## **ENGINE CONTROL**

#### SYSTEM OUTLINE

THIS SYSTEM UTILIZES AN ECU AND MAINTAINS OVERALL CONTROL OF THE ENGINE, TRANSMISSION AND SO ON. AN OUTLINE OF THE ENGINE CONTROL IS EXPLAINED HERE.

#### 1. INPUT SIGNALS

(1) WATER TEMP. SIGNAL CIRCUIT

THE WATER TEMP. SENSOR DETECTS THE ENGINE COOLANT TEMP. AND HAS A BUILT-IN THERMISTOR WITH A RESISTANCE WHICH VARIES ACCORDING TO THE WATER TEMP. THE WATER TEMP. IS INPUT INTO **TERMINAL THW** OF ENGINE CONTROL ECU AS A CONTROL SIGNAL.

(2) INTAKE AIR TEMP. SIGNAL CIRCUIT

THE INTAKE AIR TEMP. SENSOR IS INSTALLED IN THE AIR FLOW METER AND DETECTS THE INTAKE AIR TEMP., WHICH IS INPUT AS A CONTROL SIGNAL TO **TERMINAL THA** OF ENGINE CONTROL ECU.

(3) OXYGEN SENSOR SIGNAL CIRCUIT

THE OXYGEN DENSITY IN THE EXHAUST EMISSIONS IS DETECTED AND INPUT AS A CONTROL SIGNAL FROM THE OXYGEN SENSOR MAIN (FOR LEFT AND RIGHT BANK) TO **TERMINALS OXL1**, **OXR1** OF THE ECU AND FROM THE OXYGEN SENSOR SUB (FOR LEFT AND RIGHT BANK) TO **TERMINAL OXL2**, **OXR2** OF THE ECU.

TO STABILIZE DETECTION PERFORMANCE BY THE OXYGEN SENSOR (MAIN), THE OXYGEN SENSOR (MAIN) IS WARMED. THIS HEATER IS ALSO CONTROLLED BY THE ECU (HT1, HT2).

(4) RPM SIGNAL CIRCUIT

CAM SHAFT POSITION IS DETECTED BY THE CAM POSITION SENSOR (FOR LEFT AND RIGHT BANK) INSTALLED IN THE DISTRIBUTOR HOUSING AND ITS SIGNAL IS INPUT TO **TERMINALS G1+**, **G2+** OF ECU AS A CONTROL SIGNAL. ALSO, THE ENGINE RPM IS DETECTED BY THE ENGINE SPEED SENSOR INSTALLED IN THE CYLINDER BLOCK AND THE SIGNAL IS INPUT INTO **TERMINAL NE+** OF ECU AS A CONTROL SIGNAL.

(5) THROTTLE SIGNAL CIRCUIT

THE THROTTLE POSITION SENSOR DETECTS THE THROTTLE VALVE OPENING ANGLE AS A CONTROL SIGNAL, WHICH IS INPUT INTO **TERMINAL VTA 1** OF THE ECU. WHEN THE VALVE IS COMPLETELY CLOSED, THE CONTROL SIGNAL IS INPUT INTO **TERMINAL IDL 1**.

(6) VEHICLE SPEED CIRCUIT

THE VEHICLE SPEED IS DETECTED BY SPEED SENSOR NO.1 INSTALLED IN THE TRANSMISSION AND THE SIGNAL IS INPUT TO **TERMINAL SPD** OF THE ECU VIA THE COMB. METER.

(7) NEUTRAL START SIGNAL CIRCUIT

THE NEUTRAL START SW DETECTS WHETHER THE SHIFT POSITION IS IN NEUTRAL OR NOT, AND THE SIGNAL IS INPUT INTO **TERMINAL NSW** OF THE ECU.

(8) AIR CONDITIONER SW SIGNAL CIRCUIT

THE OPERATING VOLTAGE OF THE A/C MAGNET CLUTCH IS DETECTED AND THE SIGNAL IS INPUT INTO **TERMINAL ACMG** OF ECU AS A CONTROL SIGNAL.

(9) BATTERY SIGNAL CIRCUIT

VOLTAGE IS CONSTANTLY APPLIED TO **TERMINAL BATT** OF THE ECU. WITH THE IGNITION SW TURNED ON, THE VOLTAGE FOR ECU START-UP POWER SUPPLY IS APPLIED TO **TERMINAL +B** AND **+B1** OF ECU VIA ECU MAIN RELAY.

THE CURRENT FLOWING THROUGH THE IGN FUSE FLOWS TO TERMINAL IGSW OF THE ECU.

(10) INTAKE AIR VOLUME SIGNAL CIRCUIT

INTAKE AIR VOLUME IS DETECTED BY THE AIR FLOW METER AND THE SIGNAL IS INPUT TO **TERMINAL KS** OF THE ECU AS A CONTROL SIGNAL.

(11) STOP LIGHT SW SIGNAL CIRCUIT

THE STOP LIGHT SW IS USED TO DETECT WHETHER OR NOT THAT THE VEHICLE IS BRAKING AND THE SIGNAL IS INPUT INTO **TERMINAL BK** OF THE ECU AS A CONTROL SIGNAL.

(12) STA SIGNAL CIRCUIT

TO CONFIRM WHETHER THE ENGINE IS CRANKING, THE VOLTAGE APPLIED TO THE STARTER MOTOR DURING CRANKING IS DETECTED AND THE SIGNAL IS INPUT INTO **TERMINAL STA** OF THE ECU AS A CONTROL SIGNAL.

(13) ENGINE KNOCK SIGNAL CIRCUIT

ENGINE KNOCKING IS DETECTED BY KNOCK SENSOR NO.1 AND NO.2 AND THE SIGNAL IS INPUT INTO **TERMINALS KNK1** AND **KNK2** AS A CONTROL SIGNAL.

#### 2. CONTROL SYSTEM

\* EFI (ELECTRONIC FUEL INJECTION) SYSTEM

THE EFI SYSTEM MONITORS THE ENGINE RPM THROUGH THE SIGNALS INPUT FROM EACH SENSOR (INPUT SIGNALS FROM (1) TO (13) ETC.) TO THE ECU. THE BEST FUEL INJECTION TIMING IS DECIDED BASED ON THIS DATA AND THE PROGRAM MEMORIZED BY THE ECU, AND THE CONTROL SIGNAL IS OUTPUT TO **TERMINAL #10**, #20, #30 AND #40 OF THE ECU TO OPERATE THE INJECTOR. (INJECT THE FUEL). THE EFI SYSTEM PRODUCES CONTROL OF FUEL INJECTION OPERATION BY THE ECU IN RESPONSE TO THE DRIVING CONDITIONS.

\* ESA (ELECTRONIC SPARK ADVANCE) SYSTEM

THE ESA SYSTEM MONITORS THE ENGINE RPM THROUGH THE SIGNALS INPUT TO THE ECU FROM EACH SENSOR (INPUT SIGNALS FROM (1), (2), (4) TO (13) ETC.). THE BEST IGNITION TIMING IS DECIDED ACCORDING TO THIS DATA AND THE MEMORIZED DATA IN THE ECU AND THE CONTROL SIGNAL IS OUTPUT TO **TERMINAL IGT1** AND **IGT2**. THIS SIGNAL CONTROLS THE IGNITER TO PROVIDE THE BEST IGNITION TIMING FOR THE DRIVING CONDITIONS.

\* FUEL PRESSURE-UP SYSTEM

THE FUEL PRESSURE-UP SYSTEM CAUSED THE VSV (FOR FUEL PRESSURE-UP) TO COME ON FOR HIGH TEMP. STARTING AND INCREASED THE FUEL PRESSURE TO IMPROVE STARTABILITY AT HIGH TEMPERATURES AND TO PROVIDE STABLE IDLING. THE ECU EVALUATES THE INPUT SIGNALS FROM EACH SENSOR ((1), (2), (4), (9) AND (10) ETC.), AND OUTPUTS CURRENT TO TERMINAL PR OF ECU TO CONTROL THE VSV.

\* OXYGEN SENSOR HEATER CONTROL SYSTEM

THE OXYGEN SENSOR HEATER CONTROL SYSTEM TURNS THE HEATER ON WHEN THE INTAKE AIR VOLUME IS LOW (TEMP. OF EXHAUST EMISSIONS IS LOW), AND WARMS UP THE OXYGEN SENSOR (FOR LEFT AND RIGHT BANK) TO IMPROVE DETECTION PERFORMANCE OF THE SENSOR.

THE ECU EVALUATES THE SIGNALS FROM EACH SENSOR (INPUT SIGNALS FROM (1), (2), (4), (9) TO (11) ETC.), OUTPUTS CURRENT TO  $\mathbf{TERMINAL\ HT1}$ ,  $\mathbf{HT2}$  TO CONTROL THE HEATER.

\* ISC (IDLE SPEED CONTROL) SYSTEM

THE ISC SYSTEM (STEP MOTOR TYPE) INCREASES THE RPM AND PROVIDES IDLING STABILITY FOR FAST IDLE—UP WHEN THE ENGINE IS COLD, AND WHEN THE IDLE SPEED HAS DROPPED DUE TO ELECTRICAL LOAD AND SO ON. THE ECU EVALUATES THE SIGNALS FROM EACH SENSOR (INPUT SIGNALS FROM (1), (4), (5), (8), (9), (11) ETC.), OUTPUTS CURRENT TO **TERMINAL ISC1**, **ISC2**, **ISC3** AND **ISC4** TO CONTROL ISC VALVE.

\* EGR CONTROL SYSTEM

THE EGR CONTROL SYSTEM DETECTS THE SIGNAL FROM EACH SENSOR (INPUT SIGNALS FROM (1), (4), (9), (10) ETC.), AND OUTPUTS CURRENT TO **TERMINAL EGR** TO CONTROL THE EGR VALVE.

\* FUEL PUMP CONTROL SYSTEM

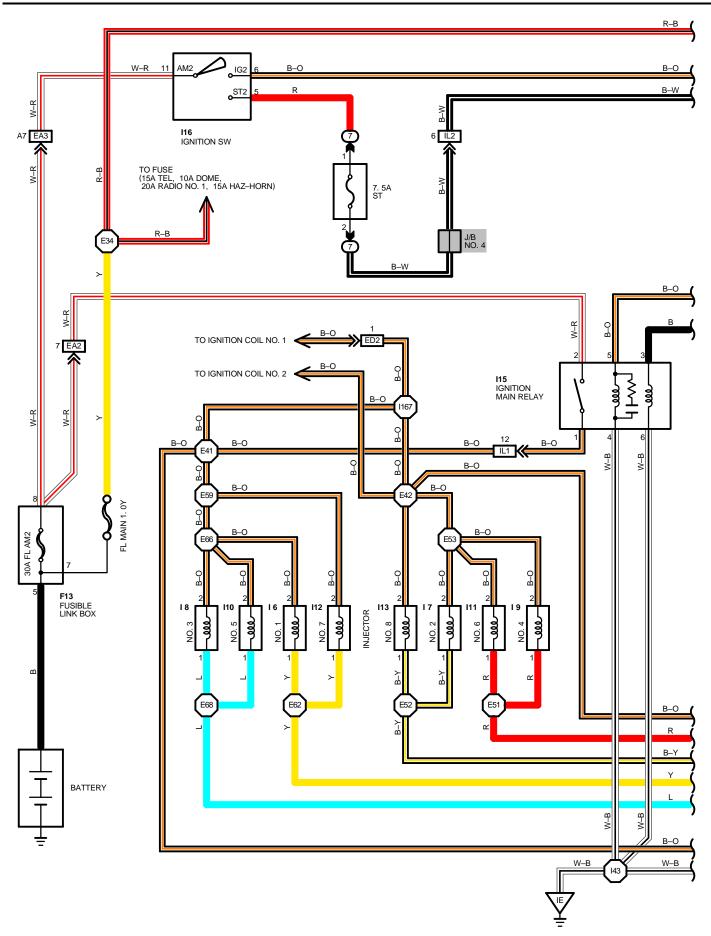
THE COMPUTER OUTPUTS CURRENT TO **TERMINAL FPR** AND CONTROLS THE FUEL PUMP CONTROL RELAY AND FUEL PUMP DRIVE SPEED IN RESPONSE TO CONDITIONS.

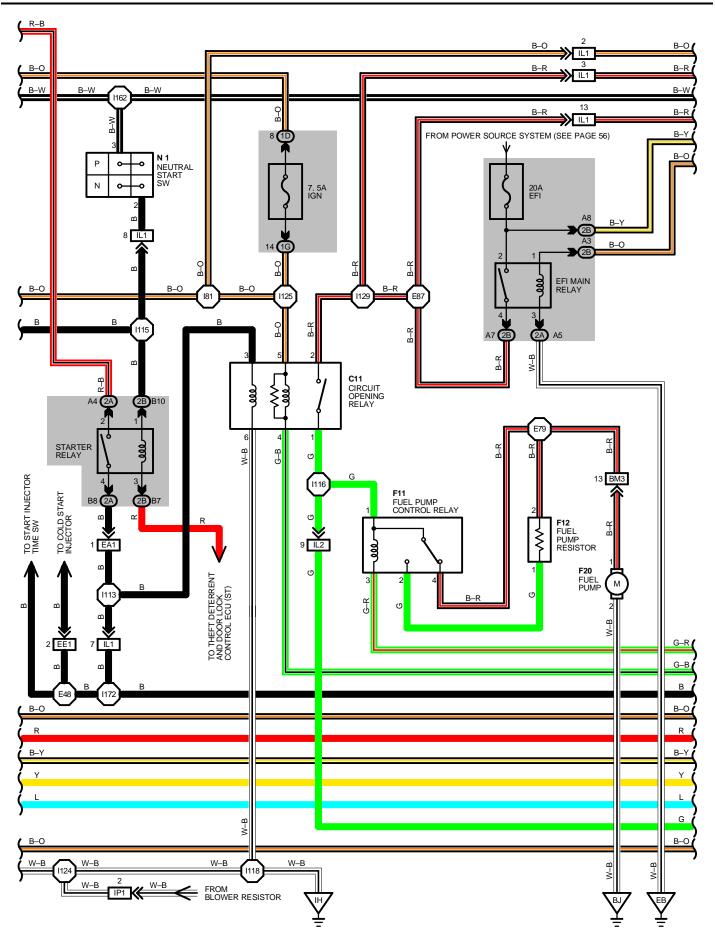
### 3. DIAGNOSIS SYSTEM

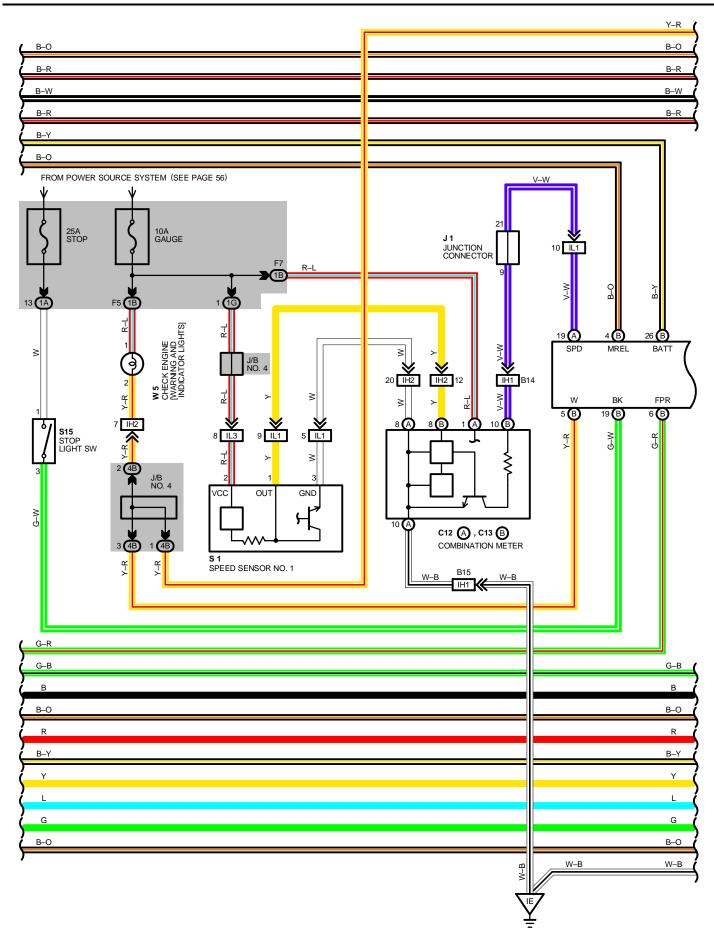
WITH THE DIAGNOSIS SYSTEM, WHEN THERE IS A MALFUNCTION IN THE ECU SIGNAL SYSTEM, THE MALFUNCTIONING SYSTEM IS RECORDED IN THE MEMORY. THE MALFUNCTIONING SYSTEM CAN BE FOUND BY THE READING THE CODE DISPLAYED BY THE CHECKING ENGINE WARNING LIGHT.

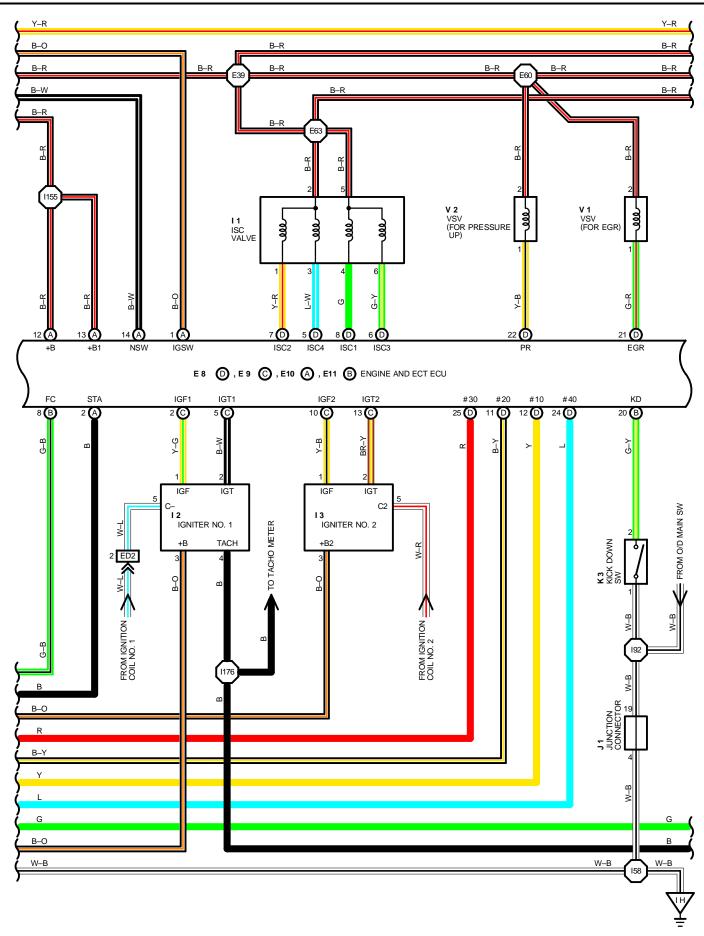
### 4. FAIL-SAFE SYSTEM

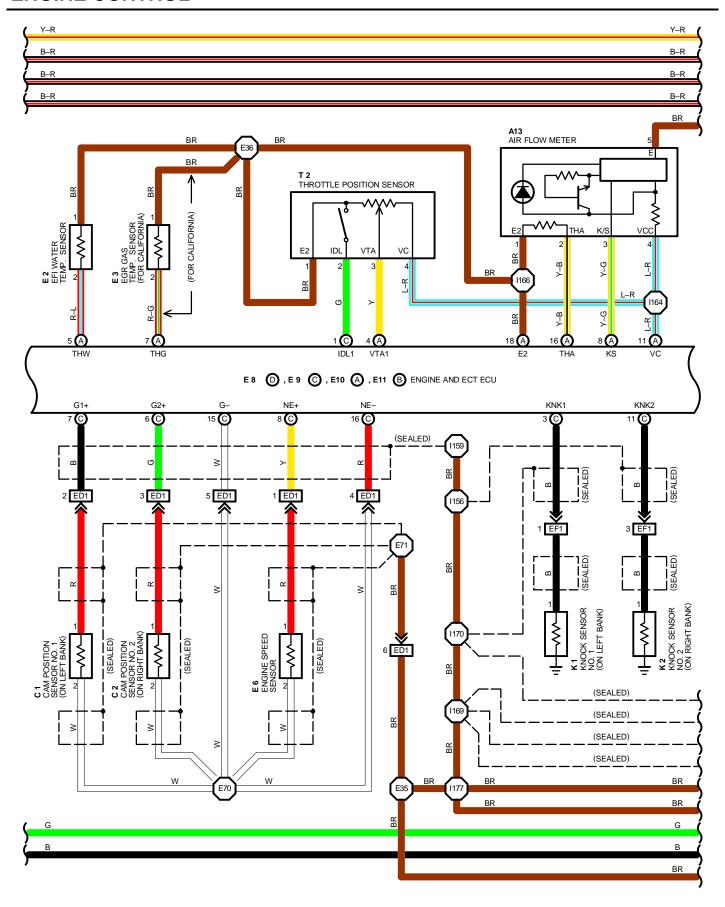
WHEN A MALFUNCTION HAS OCCURRED IN ANY SYSTEM. IF THERE IS A POSSIBILITY OF ENGINE TROUBLE BEING CAUSED BY CONTINUED CONTROL BASED ON THE SIGNALS FROM THAT SYSTEM. THE FAIL—SAFE SYSTEM EITHER CONTROLS THE SYSTEM BY USING DATA (STANDARD VALUES) RECORDED IN THE ECU MEMORY OR ELSE STOPS THE ENGINE.

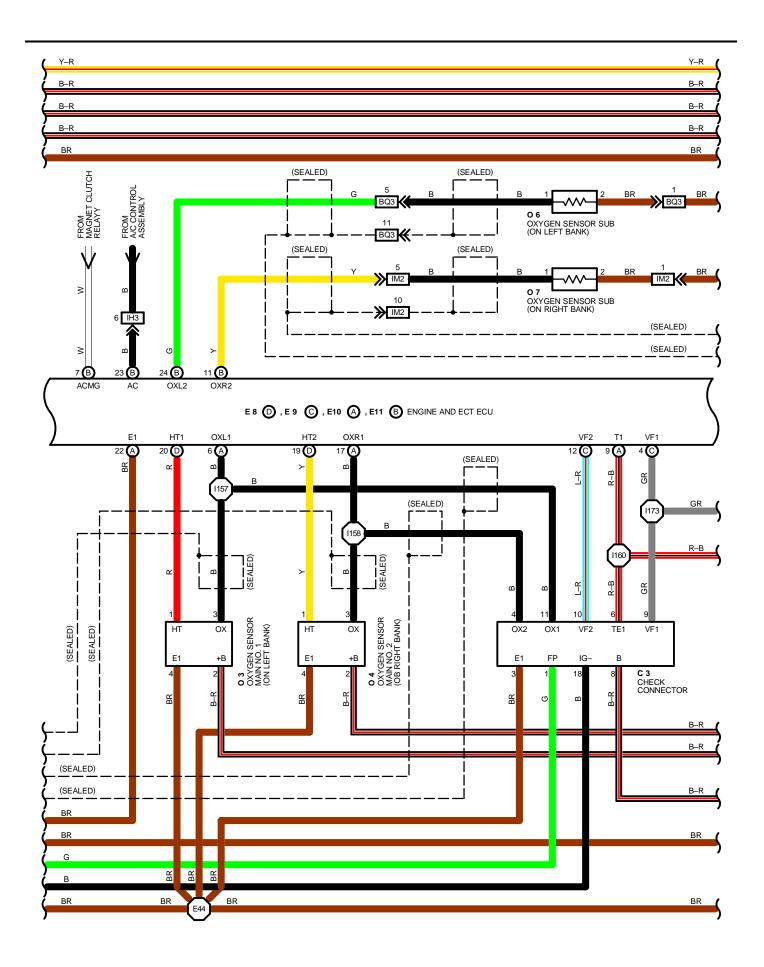


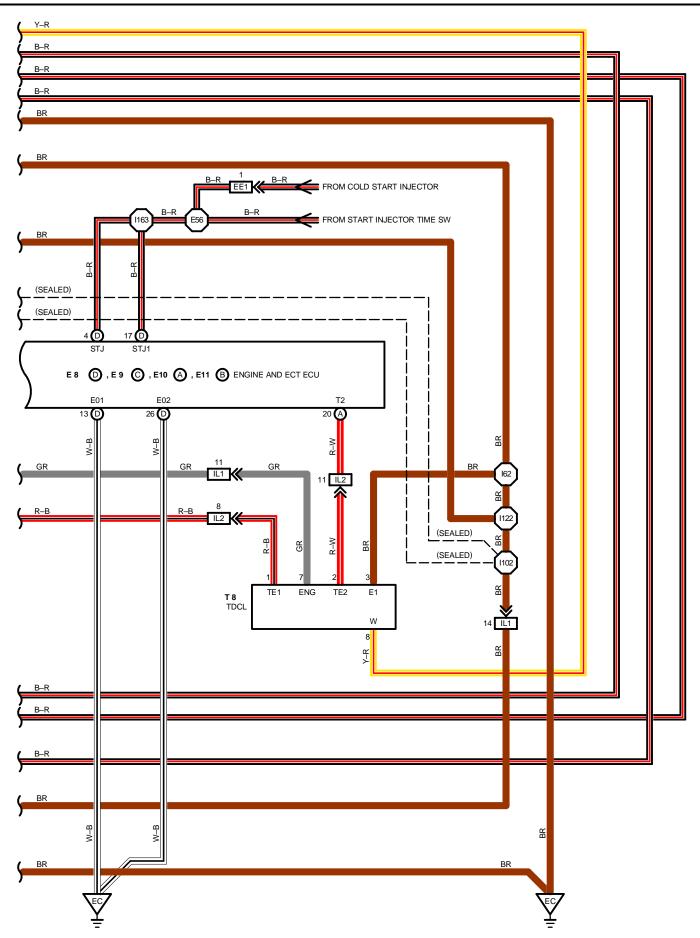












### SERVICE HINTS — FFI MAIN RFI AY 1-3: CLOSED WITH IGNITION SW AT ON OR ST POSITION C11 CIRCUIT OPENING RELAY 1-2: CLOSED WITH STARTER RUNNING OR MEASURING PLATE (AIR FLOW METER) OPEN E 2 EFI WATER TEMP. SENSOR 1–2 : APPROX. **16.2**KΩ (**–20**°C, **–4**°F) APPROX. 2.45K $\Omega$ (20°C, 68°F) APPROX. **0.32**K $\Omega$ (**80**°C, **176**°F) E 3 EGR GAS TEMP. SENSOR (FOR CALIFORNIA) 1–2 : APPROX. **78.30**KΩ (**50**°C, **122**°F) APPROX. **13.06**K $\Omega$ (**100**°C. **212**°F) APPROX. 3.16K $\Omega$ (150°C, 302°F) E 8, E 9, E10, E11 ENGINE AND ECT ECU (VOLTAGE AT ENGINE AND ECT ECU WARNING CONNECTORS) BATT-E1: ALWAYS APPROX. 12 VOLTS IGSW-E1: APPROX. 12 VOLTS WITH IGNITION SW ON +B, +B1-E1 : APPROX. 12 VOLTS WITH IGNITION SW ON IDL-E2: APPROX. 5 VOLTS WITH IGNITION SW ON AND THROTTLE VALVE OPEN VC-E2: APPROX. 5 VOLTS WITH IGNITION SW ON VTA-E2 : 0.1-1.0 VOLTS WITH IGNITION SW ON AND THROTTLE VALVE FULLY CLOSED 3-5 VOLTS WITH IGNITION SW ON AND THROTTLE VALVE FULLY OPEN KS-GROUND: APPROX. 5 VOLTS WITH IGNITION SW ON VC-GROUND: APPROX. 5 VOLTS WITH IGNITION SW ON THA-E2: 1-3 VOLTS WITH IGNITION SW ON AND INTAKE AIR TEMP. 20°C (68°F) THW-E2 : 0.1-1.0 VOLTS WITH IGNITION SW ON AND COOLANT TEMP. 80°C (176°F) #10, #20, #30, #40 -E01: APPROX. 12 VOLTS WITH IGNITION SW ON STA-E1: 6-14 VOLTS WITH ENGINE CRANKING ISC1, ISC2, ISC3, ISC4 -E1: 9-14 VOLTS WITH IGNITION SW ON IGT-E1: 0.7-1.0 VOLTS WITH ENGINE IDLING W-E1: 8-14 VOLTS WITH NO TROUBLE (CHECK ENGINE WARNING LIGHT OFF) AND ENGINE RUNNING A/C-E1: 0-2 VOLTS WITH AIR CONDITIONER ON TE1-E1: 4-6 VOLTS WITH IGNITION SW ON AND CHECK CONNECTOR TERMINALS TE1-E1 NO CONNECT 0-1 VOLTS WITH IGNITION SW ON AND CHECK CONNECTOR TERMINALS TE1-E1 CONNECT NSW-E1: 0-1 VOLTS WITH IGNITION SW ON AND SHIFT LEVER P OR N RANGE 10-14 VOLTS WITH IGNITION SW ON AND SHIFT LEVER EXCEPT P OR N RANGE BK-GROUND: APPROX. 12 VOLTS WITH STOP LIGHT SW ON (BRAKE PEDAL DEPRESSED) (RESISTANCE OF ENGINE AND ECT ECU WIRING CONNECTORS) +B, +B1-#10, #20. #30. #40 : $0.05-1.78\Omega$ +B, B1-PR : **30-50** $\Omega$ +B,+B1-EGR : $30-50\Omega$ +B. +B1-HT1. HT2 : **5.1–6.3**Ω+B, +B1-BK : INFINITY STJ-STA : ${\bf 25-45}\Omega$ WITH WATER TEMP. BELOW APPROX. ${\bf 15}^{\circ}$ C ( ${\bf 59}^{\circ}$ F) 65-85Ω WITH WATER TEMP. ABOVE APPROX. 30°C (86°F) IDL1-E2: INFINITY WITH THROTTLE VALVE OPEN $\mathbf{0}\mathbf{-2.3}\mathbf{K}\Omega$ WITH THROTTLE VALVE FULLY CLOSED THG-E2 : 69.4-88.5K $\Omega$ WITH EGR GAS TEMP. 50°C (122°F) THW-E2 : 200-400Ω WITH COOLANT TEMP. 80°C (176°F) THA-E2 : **200-300** $\Omega$ WITH INTAKE AIR TEMP. **20**°C (**68**°F) VTA1-E2 : 2.8-8KΩ WITH THROTTLE VALVE FULLY OPEN $200-800\Omega$ WITH THROTTLE VALVE FULLY CLOSED

## **ENGINE CONTROL**

### F12 FUEL PUMP RESISTOR

1–2 : APPROX.  $\mathbf{0.7}\Omega$ 

#### 11 ISC VALVE

4, 6–5 : APPROX. **21.3** $\Omega$  1, 3–2 : APPROX. **21.3** $\Omega$ 

16, 17, 18, 19, 110, 111, 112, 113 INJECTOR

1–2 : APPROX. **13.8** $\Omega$ 

O 3, O 4 OXYGEN SENSOR MAIN

1–2 : APPROX. **5.6**Ω (**20**°C, **68**°F)

T 2 THROTTLE POSITION SENSOR

1–4 : APPROX. **4–9**K $\Omega$ 

1–3 : 3.3–10.0K  $\!\Omega$  with throttle valve fully opened position

 ${f 0.2}{ ext{-}1.2}{f K}\Omega$  with Clearance between Lever and Stop Screw 0MM (0In.)

1–2 : LESS THAN 2.3K $\Omega$  WITH CLEARANCE BETWEEN LEVER AND STOP SCREW 0.4MM (0.0157IN.) INFINITY WITH CLEARANCE BETWEEN LEVER AND STOP SCREW 0.85MM (0.0335IN.)

V 2 VSV (FOR FUEL PRESSURE UP)

1-2 : APPROX. **40**Ω (**20**°C, **68**°F)

## : PARTS LOCATION

CC	DDE	SEE PAGE	CODE	SEE PAGE	CODE	SEE PAGE	
Α	13	24	F13	24	K 1	25	
С	: 1	24	F20	28	K 2	25	
С	2	24	I 1	25	K 3	27	
С	3	24	I 2	25	N 1	25	
С	:11	26	I 3	25	0 3	25	
C12	Α	26	I 6	25	0 4	25	
C13	В	26	I 7	25	O 6	29	
Е	2	24	I 8	25	0 7	29	
Е	3	24	I 9	25	S 1	25	
Е	6	24	I10	25	S15	27	
E 8	D	26	I11	25	T 2	25	
E 9	С	26	l12	25	T 8	27	
E10	Α	26	I13	25	V 1	25	
E11	В	26	I15	26	V 2	25	
F	11	24	I16	26	W 5	27	
F.	12	24	J1	27			

### : RELAY BLOCKS

CODE	SEE PAGE	RELAY BLOCKS (RELAY BLOCK LOCATION)
7	18	R/B NO.7 (RIGHT SIDE OF J/B NO.1)

## : JUNCTION BLOCK AND WIRE HARNESS CONNECTOR

CODE	SEE PAGE	JUNCTION BLOCK AND WIRE HARNESS (CONNECTOR LOCATION)		
1A	18 COWL WIRE AND J/B NO.1 (LEFT SIDE OF STEERING COLUMN TUBE)			
1B	18	INSTRUMENT PANEL WIRE AND J/B NO.1 (LEFT SIDE OF STEERING COLUMN TUBE)		
1D	18	COWL WIRE AND J/B NO.1 (LEFT SIDE OF STEERING COLUMN TUBE)		
1G		COWL WIRE AND 3/B NO.1 (LEFT SIDE OF STEERING COLUMN TOBE)		
2A	20	ENGINE ROOM MAIN WIRE AND J/B NO.2 (ENGINE COMPARTMENT LEFT)		
2B	20	COWL WIRE AND J/B NO.2 (ENGINE COMPARTMENT LEFT)		
4B	23	COWL WIRE AND J/B NO.4 (BEHIND THE COMBINATION METER)		

## : CONNECTOR JOINING WIRE HARNESS AND WIRE HARNESS

CODE	SEE PAGE	JOINING WIRE HARNESS AND WIRE HARNESS (CONNECTOR LOCATION)				
EA1		COMMUNITE AND ENGINE DOOM MAIN WIDE (FRONT OIDE OF DIGHT FENDED)				
EA2	32	COWL WIRE AND ENGINE ROOM MAIN WIRE (FRONT SIDE OF RIGHT FENDER)				
EA3	32	COWL WIRE AND ENGINE ROOM MAIN WIRE (INSIDE OF J/B NO.2)				
ED1						
ED2	32	ENGINE WIRE AND ENGINE NO.4 WIRE (FRONT SIDE OF CYLINDER HEAD COVER LH)				
EE1	32	ENGINE WIRE AND ENGINE NO.4 WIRE, FOR COLD START INJECTOR (REAR SIDE OF AIR INTAKE CHAMBER)				
EF1	32	ENGINE NO.2 WIRE AND ENGINE WIRE (REAR SIDE OF AIR INTAKE CHAMBER)				
IH1	34	INSTRUMENT PANEL WIRE AND COWL WIRE (J/B NO.1)				
IH2	24	INICEDI IMENE DANIEL MIDE AND COMUNIDE (DELINID OLOVE DOV)				
IH3	34	INSTRUMENT PANEL WIRE AND COWL WIRE (BEHIND GLOVE BOX)				
IL1						
IL2	36	ENGINE WIRE AND COWL WIRE (UNDER THE GLOVE BOX)				
IL3						
IM2	36	FLOOR NO.1 WIRE AND COWL WIRE (UNDER THE GLOVE BOX)				
IP1	36	COWL WIRE AND A/C NO.2 WIRE (BEHIND GLOVE BOX)				
ВМ3	38	COWL WIRE AND FLOOR NO.1 WIRE (RIGHT KICK PANEL)				
BQ3	38	COWL WIRE AND FLOOR NO.2 WIRE (LEFT KICK PANEL)				

# : GROUND POINTS

CODE	SEE PAGE	GROUND POINTS LOCATION
EB	32	FRONT SIDE OF LEFT FENDER
EC	32	REAR SIDE OF CYLINDER HEAD RH
IE	34	LEFT KICK PANEL
IH	34	RIGHT KICK PANEL
BJ	38	UNDER THE RIGHT REAR PILLAR

## : SPLICE POINTS

CODE	SEE PAGE	WIRE HARNESS WITH SPLICE POINTS	CODE	SEE PAGE	WIRE HARNESS WITH SPLICE POINTS
E 34	32	ENGINE ROOM MAIN WIRE	I102		
E 35		ENGINE WIRE	I113		COWL WIRE
E 36			I115		
E 39			I116		
E 41			I118	36	
E 42			I122		
E 44			I124		
E 48			I125		
E 51			I129		
E 52	32		I155	36	ENGINE WIRE
E 53			I156		
E 56			I157		
E 59			I158		
E 60			I159		
E 62			I160		
E 63			I162		
E 66			I163		
E 68			I164		
E 70	32	ENGINE NO.4 WIRE	I166		
E 71	32	ENGINE NO.4 WIKE	I167		
E 79	32	COWL WIRE	I169		
E 87	34		I170		
I 43	36		I172		
I 58			I173		
I 62			I176		
I 81			I177		
I 92					

# **ENGINE CONTROL**

