The Single S/N password is incorrect for the Single Serial Number entered.
- An All S/N password is entered for Single Serial Number use.
- The Single Serial Number password is valid; however, the Single Serial Number Access Checkbox is not checked.

Figure 2: Password Error Prompt

If the Single S/N password entered is correct for the software but does not match the entered S/N of the targeted ECM, the prompt in *Figure 3* will be displayed.

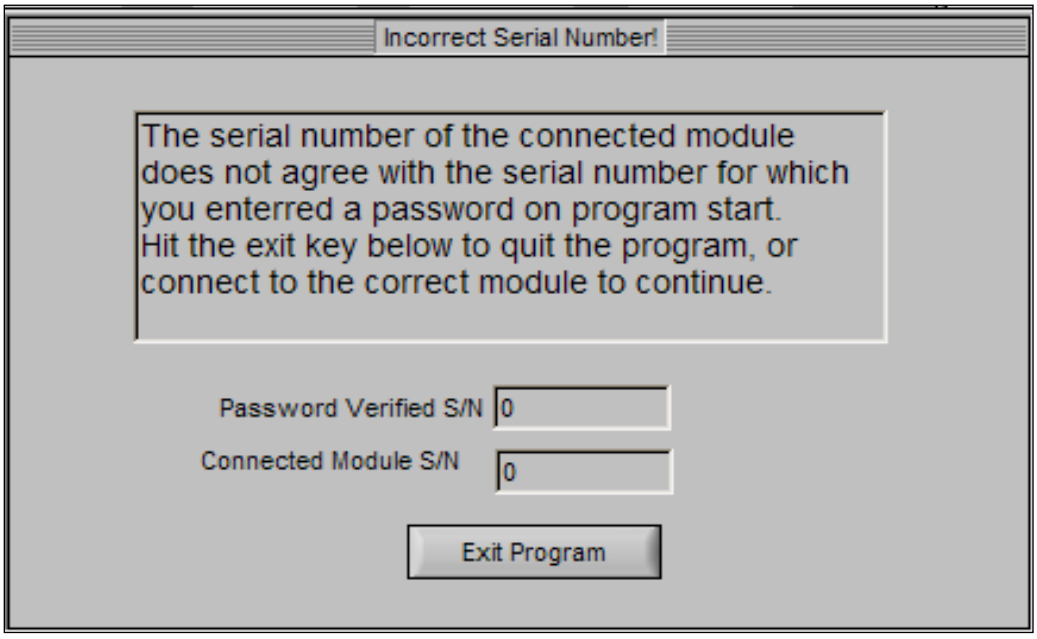


Figure 3: Incorrect Serial Number Message

Figure 4 shows the communication status if a valid software password is entered when attempting to connect to an ECM with a different key. In this instance the software will load but will not connect to the target (ECM).

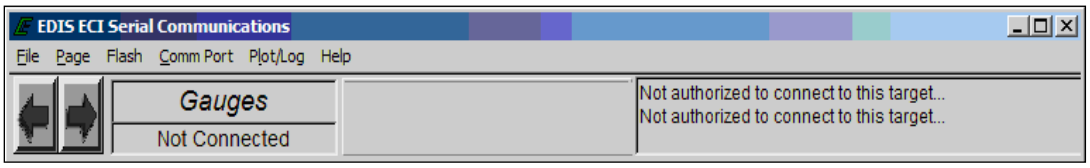
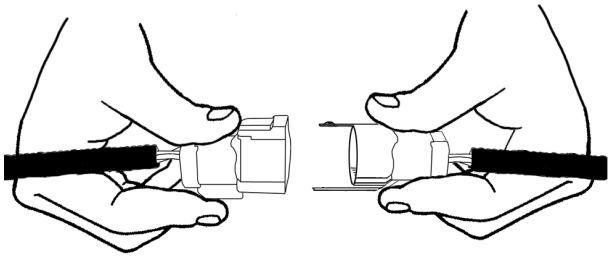


Figure 4: Not Authorized to Connect Message

In the event you receive this error message call your OEM support group for more information.

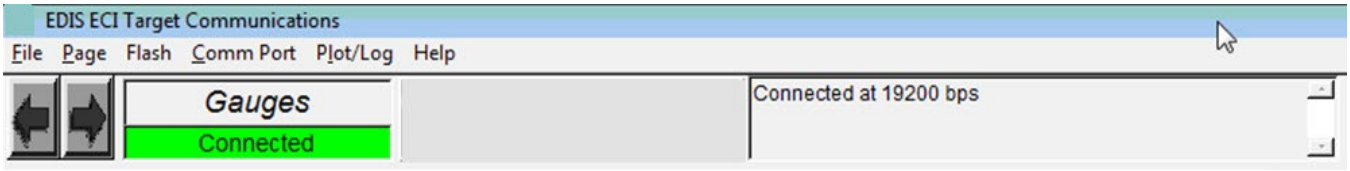
CONNECTING THE PC TO THE ENGINE WIRE HARNESS



Connecting the DST cable

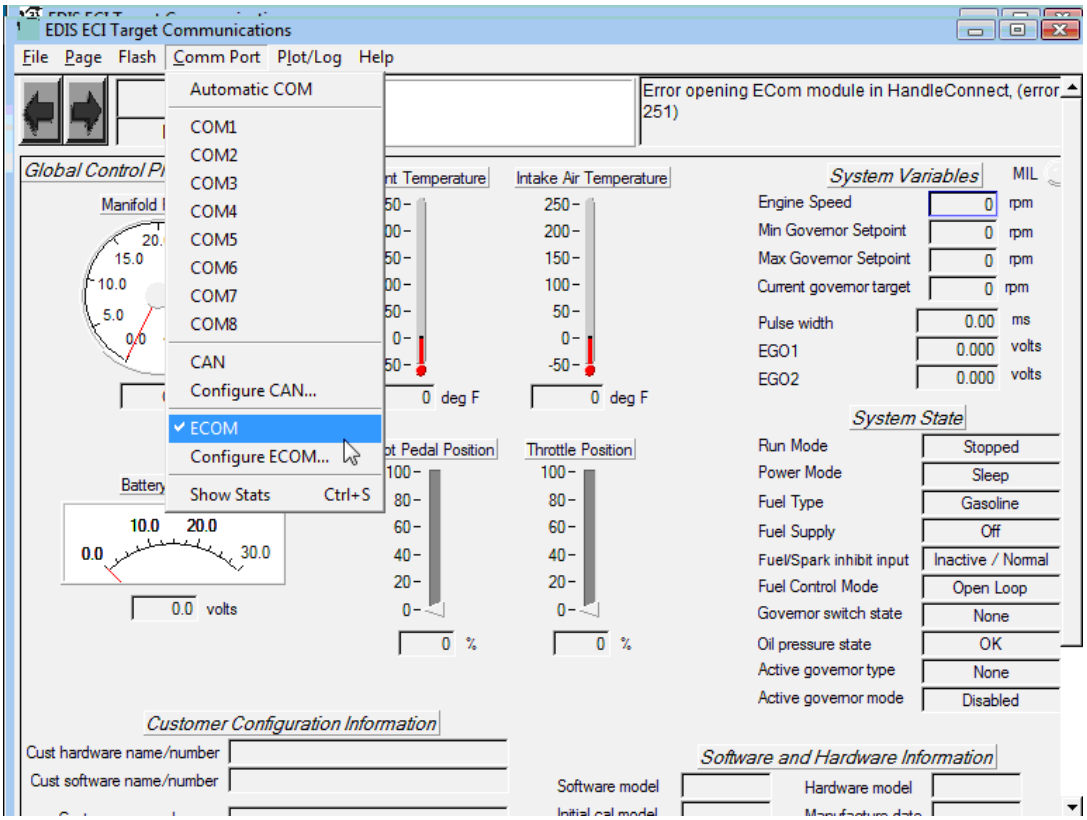
A laptop computer, with the diagnostic cable and software is the required tool for performing proper diagnostic testing of the fuel system. It is also used to monitor sensor and actuator values and to read and clear Diagnostic Trouble codes. The DST software also performs several special tests.

- Connect the system diagnostic cable to the USB port on the back of the computer.
- Connect the diagnostic cable to the DLC (diagnostic link connector) labeled in the electrical schematic. The DLC is located on the engine harness. The new 8 pin DLC requires the use of the 4 to 8 pin adapter.
- Turn the computer ON.
- Start Windows.
- From the start menu select Programs → PSI GCP Display → PSI GCP Display
- Place the ignition key in the ON position.

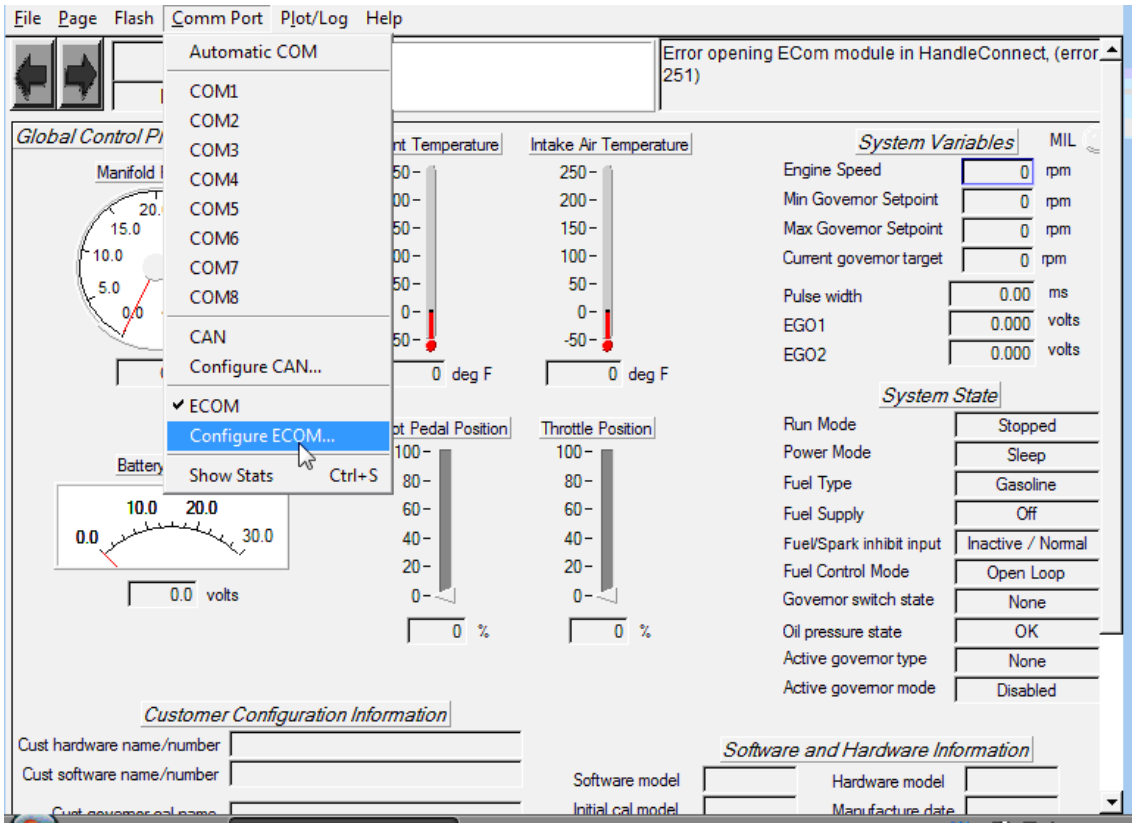


Within several seconds the system Gauge screen should now appear and a green banner in the upper left hand will read “Connected.”

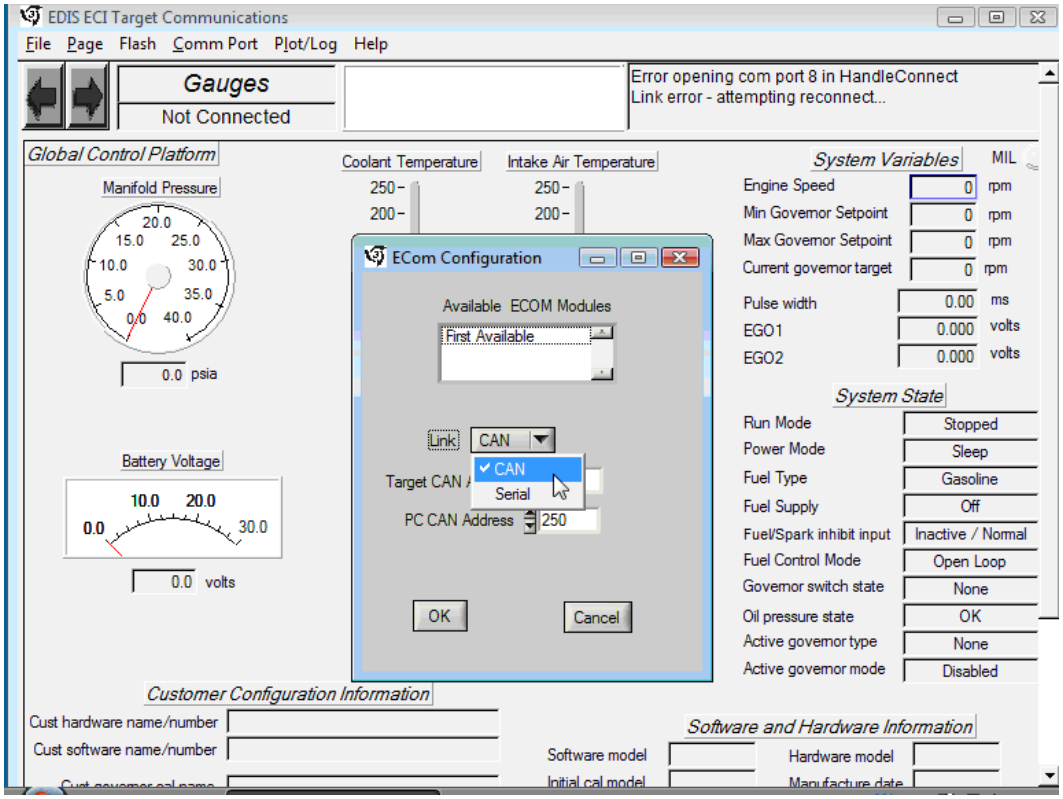
- **Connecting to the PC using the ECOM cable**



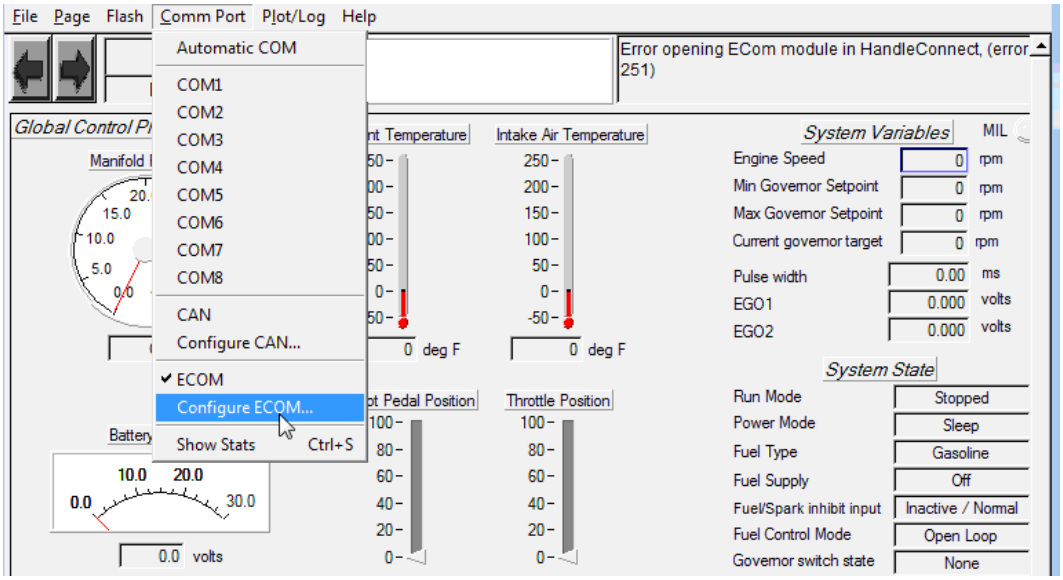
- To connect using the ECOM cable you must select ECOM from the COM Port drop down menu.



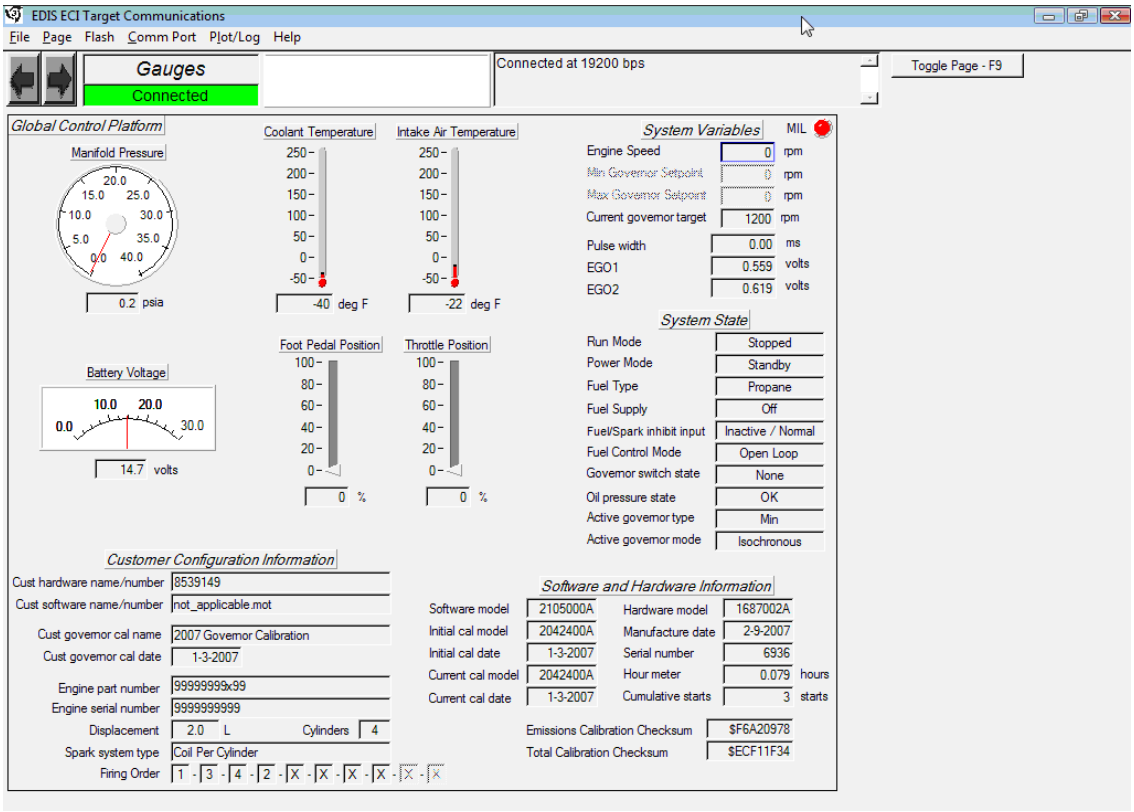
- You will now need to configure the ECOM communication protocol.



- Select the CAN for systems with CAN enabled or serial for all others. Then select OK. You are now ready to connect using the ECOM USB DLC cable.

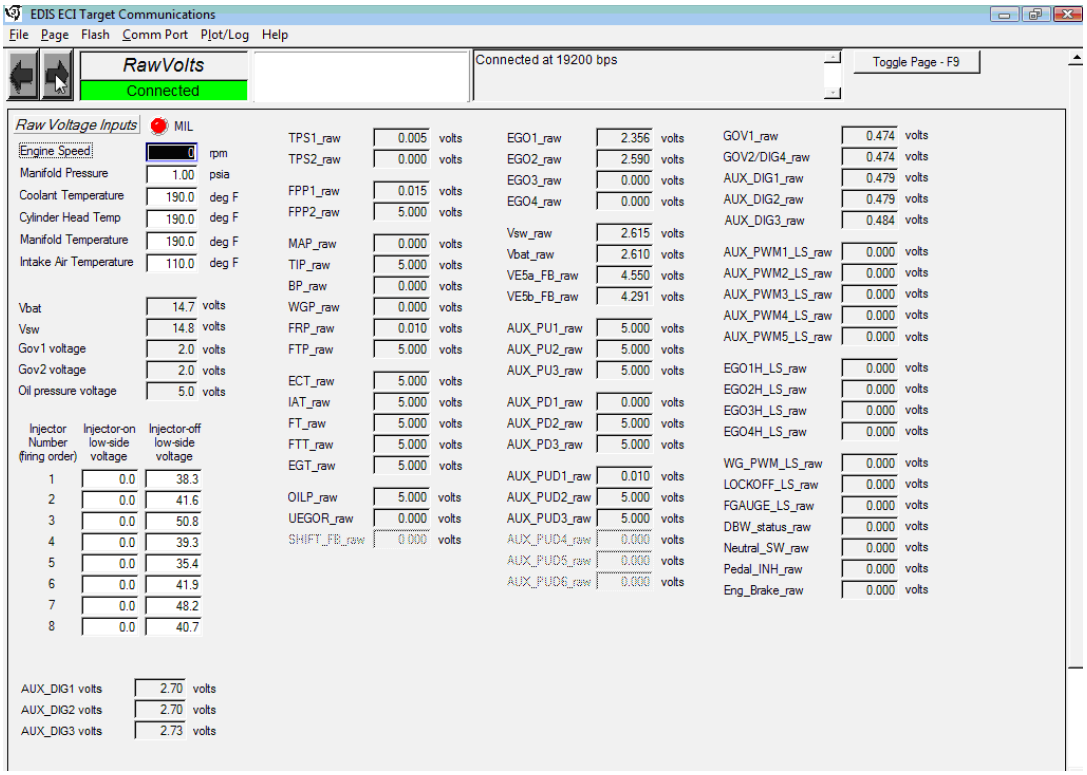


DST SERVICE PAGES



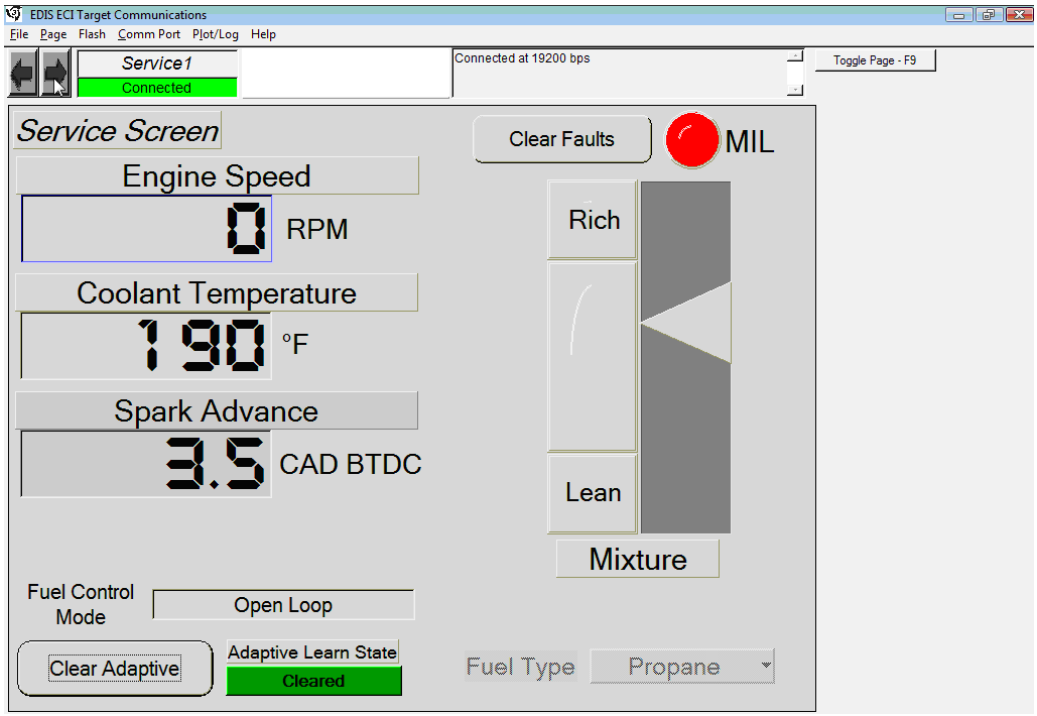
Gauge Page

Provides system data in large easy to read displays. Displays ECM configuration information for the ECM software, hardware, serial numbers and calibration dates.



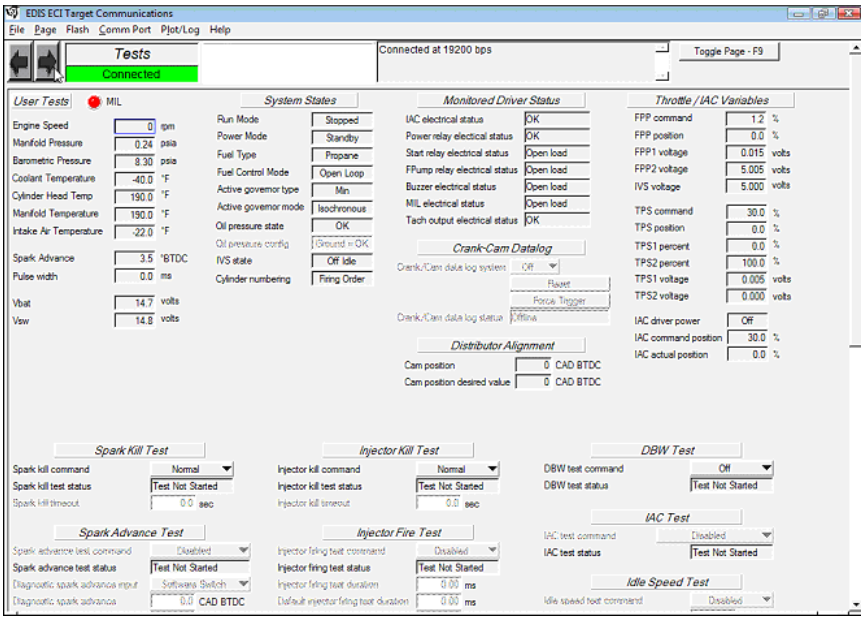
Raw Volts Page

The raw volts page displays the sensor inputs and outputs in a raw voltage format. This page is most commonly used to check values in the diagnostic trouble shooting charts.



Service 1

The Service 1 screen is used to clear the adaptive learn, shows the MIL status and provides a display for rpm, coolant temperature and spark advance. It also provides a large display to monitor the closed loop mixture control.



Tests Page

Provides diagnostic information voltages and sensor outputs and includes diagnostic engine tools such as spark and injector kill controls. Please note that not all features are available for all applications. The disabled item menus are grayed out or rendered inoperative.

SPARK KILL

The spark kill mode allows the technician to disable the ignition on individual cylinders. If the Spark Kill diagnostic mode is selected with the engine running below 1000 rpm, the minimum throttle command will lock into the position it was in when the test mode was entered. If the Spark System Test mode is selected with the engine running above 1000 rpm, the throttle will continue to operate normally. Disabling Ignition Outputs to disable the ignition system for an individual cylinder, use the mouse to highlight the “Spark Kill” button and select the desired coil. The spark output can be re-enabled by using the mouse to highlight the “Spark Kill” button and selecting “Normal.” If the engine is running below 1000 rpm, the spark output will stay disabled for 15 seconds and then re-set. If the engine is running above 1000 rpm, the spark output will stay disabled for 5 seconds and then re-set. This test mode has a timeout of 10 minutes. Record the rpm drop related to each spark output disabled. The spark outputs are arranged in the order which the engine fires, not by cylinder number.

INJECTOR KILL

The Injector Kill mode is used to disable individual fuel injectors. If the Injector Kill mode is selected with the engine running below 1000 rpm, the minimum throttle command will lock into the position it was in when the test mode was entered. If the Injector Kill mode is selected with the engine running above 1000 rpm, the throttle will continue to operate normally. To disable an injector, use the mouse to select the desired injector. The word “Normal” will change to the Injector you have selected. The injector driver can be re-enabled by selecting again. If the engine is running below 1000 rpm, the injector driver will stay disabled for 15 seconds and then re-

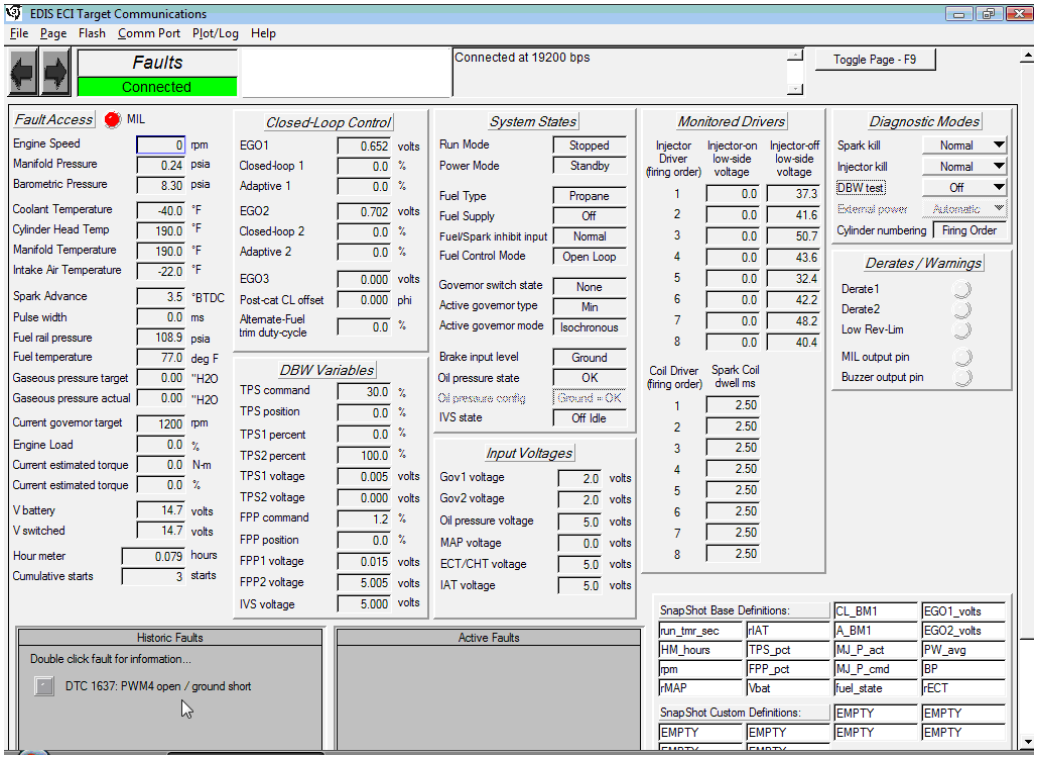
set. If the engine is running above 1000 rpm, the injector driver will stay disabled for 5 seconds and then re-set. Record the change in rpm while each driver is disabled.

DBW TEST MODE

The DBW (Drive by Wire) test mode allows the technician to control the throttle directly with the foot pedal or throttle input and is used during the diagnostic routines specified for FPP and TPS for Spectrum systems that use DBW control. FPP position displays the current position of the foot pedal as a percentage. FPP volts display the voltage which the ECM is reading from the FPP sensor. TPS Command displays the commanded throttle position expressed as a percentage, which is being sent to the throttle. TPS Position is the actual percent of throttle opening being sent to the ECM from the throttle. TPS volts display the actual TPS signal voltage the ECM is receiving from the throttle. To select this test mode the engine must be off and the key must be in the ON position.

EXTERNAL POWER TEST

The external power test manually activates relays (relay power, fuel pump, and drive-by wire power) controlled by the ECM while the engine is in the “Stopped” or “Running” states. Reverts to normal operation if “Automatic” state is selected or ignition voltage is cycled from high to low.



Faults Page

Stores DTC codes that may have occurred in the past (Historic Faults) or current set codes (Active Faults). Includes useful system voltages and sensor readings used while working with the fuel and emission trouble shooting charts. Shows power derate mode status. To erase a historic DTC code, double click on the code with the left mouse button. Then choose to “Clear All Faults.”

PLOT/LOG **MENU FUNCTIONS**

The Plot/Log menu allows the user to graphically plot or numerically log variables that have been tagged for plotting/logging. To plot or log variables, a tag must be assigned to each variable of interest. A variable is tagged for plotting/logging through a single right-mouse click in the variable's vicinity. Once a variable has been tagged for plotting/logging, it is highlighted in green.

Figure 5 shows an example of variables that have been tagged. A maximum of twenty (20) variables may be tagged for logging and a maximum of ten (10) variables may be tagged for plotting. The maximum achievable sample frequency/minimum period is dependent on the number of variables tagged.

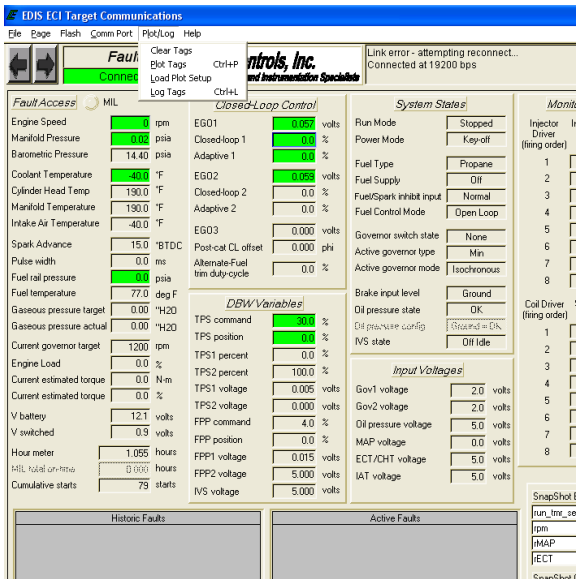


Figure 5: Tagged Variables for Plot/Log

Once the variables have been tagged as highlighted by the green color fill, select the "Plot/Log" function in the top menu bar as shown below in figure 6.

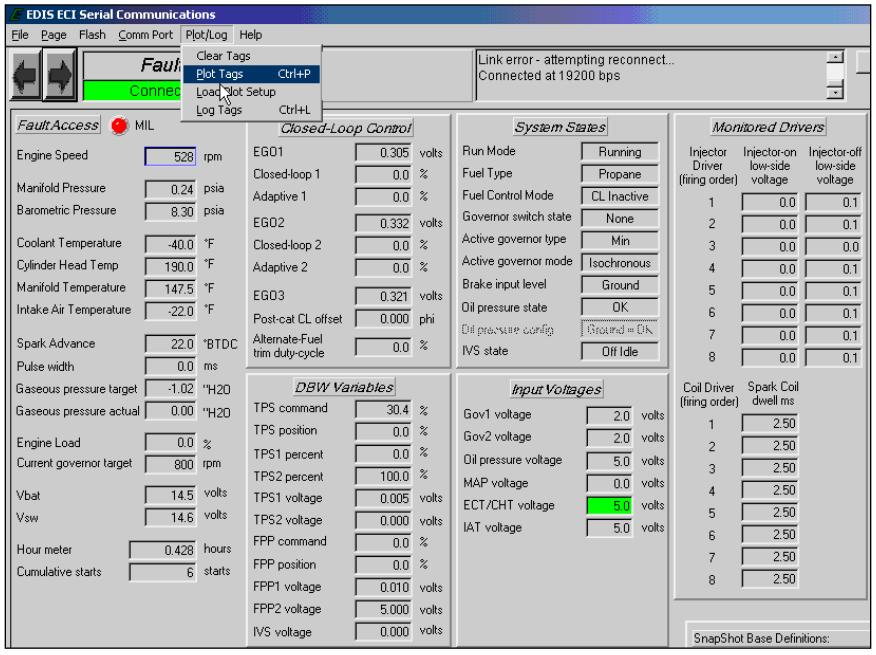


Figure 6

- Select “Plot Tags” to open the snapshot window

Other functions available from the Plot/Log menu include:

- ***Clear Tags***: Releases all plot/log variables.
- ***Plot Tags (Ctrl + P, or P)***: Graphically plot all tagged variables.
- ***Load Plot Setup***: Loads and tags variables for plotting/logging that have been stored in a plot file (.plt).
- ***Log Tags (Ctrl + L)***: Numerically log all variables that have been tagged for plotting/logging.

Once the Plot Tags menu item has been selected, tagged variables are graphically plotted in a strip chart interface. An example of a plot is shown in Figure 7. Capabilities of the plotter are outlined in Table 1.

***Start/Stop* Button**	**Start or stop plotting of selected variables**
Save Button	Save plotted data displayed in the plot to a comma-separated value file (CSV) on the PC hard drive. Format must not be altered if the *Load* function is to be used.
Snapshot Button	Convert the plot into a snapshot that may be panned, zoomed, scrolled, **and** saved
Close Button	Close the DST Plot interface
Load Setup Button	Load tags from a previously saved plot (.plt) file to allow for similar plots and logs to be generated
Load Plot Button	Load a previously saved plot from the PC into the DST Plot interface
Variable Selector Menu	Selects the active variable for axis scaling
Single Shot Acquisition Checkbox*	When checked, this does not allow the plot to scroll past the ‘Time Interval’ thereby preserving plotted data for post-processing.
Exclusive Serial Use Checkbox*	When checked, this allows exclusive serial communication for the plot variables. Other variables on the active page are not updated.
Min Y Value Field*	Specify the minimum Y-axis scaling for the active variable
Max Y Value Field*	Specify the maximum Y-axis scaling for the active variable
Sample Interval (ms) Field*	Define the sample period for recording and display *Frequency (Hz.) = 1000/Sample Interval (ms)*
Time Interval (s) Field*	Defines the total sample acquisition time for the plot.
*Accessible only when plotter is not running.	

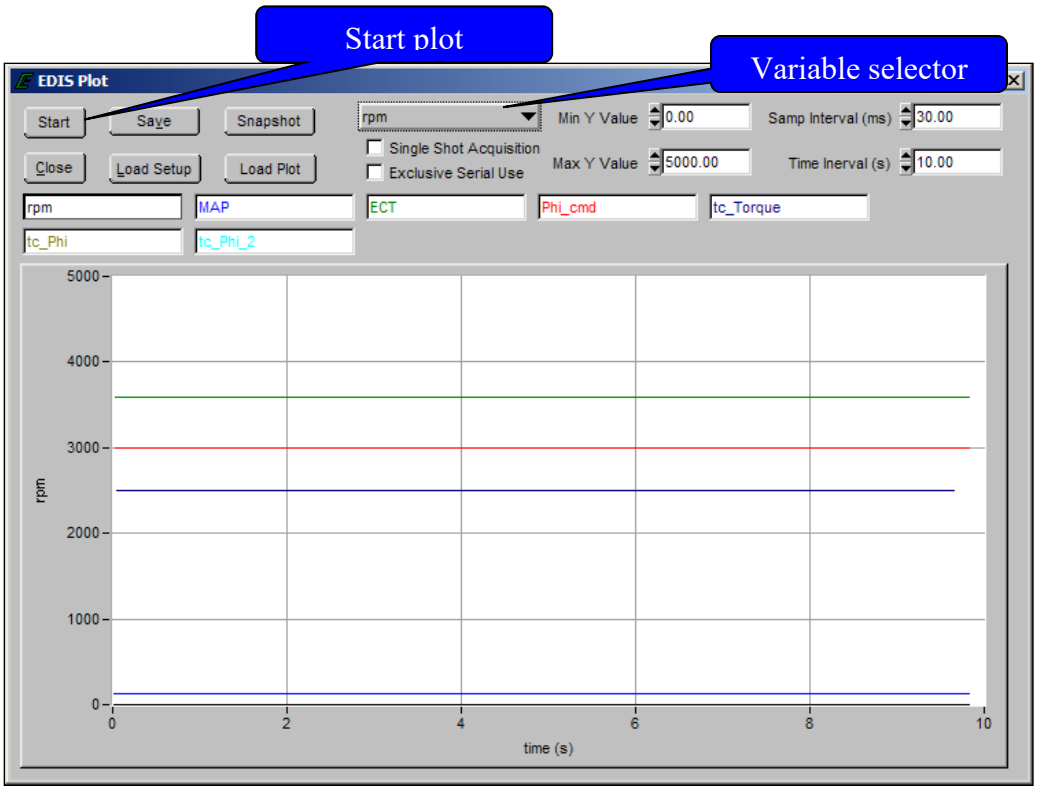


Figure 7: DST Plot

- Click on the “Start” button to start the DST plot function.
- Click on the variable selector button to view selected sensors

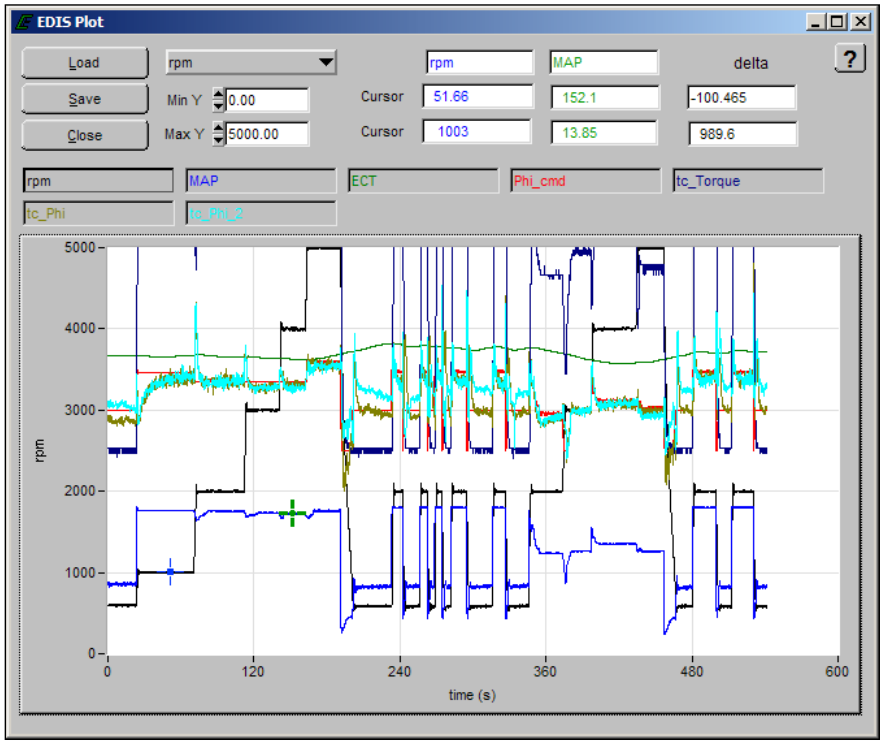
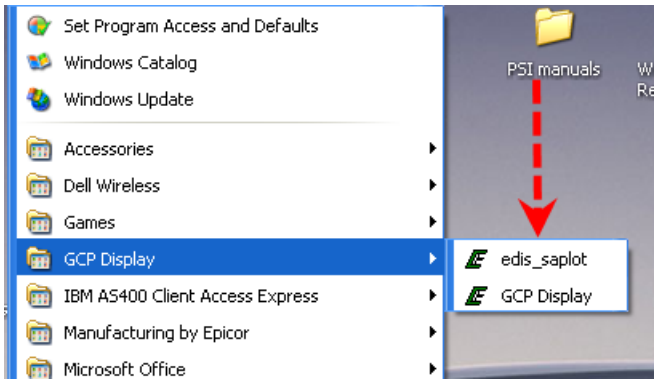


Figure 8: DST Plot Snapshot

- Click on the “Save” button to save the snapshot as a file. To replay the saved file, open the edis_saplot program from the windows start menu.



- Start Menu → Programs → PSI GCP Display → edis_saplot

DST PLOT INTERFACE FUNCTIONS

A graphic tool incorporated in the plotter is the snapshot function. This function allows data collected in a plot to be transferred into a second window for quick graphical post-processing. The snapshot allows the user to zoom in/out, pan left/right, and move cursors along the signal traces to measure the variable values in virtual real-time. An example of a snapshot is shown in Figure 8. Any CSV file in plot format (.plt) may be loaded into the snapshot. Table 2 outlines the available hot key functions of the snapshot screen.

SNAPSHOT HOT KEY FUNCTIONS

Command	Function
<Single, left-click on trace>	Snap closest cursor to data
<Ctrl + Up/Down Arrows>	Move/pan plot along y axis
<Ctrl + Left/Right Arrows>	Move/pan plot along t axis
<Ctrl+Shift + Up/Down Arrows>	Zoom plot in and out in y axis
<Ctrl+Shift + Left/Right Arrows>	Zoom plot in and out in t axis
<Ctrl + Home>	Resize plot to default settings
<Ctrl + Page Up>	Zoom out by 10%
<Ctrl + Page Down>	Zoom in by 10%
<Page Up>	Toggle to previous cursor
<Page Down>	Toggle to next cursor
<Left/Right Arrow>	Follow selected data along trace
<Up/Down Arrow>	Follow selected data along trace
<Shift + Left/Right Arrow>	Move 10 points along trace
<Shift + Up/Down Arrow>	Move 10 points along trace
<Home>	Go to first visible point on current plot
<End>	Advance to last visible point on current plot
<Shift + Up/Down Arrow>	Toggle between traces/variables

Table 1

DST LOGGER

Another data capture function incorporated in the software is the DST logger. This tool serves as a PC data logger for any variable available in the ECM through the interface software. Figure 9 shows the interface display for configuring the DST Log. The interface allows the user to create the filename, set the sample rate for acquisition, set the time interval for sampling, and display the progress of acquisition. A maximum of twenty (20) variables may be tagged for the log. The amount of data stored is only limited by available PC RAM. The resulting text file may then be viewed by any standard Windows text editor/reader program. To create a log file select the "Log Tags" in the drop down menu as shown in figure 6.

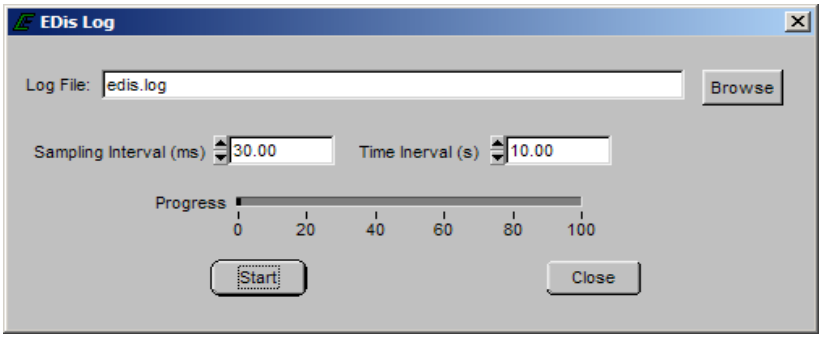


Figure 9: DST Log Interface

MALFUNCTION INDICATOR LAMP (MIL)

The Fuel system has built-in diagnostics for system trouble shooting. The system has a dash mounted malfunction indicator lamp (MIL) that provides indications of engine or fuel system related problem. Most engine control system related problems that affect emissions or driveability of the vehicle will set a (DTC) diagnostic trouble code and illuminate the MIL.

The MIL serves as notification to the operator of a problem related to the emission control system so the driver can arrange for service as soon as possible. It will also display DTCs that have been stored due to a system malfunction.

The MIL should illuminate when the key is in the ON position and the engine is not running. This feature verifies that the lamp is in proper working order. If the MIL does not illuminate with the vehicle key ON/engine OFF, repair it as soon as possible. Once the engine is in start or run mode, the MIL should turn off. If the lamp remains on while the engine is in the start or run mode a diagnostic trouble code may be set.

The MIL will be turned OFF after three (3) consecutive run cycles or by clearing the active code with the Diagnostic Scan Tool (DST).

DIAGNOSTIC TROUBLE CODES (DTC)

Diagnostic Trouble Codes are set when the Spectrum ECM (Electronic Control Module) runs a diagnostic self test and the test fails. When a DTC is set, the ECM will illuminate the MIL on the instrument panel and also save the DTC in memory. The ECM will continue to run the self test. If the system continues to fail the test, the lamp will stay illuminated and the DTC is stored as an active DTC. If the self test runs and passes, the DTC will be stored as historic DTC. All DTCs are stored as historic faults until they are cleared. Most DTCs will automatically clear from memory if

the DTC does not reset within 50 to 100 consecutive engine run cycles.

While a Diagnostic Trouble Code is current for a sensor, the ECM may assign a default “limp home” value and use that value in its control algorithms. All of the system diagnostic self-tests run continuously during normal vehicle operation.

The Diagnostic Trouble Codes can be read by using either the MIL lamp or a laptop computer. Diagnostic Trouble Codes can be cleared from memory with a laptop computer, or by turning the ignition key to the OFF position and removing the ECM power fuse or battery cable for at least 15 seconds.

If more than one DTC is detected, start the diagnostic repair with the lowest DTC number set. Diagnose each problem to correction unless directed to do otherwise by the diagnostic chart. The DTCs are numbered in order of importance. Both DTC 112 and DTC122 pertain to the oxygen sensor, so it is possible that a repair that corrects DTC 112 may also correct the problem causing the DTC 122.

Diagnostic test charts contained in this manual refer to the DST to be connected and in the “System Data Mode.” This simply means that the DST is connected and communicating with the PC. In some instances the chart will call out a special test mode. An example of this would be instructions for the DST to be connected and in the DBW (drive by wire) mode. Always be sure to follow the special instructions to avoid a false diagnosis of fuel system components.

DLC COMMUNICATION ERROR

The ECM 5 volt reference circuit powers the Spectrum diagnostic link cable. In the event that the 5 volt reference signal is open or shorted to ground, you will not be able to connect to the system. If you are unable to connect, follow the quick checks listed below:

Be sure you are using the correct password and latest software for the system you are connecting to.

Check the ECM system power and ground circuits. Refer to DTC 562 for the power schematic. Also check for +12 volts switched power at ECM pin 45 with the ignition key ON.

Check for power at the DLC connector for + 5 volts between pin 1 (BLK /LT GRN) and pin 2 (LT GRN RED) with the ignition key in the ON position.

You may still be able to retrieve a code using the blink code function if none of the above recommendations prove useful. In the event of a 5 volt reference signal malfunction, DTC 642 or DTC 643 should set. If you find one of these codes using the blink code function, follow the DTC diagnostic chart recommendations for that specific DTC.

BLINK CODE FUNCTION

Flashing Diagnostic Trouble Codes (DTC) using the blink code function is not available. DTC's will need to be pulled out of the ECM using the GCP Display software available from the OEM or PSI.

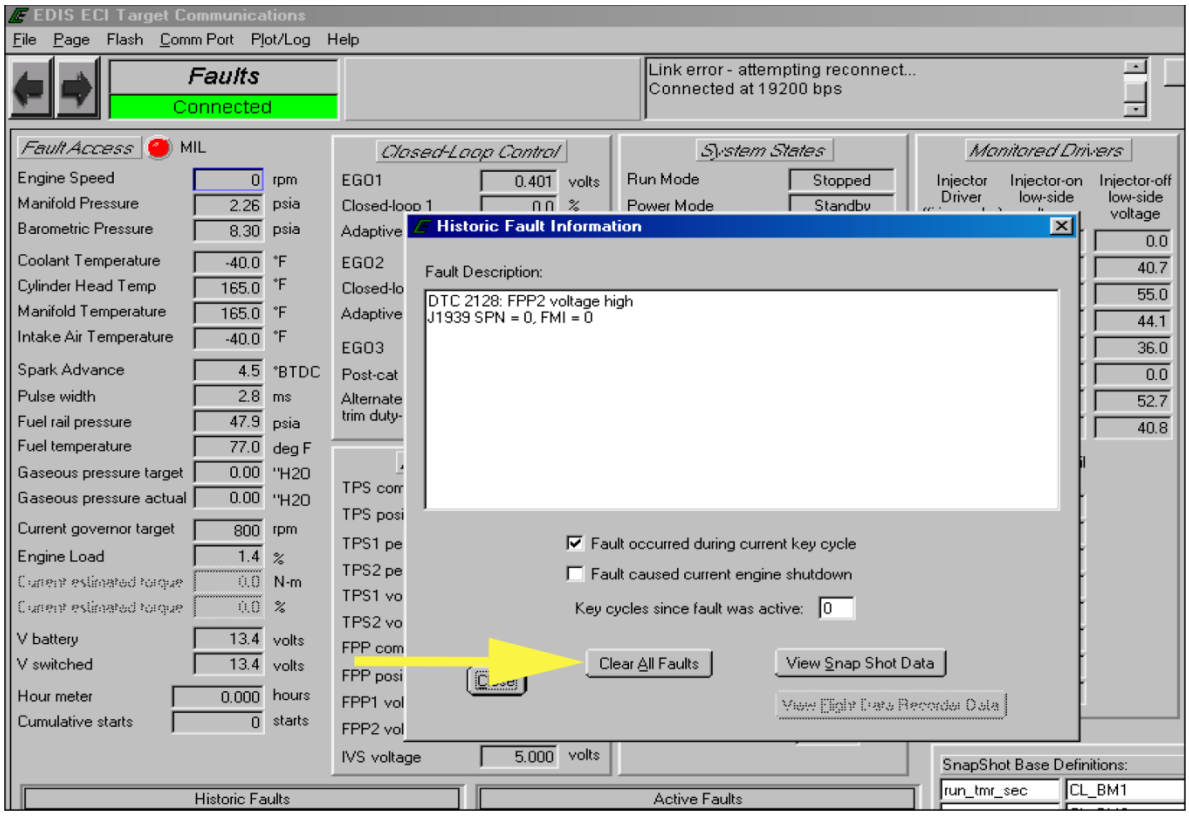


Diagram 1

When using the DST program to clear a DTC, always select the “Clear All Faults” function to immediately turn the MIL OFF after a successful repair (as shown in diagram 1 above).

INTERMITTENT PROBLEMS

Intermittent fuel system problems can prove to be the most challenging to repair. It is most important to remember when looking to find the cause of these problems, to operate the system in the condition when and where the problem occurs. An example of this would be, if the DST showed a lean fuel mixture at full load, one of the first things to look at would be the fuel pressure. The fuel pressure would need to be monitored while the machine is operating at full load, not at idle because the leaning effect does not occur at idle. Electrical problems should be treated the same way. One excellent tool for finding intermittent electrical problems is the DST plot/log function. Set up the plot for the code that sets. An example of this would be if an intermittent IAT code set, tag the IAT voltage and watch the plot. While watching the plot, agitate the electrical wire connection at the sensor and ECM connector. The resolution of the plot screen is such that you will be able to see any unstable voltages that you would otherwise not see with a standard DVOM.

Caution should be used when pressure washing the under hood of any electrical system. Avoid direct pressure spray on the system electrical connectors. They are splash proof, but if water is sprayed directly at the connector moisture can become trapped behind the connector seal and cause serious system problems.

Extra care must be taken when probing electrical pins and terminals. Do not bend or spread these terminals as this can also be a source of intermittent problems cause by improper handling of these connectors.

Engine Wire Harness Repair

ON-VEHICLE SERVICE
WIRE HARNESS REPAIR

The ECM harness electrically connects the ECM to a various components in both the engine and passenger compartments.

Wire harnesses should be replaced with proper part number harnesses. When wires are spliced into a harness, use wire with high temperature insulation only.

Low current and voltage levels are used in the system, so it is important that the best possible bond at all wire splices be made by soldering the splices.

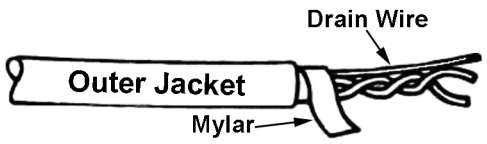
CONNECTORS AND TERMINALS

Use care when probing a connector or replacing terminals in them to prevent shorting opposite terminals and damage certain components. Always use jumper wires between connectors, for circuit checking. Do not probe through the Weather-Pack seals with oversized wire probes. Use tachometer adapter J 35812 (or equivalent) which provides an easy hook up of the tach lead. The connector test adapter kit J 35616 (or equivalent), contains an assortment of flexible connectors used to probe terminals during diagnosis. Fuse remover and test tool BT 8616, or equivalent, is used for removing a fuse and to adapt fuse holder, with a meter, for diagnosis. Do not solder oxygen sensor wire terminals as these wire ends are used for the sensors oxygen reference.

Open circuits are often difficult to locate by sight due to dirt, oxidation, or terminal misalignment. Merely wiggling a connector on a sensor, or in the wiring harness, may correct the open circuit condition. This should always be considered, when an open circuit, or failed sensor is indicated. Intermittent problems may also be caused by oxidized or loose connections.

Before making a connector repair, be certain of the type of connector. Weather-Pack and Compact Three connectors look similar, but are serviced differently.

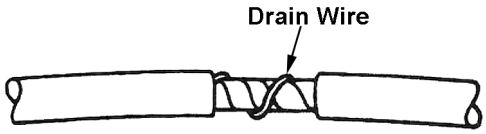
REPAIRING TWISTED/SHIELDED CABLE



1. Remove outer jacket

2. Unwrap aluminum/Mylar tape. Do not remove Mylar.

3. Untwist conductors, strip insulation as necessary.



4. Splice wire using splice clips and rosin core solder. Wrap each splice to insulate.

5. Wrap with Mylar and drain wire (uninsulated) wire.

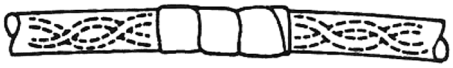
6. Tape over entire juncture and secure.

REPAIRING TWISTED LEADS

1. Locate Damaged Wire.

2. Remove insulation as required.

3. Splice two wires together suing splice clips and rosin core solder.

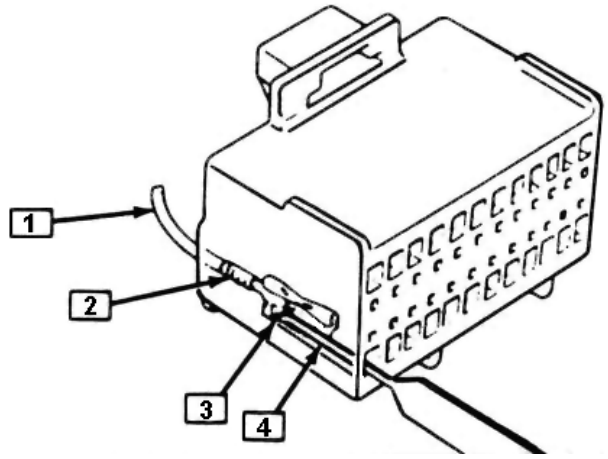


4. Cover splice with tape to insulated from other wires.

5. Retwist as before and tape with electrical tape and hold in place.

MICRO-PACK

Refer to Figure 2 and repair procedure for replacement of a Micro-Pack terminal.

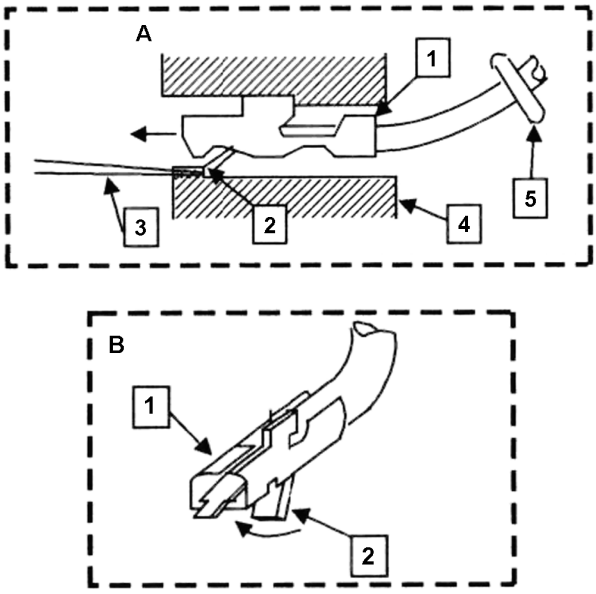


Micropack Connector

1. Cable
2. Terminal
3. Locking Tang
4. Tool J33095/BT8234-A

METRI-PACK

Some connectors use terminals called Metri-Pack Series 150. They are also called “Pull-To-Seat” terminals because of the method of installation. The wire is inserted through the seal and connector, the terminal is crimped on the wire and then pulled back into the connector to seat it in place.



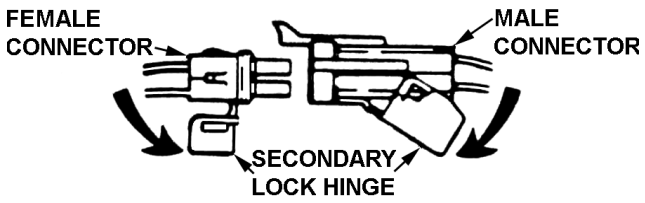
Metri-Pack Series 150 Terminal Removal

1. Slide the seal back on the wire.
2. Insert tool BT-8518, or J 35689, or equivalent, as shown in insert “A” and “B” to release the terminal locking tab (2).
3. Push the wire and terminal out through the connector. If reusing the terminal, reshape the locking tab (2).

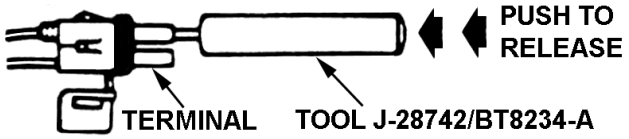
WEATHER-PACK

A Weather-Pack connector can be identified by a rubber seal, at the rear of the connector. The connector is used in the engine compartment to protect against moisture and dirt that may oxidize and/or corrode the terminals. Given the low voltage and current levels found in the electronic system, this protection is necessary to ensure a good connection.

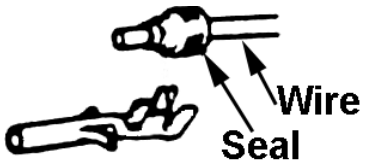
WEATHER-PACK TERMINAL REPAIR



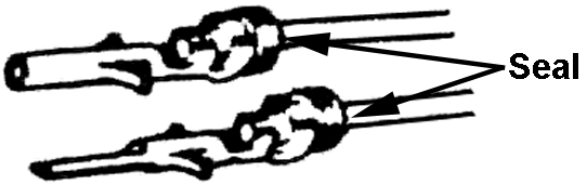
1. Open secondary lock hinge on connector.



2. Remove terminal using tool.



3. Cut wire immediately behind cable seal



4. Replace terminal.
   a. Slip new seal onto wire
   b. Strip 5 mm (.2”) of insulation from wire.
   c. Crimp terminal over wire and seal.

5. Push terminal and connector and engage locking tangs.

6. Close secondary lock hinge.

Use tool J M28742, or BT8234-A or equivalent to remove the pin and sleeve terminals. If the removal is attempted with an ordinary pick, there is a good chance that the terminal will be bent, or deformed. Unlike standard blade type terminals, these terminals cannot be straightened once they are bent.

Verify that the connectors are properly seated and all of the sealing rings in place, when connecting leads. The hinge type flap provides a backup, or secondary locking feature for the connector. They are used to improve the connector reliability by retaining the terminals, if the small terminal lock tabs are not positioned properly.

Weather-Pack connections cannot be replaced with standard connections. Additional instructions are provided with Weather-Pack connector and terminal packages.

FUEL SYSTEM SYMPTOM DIAGNOSTICS

Checks	Action
Before Using This Section	Before using this section, you should have performed On Board Diagnostic (OBD) Check and determined that: 1. The ECM and MIL are operating correctly. 2. There are no Diagnostic Trouble Codes (DTCs) stored, or a DTC exists but without a MIL. Several of the following symptom procedures call for a careful visual and physical check. These checks are very important as they can lead to prompt diagnosis and correction of a problem.
Fuel System Check	1. Verify the customer complaint. 2. Locate the correct symptom table. 3. Check the items indicated under that symptom. 4. Operate the equipment under the conditions the symptom occurs. Verify HEGO switching between lean and rich. **IMPORTANT! Normal HEGO switching indicates the fuel system is in closed loop and operating correctly at that time.** 5. Take a data snapshot using the DST under the condition that the symptom occurs to review at a later time.
Visual and Physical Checks	• Check all ECM system fuses and circuit breakers. • Check the ECM ground for being clean, tight and in its proper location. • Check the vacuum hoses for splits, kinks and proper connections. • Check thoroughly for any type of leak or restriction. • Check for air leaks at all the mounting areas of the intake manifold sealing surfaces. • Check for proper installation of the mixer assembly. • Check for air leaks at the mixer assembly. Check the ignition wires for the following conditions: • Cracking • Hardening • Proper routing • Carbon tracking. • Check the wiring for the following items: proper connections, pinches or cuts. • The following symptom tables contain groups of possible causes for each symptom. The order of these procedures is not important. If the DST readings do not indicate a problem, then proceed in a logical order, easiest to check or most likely to cause the problem.

INTERMITTENT

Checks	Action
DEFINITION: *The problem may or may not turn ON the (MIL) or store a Diagnostic Trouble Code (DTC).*	
Preliminary Checks	Do not use the DTC tables. If a fault is an intermittent, the use of the DTC tables with this condition may result in the replacement of good parts.
Faulty Electrical Connections or Wiring	Faulty electrical connections or wiring can cause most intermittent problems. Check the suspected circuit for the following conditions: • Faulty fuse or circuit breaker, connectors poorly mated, terminals not fully seated in the connector (backed out). Terminals not properly formed or damaged. • Wire terminals poorly connected. • Terminal tension is insufficient. • Carefully remove all the connector terminals in the problem circuit in order to ensure the proper contact tension. • If necessary, replace all the connector terminals in the problem circuit in order to ensure the proper contact tension (except those noted as “Not Serviceable”). See section *Wiring Schematics*. • Checking for poor terminal to wire connections requires removing the terminal from the connector body.
Operational Test	If a visual and physical check does not locate the cause of the problem, operate the vehicle with the DST connected. When the problem occurs, an abnormal voltage or scan reading indicates a problem circuit.
Intermittent MIL Illumination	The following components can cause intermittent MIL and no DTC(s): • A defective relay. • Switch that can cause electrical system interference. Normally, the problem will occur when the faulty component is operating. • The improper installation of add on electrical devices, such as lights, 2-way radios, electric motors, etc. • The ignition secondary voltage shorted to a ground. • The MIL circuit or the Diagnostic Test Terminal intermittently shorted to ground. • The MIL wire grounds.
Loss of DTC Memory	To check for the loss of the DTC Memory: 1. Disconnect the TMAP sensor. 2. Idle the engine until the MIL illuminates. 3. The ECM should store a TMAP DTC which should remain in the memory when the ignition is turned OFF. If the TMAP DTC does not store and remain, the ECM is faulty.

NO START

Checks	Action
DEFINITION: *The engine cranks OK but does not start.*	
Preliminary Checks	None
ECM Checks	Use the DST to : • Check for proper communication with both the ECM • Check all system fuses engine fuse holder. Refer to *Engine Controls Schematics.* • Check battery power, ignition power and ground circuits to the ECM. Refer to *Engine Control Schematics.* Verify voltage and/or continuity for each.
Sensor Checks	• Check the TMAP sensor. • Check the cam angle sensor for output (RPM).
Fuel System Checks	**Important**: A closed LPG manual fuel shut off valve will create a no start condition. • Check for air intake system leakage between the mixer and the throttle body. Verify proper operation of the low pressure lock-off solenoids. • Verify proper operation of the fuel control solenoids. • Check the fuel system pressures. • Refer to the *LPG Fuel System Diagnosis*. • Check for proper mixer air valve operation.
Ignition System Checks	Note: LPG being a gaseous fuel requires higher secondary ignition system voltages for the equivalent gasoline operating conditions. 1. Check for the proper ignition voltage output with *J 26792* or the equivalent. 2. Verify that the spark plugs are correct for use with LPG. Check the spark plugs for the following conditions: • Wet plugs. • Cracks. • Wear. • Improper gap. • Burned electrodes. • Heavy deposits. • Check for bare or shorted ignition wires. • Check for loose ignition coil connections at the coil.

NO START

Checks	Action
Engine Mechanical Checks	**Important:** The LPG Fuel system is more sensitive to intake manifold leakage than the gasoline fuel system. Check for the following: • Vacuum leaks. • Improper valve timing. • Low compression. • Improper valve clearance. • Worn rocker arms. • Broken or weak valve springs. Worn camshaft lobes.
Exhaust System Checks	Check the exhaust system for a possible restriction: • Inspect the exhaust system for damaged or collapsed pipes: • Inspect the muffler for signs of heat distress or for possible internal failure. • Check for possible plugged catalytic converter. Refer to *Restricted Exhaust System Diagnosis.*

HARD START

Checks	Action
DEFINITION: *The engine cranks OK, but does not start for a long time. The engine does eventually run, or may start but immediately dies.*	
Preliminary Checks	Make sure the vehicle's operator is using the correct starting procedure.
Sensor Checks	• Check the Engine Coolant Temperature sensor with the DST. Compare the engine coolant temperature with the ambient air temperature on a cold engine. If the coolant temperature reading is more than 10 degrees greater or less than the ambient air temperature on a cold engine, check for high resistance in the coolant sensor circuit. Check the cam angle sensor. • Check the Throttle Position (TPS) and Foot Pedal Position (FPP) sensor connections.
Fuel System Checks	**Important**: A closed LPG manual fuel shut off valve will create an extended crank OR no start condition. • Verify the excess flow valve is not tripped or that the manual shut-off valve is not closed. Check mixer assembly for proper installation and leakage. • Verify proper operation of the low pressure lock-off solenoid. • Verify proper operation of the EPR. • Check for air intake system leakage between the mixer and the throttle body. Check the fuel system pressures. Refer to the *Fuel System Diagnosis*.
Ignition System Checks	Note: LPG being a gaseous fuel requires higher secondary ignition system voltages for the equivalent gasoline operating conditions. • Check for the proper ignition voltage output with *J 26792* or the equivalent. • Verify that the spark plugs are the correct type and properly gapped. Check the spark plugs for the following conditions: • Wet plugs. • Cracks. • Wear. • Burned electrodes. • Heavy deposits • Check for bare or shorted ignition wires. • Check for moisture in the distributor cap. • Check for loose ignition coil connections. **Important**: 1. If the engine starts but then immediately stalls, check the cam angle sensor. 2. Check for improper gap, debris or faulty connections.

HARD START

Checks	Action
Engine Mechanical Checks	**Important:** The LPG Fuel system is more sensitive to intake manifold leakage than the gasoline fuel supply system. Check for the following: • Vacuum leaks • Improper valve timing • Low compression • Improper valve clearance. • Worn rocker arms • Broken or weak valve springs • Worn camshaft lobes. Check the intake and exhaust manifolds for casting flash.
Exhaust System Checks	Check the exhaust system for a possible restriction: • Inspect the exhaust system for damaged or collapsed pipes. • Inspect the muffler for signs of heat distress or for possible internal failure. Check for possible plugged catalytic converter. Refer to *Restricted Exhaust System Diagnosis.*

CUTS OUT, MISSES

Checks	Action
***DEFINITION**: A surging or jerking that follows engine speed, usually more pronounced as the engine load increases, but normally felt below 1500 RPM. The exhaust has a steady spitting sound at idle, low speed, or hard acceleration for the fuel starvation that can cause the engine to cut-out.*	
Preliminary Checks	None
Ignition System Checks	1. Start the engine. 2. Check for proper ignition output voltage with spark tester J 26792. 3. Check for a cylinder misfire. 4. Verify that the spark plugs are the correct type and properly gapped. Remove the spark plugs and check for the following conditions: • Insulation cracks. • Wear. • Improper gap. • Burned electrodes. • Heavy deposits. Visually/Physically inspect the secondary ignition for the following: • Ignition wires for arcing and proper routing. • Cross-firing. • Ignition coils for cracks or carbon tracking
Engine Mechanical Checks	Perform a cylinder compression check. Check the engine for the following: • Improper valve timing. • Improper valve clearance. • Worn rocker arms. • Worn camshaft lobes. • Broken or weak valve springs. • Check the intake and exhaust manifold passages for casting flash.
Fuel System Checks	Check the fuel system: • Plugged fuel filter. • Low fuel pressure, etc. Refer to *LPG Fuel System Diagnosis*. • Check the condition of the wiring to the low pressure lock-off solenoid.
Additional Check	Check for Electromagnetic Interference (EMI), which may cause a misfire condition. Using the DST, monitor the engine RPM and note sudden increases in rpms displayed on the scan tool but with little change in the actual engine rpm. If this condition exists, EMI may be present. Check the routing of the secondary wires and the ground circuit.

HESITATION, SAG, STUMBLE

Checks	Action
DEFINITION: *The engine has a momentary lack of response when putting it under load. The condition can occur at any engine speed. The condition may cause the engine to stall if it's severe enough.*	
Preliminary Checks	None.
Fuel System Checks	• Check the fuel pressure. Refer to *LPG Fuel System Diagnosis*. • Check for low fuel pressure during a moderate or full throttle acceleration. If the fuel pressure drops below specification, there is possibly a faulty low pressure regulator or a restriction in the fuel system. • Check the TMAP sensor response and accuracy. • Check Shut-Off electrical connection. • Check the mixer air valve for sticking or binding. • Check the mixer assembly for proper installation and leakage. Check the EPR.
Ignition System Checks	Note: LPG being a gaseous fuel requires higher secondary ignition system voltages for the equivalent gasoline operating conditions. If a problem is reported on LPG and not gasoline, do not discount the possibility of a LPG only ignition system failure and test the system accordingly. • Check for the proper ignition voltage output with *J 26792* or the equivalent. Verify that the spark plugs are the correct type and properly gapped. • Check for faulty spark plug wires. • Check for fouled spark plugs.
Additional Check	• Check for manifold vacuum or air induction system leaks. • Check the alternator output voltage.

BACKFIRE

Checks	Action
DEFINITION: *The fuel ignites in the intake manifold, or in the exhaust system, making a loud popping noise.*	
Preliminary Check	None.
Ignition System Checks	**Important! LPG, being a gaseous fuel, requires higher secondary ignition system voltages for the equivalent gasoline operating conditions. The ignition system must be maintained in peak condition to prevent backfire.** • Check for the proper ignition coil output voltage using the spark tester *J26792* or the equivalent. • Check the spark plug wires by connecting an ohmmeter to the ends of each wire in question. If the meter reads over 30,000 ohms, replace the wires. • Check the connection at ignition coil. • Check for deteriorated spark plug wire insulation. Remove the plugs and inspect them for the following conditions: • Wet plugs. • Cracks. • Wear. • Improper gap. • Burned electrodes. • Heavy deposits.
Engine Mechanical Check	**Important! The LPG Fuel system is more sensitive to intake manifold leakage than a gasoline fuel supply system.** Check the engine for the following: • Improper valve timing. • Engine compression. • Manifold vacuum leaks. • Intake manifold gaskets. • Sticking or leaking valves. • Exhaust system leakage. • Check the intake and exhaust system for casting flash or other restrictions.
Fuel System Checks	Perform a fuel system diagnosis. Refer to *LPG Fuel System Diagnosis*.

LACK OF POWER, SLUGGISHNESS, OR SPONGINESS

Checks	Action
DEFINITION: *The engine delivers less than expected power.*	
Preliminary Checks	• Refer to the *LPG Fuel system OBD System Check.* • Compare the customer's vehicle with a similar unit to verify customer has an actual problem. *Do not compare the power output of the vehicle operating on LPG to a vehicle operating on gasoline as the fuels do have different drive feel characteristics.* • Remove the air filter and check for dirt or restriction. • Check the vehicle transmission. • Refer to the OEM transmission diagnostics.
Fuel System Checks	• Check for a restricted fuel filter, contaminated fuel, or improper fuel pressure. Refer to *LPG Fuel System Diagnosis*. • Check for the proper ignition output voltage with the spark tester *J 26792* or the equivalent. • Check for proper installation of the mixer assembly. Check all air inlet ducts for condition and proper installation. • Check for fuel leaks between the EPR and the mixer. • Verify that the LPG tank manual shut-off valve is fully open. • Verify that liquid fuel (not vapor) is being delivered to the EPR.
Sensor Checks	• Check the Heated Exhaust Gas Oxygen Sensors (HEGO) for contamination and performance. Check for proper operation of the TMAP sensor. • Check for proper operation of the TPS and FPP sensors.
Exhaust System Checks	Check the exhaust system for a possible restriction: • Inspect the exhaust system for damaged or collapsed pipes. • Inspect the muffler for signs of heat distress or for possible internal failure. • Check for possible plugged catalytic converter.
Engine Mechanical Check	Check the engine for the following: • Engine compression. • Valve timing. • Improper or worn camshaft. • Refer to *Engine Mechanical* in the Service Manual.
Additional Check	• Check the ECM grounds for being clean, tight, and in their proper locations. • Check the alternator output voltage. If all procedures have been completed and no malfunction has been found, review and inspect the following items: • Visually and physically, inspect all electrical connections within the suspected circuit and/or systems. • Check the DST data.

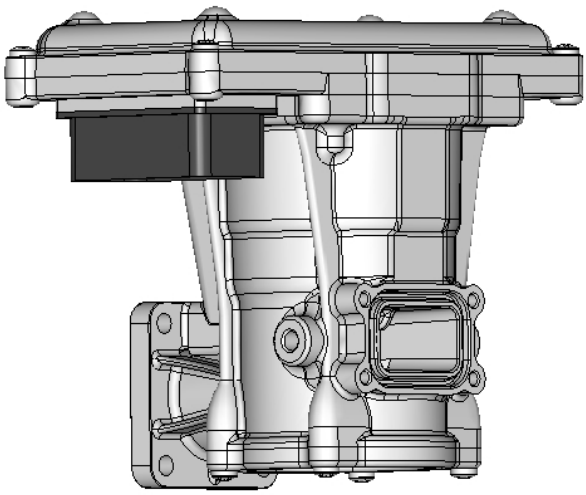
ROUGH, UNSTABLE, OR INCORRECT IDLE, STALLING

Checks	Action
DEFINITION: *The engine runs unevenly at idle. If severe enough, the engine may shake.*	
Preliminary Check	None.
Sensor Checks	Check the Heated Exhaust Gas Oxygen Sensors (HEGO) performance: • Check for silicone contamination from fuel or improperly used sealant. If contaminated, the sensor may have a white powdery coating result in a high but false signal voltage (rich exhaust indication). The ECM will reduce the amount of fuel delivered to the engine causing a severe driveability problem. Check the Temperature Manifold Absolute Pressure (TMAP) sensor response and accuracy.
Fuel System Checks	• Check for rich or lean symptom that causes the condition. • Drive the vehicle at the speed of the complaint. • Monitoring the oxygen sensors will help identify the problem. • Check for a sticking mixer air valve. • Verify proper operation of the EPR. • Perform a cylinder compression test. Refer to *Engine Mechanical* in the Service Manual. • Check the EPR fuel pressure. Refer to the *LPG Fuel System Diagnosis*. • Check mixer assembly for proper installation and connection.
Ignition System Checks	• Check for the proper ignition output voltage using the spark tester *J26792* or the equivalent. • Verify that the spark plugs are the correct type and properly gapped. Remove the plugs and inspect them for the following conditions: • Wet plugs. • Cracks. • Wear. • Improper gap. • Burned electrodes. • Blistered insulators. • Heavy deposits. Check the spark plug wires by connecting an ohmmeter to the ends of each wire in question. If the meter reads over 30,000 ohms, replace the wires.
Additional Checks	**Important:** The LPG Fuel system is more sensitive to intake manifold leakage than the gasoline fuel supply system. • Check for vacuum leaks. Vacuum leaks can cause a higher than normal idle and low throttle angle control command. • Check the ECM grounds for being clean, tight, and in their proper locations. Check the battery cables and ground straps. They should be clean and secure. Erratic voltage may cause all sensor readings to be skewed resulting in poor idle quality.

ROUGH, UNSTABLE, OR INCORRECT IDLE, STALLING

Checks	Action
Engine Mechanical Check	Check the engine for: • Broken motor mounts. • Improper valve timing. • Low compression. • Improper valve clearance. • Worn rocker arms. • Broken or weak valve springs. • Worn camshaft lobes.

FUEL SYSTEM DIAGNOSIS



Integrated Electronic Pressure Regulator Assembly

FUEL SYSTEM DESCRIPTION

The Engine Control Module (ECM) receives information from various engine sensors in order to control the operation of the Integrated Electronic Pressure Regulator (EPR) and Shut-Off Valve. The Shut-Off Valve solenoid prevents fuel flow unless the engine is cranking or running.

At Key ON, the IEPR valve receives a two (2) second prime pulse from the ECM, allowing time for the fuel to flow through the fuel filter and fuel lines to the IEPR.

The fuel is then to the Mixer. Engine cranking generates vacuum which provided lift for the mixer air valve and is commonly referred to as air valve vacuum. Once in the mixer, the fuel is combined with air and is drawn into the engine for combustion.

DIAGNOSTIC AIDS

This procedure is intended to diagnose equipment operating on LPG. If the equipment will not continue to run, refer to Hard Start for preliminary checks. Before starting this procedure, complete the following tasks to verify that liquid fuel is being delivered to the IEPR:

- Inspect the fuel supply lines to verify they are properly connected and do not have any kinks or damage
- Verify the fuel shut off valve is operating properly. Refer to the OEM for information on the fuel shut off valve.

TOOLS REQUIRED:

DST

- Diagnostic Scan Tool (DST)

PRESSURE GAUGES

- 0-10” Water Column Gauge

TEST DESCRIPTION

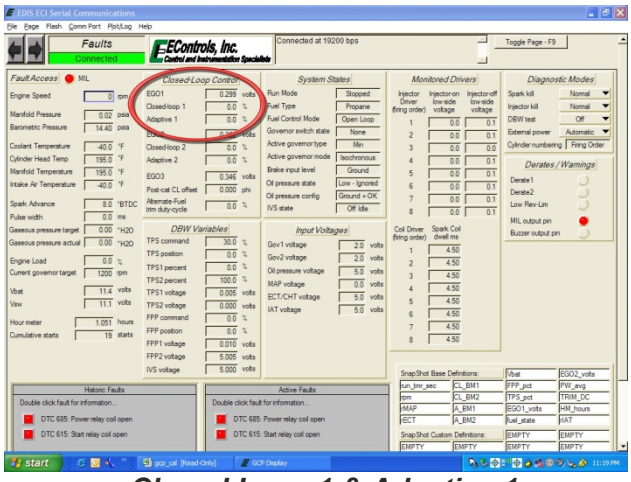
The basis of the fuel system test is to determine if the fuel is operating within proper fuel control parameters. This fuel control system operates on the basis of short term and long term fuel correction to compensate for the normal operation and aging of the engine. Abnormal operation of the engine, due to a component issue or lack of maintenance will cause fuel system control parameters to operate outside of the normal range.

The fuel system correction factors are viewable using the laptop based Diagnostic Service Tool (DST).

The short term correction factor is a percentage based fuel correction that will immediately be applied once the engine reaches the closed loop fuel control mode. The short term correction factor is known as “Closed Loop 1” on the DST.

The long term correction factor writes the short term correction into long term memory so it is available immediately on the next start/run cycle. The long term correction factor is known as “Adaptive 1” on the DST.

Closed Loop 1 and Adaptive 1 can be viewed on the Closed Loop Control panel on the Faults Page of the DST.



Closed Loop 1 & Adaptive 1

Any parameter found to be out of conformance will require additional diagnosis.

HOW THE CORRECTION FACTORS WORK

The correction factors are displayed in the DST as a positive or negative percent. The numbers will range between -35% and +35%. A negative fuel correction number indicates the removal of fuel.

An outside condition causing the system to be rich, such as a restricted air cleaner, can cause a negative short term and long term fuel correction. An outside condition causing the system to be lean, such as a vacuum leak, can cause a positive fuel correction.

DETERMINING TOTAL FUEL CORRECTION

The total fuel correction is the sum of the short term correction (Closed Loop 1) and the long term correction (Adaptive 1).

For instance, a Closed Loop 1 reading of -1.5% and an Adaptive 1 reading of -3.5% would mean a total fuel correction of -5% was taking place at that time. The system is removing 5% fuel at that time.

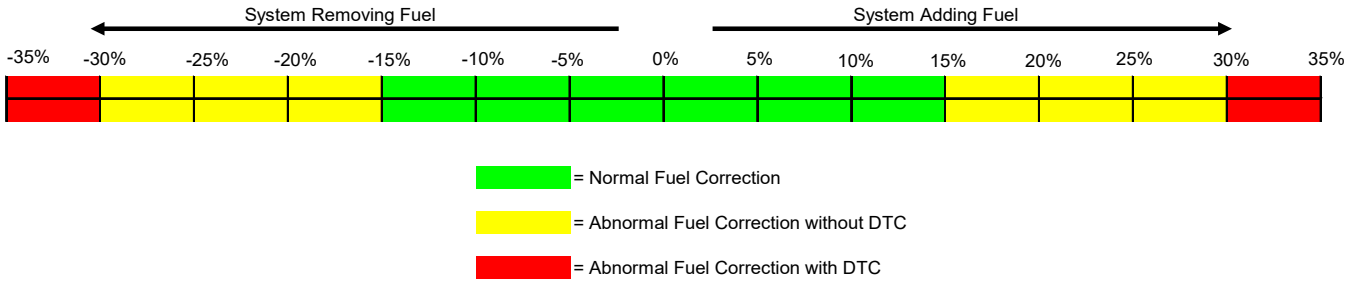
A Closed Loop 1 reading of 1.5% and an Adaptive 1 reading of 3.5% (note both are positive numbers) would mean that a total fuel correction of 5% was taking place at that time. The system is adding 5% fuel.

NORMAL & ABNORMAL FUEL CORRECTION

Generally, the system is operating within specification when total fuel correction falls between -15% and +15%. Operation outside of this range will require further diagnosis to determine the system level issue affecting fuel control. The system will set Diagnostic Trouble Codes (DTC's) for correction factors in the +/- 30%-35% range.

If total fuel correction is found to be operating outside of the normal range additional diagnostic procedure will be required to determine the cause. Follow the appropriate Symptom Routine or DTC Chart for additional help.

Total Fuel Correction Chart



Fuel System Diagnosis

Step	Action	Value(s)	Yes	No
1	Were you referred to this procedure by a DTC diagnostic chart?		Go to Step 3	Go to Step 2
2	1. Perform the On Board Diagnostic (OBD) System Check. Are any DTC's present in the ECM?		Go to the applicable DTC Table	Go to Step 3
3	1. Verify that the fuel supply lines are connected properly without any kinks or damage Are fuel supply lines ok?		Go to Step 4	Repair and Go to Step 4
4	1. Connect the DST and start the engine and allow it to reach operating temperature. Does the engine start and run?		Go to Step 5	Go to Step 11
5	1. Bring the engine to operating speed and slowly increase the load in increments to full load. Does the engine pull full load?		Go to Step 6	Go to Step 13
6	1. Return the engine to its lowest operating speed and load. 2. View the DST and make sure the fuel control mode is "Closed Loop + Adapt". Note: The engine must be at 165°F or higher to reach this fuel control mode. Is the fuel control mode correct?	Closed Loop + Adapt	Go to Step 7	Go to Step 22
7	3. Continue to run the engine at its lowest speed and load and check EGO1 voltage. Is EGO fluctuating rapidly?		Go to Step 8	Go to Step 23
8	1. Continue to operate the engine at its lowest speed and no load. 2. Using the DST observe Closed Loop 1 and Adaptive 1 and calculate total fuel correction. Is total fuel correction within the specified range?	-15% to +15%	Go to Step 9	Go to Step 24
9	1. Raise the engine rpm to operating speed and load the engine to a mid-load point. 2. Using the DST observe Closed Loop 1 and Adaptive 1 and calculate total fuel correction. Is total fuel correction within the specified range?	-15% to +15%	Go to Step 10	Go to Step 24

Step	Action	Value(s)	Yes	No
10	1. Run the engine at operating speed and raise the load to fullload. 2. Using the DST observe Closed Loop 1 and Adaptive 1 and calculate total fuel correction. 3. Is total fuel correction within the specified range?	-15% to +15%	Go to 25	Go to Step 24
11	1. Connect the DST 2. Turn the key on and set the DST view to the “Faults” page 3. Crank the engine and view the Gaseous Pressure Target and Gaseous Pressure Actual values. Is there fuel pressure registered in Gaseous Pressure Actual and does it match Gaseous Pressure Target within .5” w.c.?		Go to Step 12	Got to Step 14
12	4. Remove Air induction hose to the mixer. 5. Observe the air valve for movement while the engine is cranking. **Note:** Movement of the air valve will be minimal at cranking speeds. Does the air valve move when the engine is cranked?		Go to Ignition System Test	Go to Step 13
13	1. Inspect the air intake stream to the mixer assembly and the throttle body for vacuum leaks. Were vacuum leaks found and repaired?		Return to Step 4	Go to Step 21
14	1. Inspect the fuel supply hose between the source and the IEPR and the mixer assembly for damage or leakage. Was a problem found and repaired?		Return to Step 4	Go to Step 15
15	1. Connect a water column gauge or manometer to the fuel supply hose between the fuel source and the fuel shut off valve. Is fuel pressure in the specified range?	7”-11” w.c.	Go to Step 16	Repair fuel source and Move to Step 4
16	1. Connect a water column gauge or manometer to the fuel supply hose between the fuel shut off valve and the IEPR. Is fuel pressure within specified range?	7”-11” w.c.	Go to Step 19	Go to Step 17
17	1. Turn OFF the ignition. 2. Connect volt meter across the harness side of the fuel shut off solenoid connector 3. Crank the engine. Is voltage present?	11-13 volts	Go to Step 20	Go to Step 18

Step	Action	Value(s)	Yes	No
18	1. Repair the open or broken electrical connection in the Shut-Off Valve circuit. Is the action complete?		Go to Step 25	
19	1. Replace the IEPR. Refer to Integrated Electronic Pressure Regulator Repair. Is the action complete?		Go to Step 4 and Re-start Test	Recheck DTC's and try Addi-tional Steps
20	1. Replace the Shut-Off Valve. Refer to the *Shut-Off Valve Replacement*. Is the action complete?		Go to Step 4 and Re-start Test	
21	1. Replace the mixer assembly. Refer to *Fuel Mixer Replacement*. Is the action complete?		Go to Step 4 and Re-start Test	
22	Check that the engine is reaching normal operating temperature. If engine is not reaching temperature diagnose problem with cooling system. If engine is reaching 165°F and does not go into Closed Loop mode check operation of O2 sensor and recheck DTC's. Was a problem found and repaired?		Go to Step 6	Recheck DTC's and Re-pair
23	Disconnect EGO1 connector and check heater circuit for 12V and ground. If present replace O2 sensor. If 12V and ground not present repair circuit. Check for DTC and follow DTC chart. Was a problem found and repaired?		Go to Step 7	Recheck DTC and fol-low DTC diagno-sis
24	You were referred to this step because the total fuel correction was found to be out of tolerance. Check the system for pinched cut or disconnected vacuum hoses or electrical connections. Check for a restricted or missing air filter. Check for loose mounting hardware for the mixer and IEPR. Check to see that actual engine coolant temperature matches the Engine Coolant Temperature (ECT) reading with the DST. Was a problem found and corrected?		Go to Step 4 and re-start Test	Recheck DTC's and try Addi-tional Steps
25	The Fuel Control System is operating normally. Remove all test equipment.		System OK	

ADDITIONAL STEPS

STEP	ACTION	VALUE(S)	YES	NO
1	1. Perform the On-Board Diagnostic (OBD) System check. Are any DTCs present in the ECM?		Go to Applicable DTC Table	Go to Step 2
2	Has the Fuel system diagnosis been performed?		Go to Step 3	Go to Fuel system Diagnosis
3	1. Replace the Engine Control Unit (ECM). Refer to Engine Control Unit (ECM) replacement. Is this action complete?		Go to Step 5	Go to Step 4
4	1. Repair the open or damaged circuit. Is this action complete?		Go to Step 5	Go to Step 8
5	1. Return the fuel system to normal operating condition. 2. Observe the Adaptive 1 fuel correction. 3. Raise the engine speed to approximately 2500 rpm. Is the Adaptive 1 fuel correction within the specified range at idle and 2500 rpms?	-15 to +15	Go to Step 9	Go to Step 6
6	1. Check all vacuum hoses and mixer connections for leakage. Was a problem found?		Go to Step 5	Go to Step 7
7	1. Replace Mixer. Is this action complete?		Go to Step 5	Go to Step 9
8	1. The fuel control system is operating normally. Refer to Symptoms Diagnosis 1. Disconnect all test equipment 2. 2. If you were sent to this routine by another diagnostic chart, retune to the previous diagnostic procedure. Is this action complete?		System OK	
9	1. Disconnect all test equipment 2. Start the engine 3. Using a liquid leak detection solution leak check any fuel system repairs made. Is this action complete?		System OK	

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