Chrysler Scanner

Hardware and software for interfacing Chrysler's legacy CCD/PCI/SCI-bus.

SCI-bus commands

By default PCMs and TCMs use low speed mode (7812.5 baud) to communicate diagnostic data like fault codes, low reso tion engine/tranmission data and in this mode the user can engage actuator tests.

There's a great DRB-II communication protocol description on GitHub. Fortunately most commands apply to controllers ing DRB-III protocol too.

```
Output error codes            [ 0x10 ]                    -> code1, code2, ..., 0xfe
Output error bits             [ 0x11 ]                    -> HB, LB
Setup hi speed data transfer  [ 0x12 ]                    -> nothing
Setup ATM                     [ 0x13 ] [ arg  ]           -> depends on function?
Send diagnostic data to SCI   [ 0x14 ] [ loc  ]           -> 1 byte
Send 16-bit memory location   [ 0x15 ] [ arg1 ] [ arg2 ]  -> 1 byte
Send ECU ID to SCI            [ 0x16 ] [ arg1 ]           -> ?
Clear error codes             [ 0x17 ]                    -> 0xe0, 0xe0, 0xe0
Control ASD relay             [ 0x18 ] [ arg1 ]           -> nothing?
Set min idle speed            [ 0x19 ] [ arg1 ]           -> nothing?
Switch test                   [ 0x1A ] [ arg1 ]           -> ?
Init byte mode download       [ 0x1B ]                    -> nothing
Reset EMR                     [ 0x1C ] [ arg1 ] [ arg2 ]  -> 0xe2 or 0x00
Setup lo speed data transfer  [ 0xFE ]                    -> nothing
```

SMEC/SBEC DRB-II Routines (Excel Table)

Now that we have power over the DRB-III database let's take a closer look on these commands.

0x10

In a previous post I already analyzed this command.

0x11

There's not much information about it:

```
> txsearch SCI && xmit: 11-
SCI_EMERGE_DTC: SCI; xmit: 11-00-00; sc: Engine; 0x800000cd

> dumpconverter 0x800000cd
TYPE:  NUMERIC
REC:   11-11-0B-D9-01-03
DSREC: 0B-D9-00-00-3F-80-00-00-00-00-00-00-00-00-00-08-00-00-20-48

UNIT: (null)
SLOPE:  1
OFFSET: 0
SLCONV: 1
OFCONV: 0
```

0x12

This command switches the controller to high speed mode (62500 baud). You have to repeatedly send 0x12 until it is echoed back by the controller. Sometimes it takes several try until the command is accepted. Right after the echo the sp changes from 7812.5 baud to 62500 baud. Remaining in low speed won't do any harm, the controller just won't recogniz whatever data is thrown at it.

After switching the diagnostic tool to high speed mode the command format changes a bit. Now we have access to the controller's RAM with all of its raw data. The requested RAM address should be sent and without echo the memory value returned. The whole RAM is splitted into multiple tables.

There are special bytes (0xF0 – 0xFD) that makes the controller switch between these tables. In theory 14 tables are poss ble each with 240 readable bytes (remember, the last 16 bytes are special). In the DRB-III database every high-speed com mand is preceded by an 0xF? byte. Actually this "table-select" byte should be sent only once when switching between tab

It's better to imagine these tables like a 16×16 grid like this:

Chrysler Stratus 2.0L JA 1995

SCI-bus Memory Map (High Speed Mode / 62.5 kbps)

F2	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
00	00	00	00	00	00	00	A8	57	12	29	00	3B	6B	F4	00	E3
10	00	00	89	20	1C	1F	24	38	03	2D	CD	55	04	C4	B4	00
20	33	B9	EB	A8	86	03	93	10	35	0E	17	FA	12	00	0A	07
30	0B	00	00	FB	00	02	C4	18	00	00	00	00	00	00	00	00
40	00	00	00	00	00	00	00	00	00	45	00	FF	00	00	00	00
50	00	00	00	FC	00	00	00	00	00	00	00	03	00	00	00	00
60	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
70	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
80	00	00	04	00	60	00	00	00	00	00	00	00	00	00	00	00
90	00	80	80	80	80	80	80	80	80	80	80	00	00	00	00	00
A0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
B0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	E5
C0	00	00	32	00	04	69	00	00	00	00	00	00	10	02	00	10
D0	02	10	00	C0	38	01	10	01	02	00	0C	00	00	00	00	00
E0	00	00	20	C0	00	24	00	00	00	00	00	00	00	00	00	00
F0	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF

F4	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
00	F0	00	00	04	00	00	00	00	00	00	00	00	00	00	24	C8
10	67	93	23	29	23	8C	95	EA	F4	F4	00	18	18	8D	95	00
20	00	EA	F0	34	00	2F	29	19	80	19	80	FB	00	F0	0F	00
30	00	0F	0F	0F	0F	1C	40	3B	0F	0F	E5	00	FF	FB	3B	80
40	10	01	00	0C	00	00	0F	0F	18	17	07	18	82	C0	00	10
50	00	80	80	80	0F	80	80	80	0F	0F	0F	0F	0F	0F	0F	0F
60	0F	0F	10	35	0E	17	FA	12	00	0A	07	0B	00	00	FB	00
70	02	C4	18	00	00	00	00	00	00	00	19	18	00	00	00	00
80	00	00	00	00	00	00	00	00	00	00	00	00	00	0F	0F	0F
90	0F	0F	0F	0F	0F	0F	0F	0F	0F	0F	0F	0F	0F	0F	0F	0F
A0	0F	0F	0F	0F	0F	0F	00	00	0F	0F	0F	0F	0F	0F	0F	0F
B0	0F	0F	0F	0F	0F	0F	0F	00	00	00	80	0F	0F	0F	0F	0F

C0	00	00	00	00	0F	0F	0F	0F	00	00	00	00	03	2D	CD	55
D0	0F	0F	00	00	00	00	00	00	00	00	00	00	00	FF	8E	4F
E0	0F	0A	0F	0F	0F	0F	0F	0F	0F	0F	0F	0F	0F	0F	0F	0F
F0	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF

Offset	Parameter	Scaling / Masking	Dimension
F4 01	DTC		
F4 02	DTC Freeze Frame		
F4 03	Fuel System Status (Bank 1)	Table 1	
F4 04	Fuel System Status (Bank 2)	N/A	
F4 0A 0B	Engine RPM	0.125	rpm
F4 0C 0D	Vehicle Speed	0.0251057664	km/h

Table 1	
0x01	Open Loop
0x02	Closed Loop
0x04	Open Loop / Drive
0x08	Open Loop / DTC
0x10	Closed Loop / DTC

In this car the tables residing in F2 and F4 hold most of the raw parameters. I took the courage to read every available by and make a excel-table out of it. Few important parameters are color-coded. Red cells are RAM values that are not availa for reading (they timeout when requested).

Typically a diagnostic session goes like this below. Notice that in low speed mode every byte sent is echoed back by the c troller before answering. In high speed mode only special bytes are echoed back (F0 – FE).

```
[Default low speed mode]
TX: 10       (request fault codes)
RX: 10 FE 0E (no fault codes)
TX: 12       (switch controller to high speed mode)
TX: 12       (no response, try again)
TX: 12       (no response, try again)
RX: 12       (controller is in high speed mode)
[Switch scanner to high speed mode]
TX: F4       (select memory table)
TX: F4       (no response, try again)
RX: F4       (memory table selected)
TX: 0A       (request memory value at RAM address 0A: engine rpm high byte)
RX: 00       (engine rpm high byte)
TX: 0B       (request memory value at RAM address 0B: engine rpm low byte)
RX: 00       (engine rpm low byte)
```

```
TX: FE       (switch controller back to low speed mode)
TX: FE       (no response, try again)
TX: FE       (no response, try again)
TX: FE       (no response, keep trying)
RX: FE       (controller is in low speed mode)
[Switch scanner to low speed mode]
TX: 10       (request fault codes)
RX: 10 FE 0E (no fault codes)
```

62500 baud is plenty enough to request several RAM values in series and get continuous lag-free real-time data. Even if a whole table is requested it takes ~300-400 milliseconds to get an update. It's better to try out first which addresses respo properly because timeouts add together quickly and an update could take several seconds.

0x13

This command initiates actuator testing in low speed mode. Let's see what the DRB-III database has to say about it.

```
> txsearch SCI && xmit: 13-
TESTS STOPPED: SCI; xmit: 13-00-00; sc: Engine; 0x80000bc8
COIL #1 (CYL 1&4): SCI; xmit: 13-01-00; sc: Engine; 0x80000bca
COIL #1 (CYL 1&6): SCI; xmit: 13-01; sc: Engine; 0x80000bcb
COIL #2 (CYL 2&5): SCI; xmit: 13-02; sc: Engine; 0x80000bcc
COIL #2 (CYL 2&3): SCI; xmit: 13-02-00; sc: Engine; 0x80000bcd
COIL #2 (CYL 5&10): SCI; xmit: 13-02-00; sc: Engine; 0x80000bce
COIL #3 (CYL 3&6): SCI; xmit: 13-03-00; sc: Engine; 0x80000bcf
COIL #3 (CYL 8&9): SCI; xmit: 13-03; sc: Engine; 0x80000bd0
COIL #4 (CYL 4&7): SCI; xmit: 13-23; sc: Engine; 0x80000bd1
COIL #5 (CYL 2&3): SCI; xmit: 13-24; sc: Engine; 0x80000bd2
FUEL INJECTOR #1: SCI; xmit: 13-04; sc: Engine; 0x80000bd3
FUEL INJECTOR #2: SCI; xmit: 13-05; sc: Engine; 0x80000bd4
FUEL INJECTOR #3: SCI; xmit: 13-06; sc: Engine; 0x80000bd5
FUEL INJECTOR #4: SCI; xmit: 13-1D; sc: Engine; 0x80000bd6
FUEL INJECTOR #5: SCI; xmit: 13-1E; sc: Engine; 0x80000bd7
FUEL INJECTOR #5: SCI; xmit: 13-1E; sc: Engine; 0x80000bd8
FUEL INJECTOR #6: SCI; xmit: 13-1F; sc: Engine; 0x80000bd9
FUEL INJECTOR #6: SCI; xmit: 13-1F; sc: Engine; 0x80000bda
FUEL INJECTOR #7: SCI; xmit: 13-25; sc: Engine; 0x80000bdb
FUEL INJECTOR #8: SCI; xmit: 13-26; sc: Engine; 0x80000bdc
FUEL INJECTOR #9: SCI; xmit: 13-30; sc: Engine; 0x80000bdd
FUEL INJECTOR #10: SCI; xmit: 13-31; sc: Engine; 0x80000bde
IAC STEPPER MOTOR: SCI; xmit: 13-07; sc: Engine; 0x80000beb
ASD FUEL SYSTEM TST: SCI; xmit: 13-1C; sc: Engine; 0x80000bec
ASD FUEL SYSTEM TST: SCI; xmit: 13-1C; sc: Engine; 0x80000bed
ALL SOL/RELAYS: SCI; xmit: 13-14; sc: Engine; 0x80000bee
```

RAD FAN CONTROL: SCI; xmit: 13-08; sc: Engine; 0x80000bef

RAD FAN CONTROL: SCI; xmit: 13-08-00; sc: Engine; 0x80000bf1

RAD FAN CONTROL: SCI; xmit: 13-08; sc: Engine; 0x80000bf3

LOW SPEED FAN RELAY: SCI; xmit: 13-2E; sc: Engine; 0x80000bf4

LOW SPEED FAN RELAY: SCI; xmit: 13-2E-00; sc: Engine; 0x80000bf5

HIGH SPEED FAN RELAY: SCI; xmit: 13-2F; sc: Engine; 0x80000bf6

HIGH SPEED FAN RELAY: SCI; xmit: 13-2F-00; sc: Engine; 0x80000bf9

H-SPD FANS/HI FAN GND: SCI; xmit: 13-2F-00; sc: Engine; 0x80000bfa

CONDENSER FAN HI: SCI; xmit: 13-2F-00; sc: Engine; 0x80000bfb

CONDENSER FAN HI: SCI; xmit: 13-2F-00; sc: Engine; 0x80000bfc

CONDENSER FAN HI: SCI; xmit: 13-2F-00; sc: Engine; 0x80000bfd

LO & HI SPEED FAN: SCI; xmit: 13-08-00; sc: Engine; 0x80000bfe

LO & HI SPEED FAN: SCI; xmit: 13-08-00; sc: Engine; 0x80000bff

A/C CLUTCH RELAY: SCI; xmit: 13-09; sc: Engine; 0x80000c00

AUTO SHUTDOWN RELAY: SCI; xmit: 13-0A; sc: Engine; 0x80000c02

FUEL PUMP RELAY: SCI; xmit: 13-33-00; sc: Engine; 0x80000c03

HIPRES FUEL SHUTOFF: SCI; xmit: 13-33-00; sc: Engine; 0x80000c05

INTAKE HEATER #1: SCI; xmit: 13-28-00; sc: Engine; 0x80000c06

INTAKE HEATER #2: SCI; xmit: 13-29-00; sc: Engine; 0x80000c07

S/C 12 VOLT FEED: SCI; xmit: 13-2C; sc: Engine; 0x80000c08

S/C 12 VOLT FEED: SCI; xmit: 13-2C-00; sc: Engine; 0x80000c0c

EVAP PURGE SOLENOID: SCI; xmit: 13-0B-00; sc: Engine; 0x80000c0d

EVAP PURGE SOLENOID: SCI; xmit: 13-0B; sc: Engine; 0x80000c13

EGR SOLENOID: SCI; xmit: 13-10-00; sc: Engine; 0x80000c16

EGR SOLENOID: SCI; xmit: 13-10-00; sc: Engine; 0x80000c17

EGR SOLENOID: SCI; xmit: 13-10-00; sc: Engine; 0x80000c19

EGR SOLENOID: SCI; xmit: 13-10-00; sc: Engine; 0x80000c1a

EGR SOLENOID: SCI; xmit: 13-10-00; sc: Engine; 0x80000c1b

TRANS 12V RELAY: SCI; xmit: 13-43-00; sc: Engine; 0x80000c1c

TRANS 12V RELAY: SCI; xmit: 13-43-00; sc: Engine; 0x80000c1d

TRANS 12V RELAY: SCI; xmit: 13-43-00; sc: Engine; 0x80000c1e

TRANS 12V RELAY: SCI; xmit: 13-43; sc: Engine; 0x80000c1f

TORQUE CONV CLUTCH: SCI; xmit: 13-0F-00; sc: Engine; 0x80000c21

OVERDRIVE SOLENOID: SCI; xmit: 13-16; sc: Engine; 0x80000c27

OVERDRIVE SOLENOID: SCI; xmit: 13-16; sc: Engine; 0x80000c28

OVERDRIVE LAMP: SCI; xmit: 13-41-00; sc: Engine; 0x80000c29

OVERDRIVE LAMP: SCI; xmit: 13-41-00; sc: Engine; 0x80000c2a

OVERDRIVE LAMP: SCI; xmit: 13-41; sc: Engine; 0x80000c2b

OVERDRIVE LAMP: SCI; xmit: 13-41; sc: Engine; 0x80000c2c

S/C SERVOS: SCI; xmit: 13-0C; sc: Engine; 0x80000c2d

S/C SERVOS: SCI; xmit: 13-0C-00; sc: Engine; 0x80000c2e

S/C VENT SOLENOID: SCI; xmit: 13-1A; sc: Engine; 0x80000c30

S/C VENT SOLENOID: SCI; xmit: 13-1A-00; sc: Engine; 0x80000c31

S/C VAC SOLENOID: SCI; xmit: 13-1B; sc: Engine; 0x80000c33

S/C VAC SOLENOID: SCI; xmit: 13-1B-00; sc: Engine; 0x80000c34

SKIP SHIFT SOL: SCI; xmit: 13-32-00; sc: Engine; 0x80000c36

MANIFOLD TUNE VALVE: SCI; xmit: 13-2D-00; sc: Engine; 0x80000c37

MANIFOLD TUNE VALVE: SCI; xmit: 13-2D-00; sc: Engine; 0x80000c38

SHORT RUNNER VALVE: SCI; xmit: 13-46-00; sc: Engine; 0x80000c39

GENERATOR FIELD: SCI; xmit: 13-0D; sc: Engine; 0x80000c3a

TACHOMETER OUTPUT: SCI; xmit: 13-0E-00; sc: Engine; 0x80000c3b

TACHOMETER OUTPUT: SCI; xmit: 13-0E-00; sc: Engine; 0x80000c3c

SHIFT INDICATOR LMP: SCI; xmit: 13-17; sc: Engine; 0x80000c3d

O2 HEATER TEST: SCI; xmit: 13-40; sc: Engine; 0x80000c3e

O2 HEATER TEST: SCI; xmit: 13-56; sc: Engine; 0x80000c3f

LDP SOLENOID: SCI; xmit: 13-3D; sc: Engine; 0x80000c41

WASTEGATE: SCI; xmit: 13-11-00; sc: Engine; 0x80000c42

BARO SOLENOID: SCI; xmit: 13-12-00; sc: Engine; 0x80000c43

SURGE VALVE SOL: SCI; xmit: 13-19-00; sc: Engine; 0x80000c44

FUEL PUMP RELAY: SCI; xmit: 13-33; sc: Engine; 0x80000c6f

TORQUE CONV CLUTCH: SCI; xmit: 13-0F; sc: Engine; 0x80000c8b

TRANS 12V RELAY: SCI; xmit: 13-43; sc: Engine; 0x80000c8c

ENG STOP ALL ACTUATORS: SCI; xmit: 13-00; sc: Engine; 0x80000c8d

LOW SPEED FAN RELAY: SCI; xmit: 13-2E; sc: Engine; 0x80002f48

HIGH SPEED FAN RELAY: SCI; xmit: 13-2F; sc: Engine; 0x80002f49

RAD FAN ON/OFF RELAY: SCI; xmit: 13-2E; sc: Engine; 0x80002f4a

RAD FAN HI/LO RELAY: SCI; xmit: 13-08; sc: Engine; 0x80002f4b

1/1 2/1 O2 HEATER RELAY: SCI; xmit: 13-52; sc: Engine; 0x80002f4e

1/1 2/1 O2 HEATER RELAY: SCI; xmit: 13-52; sc: Engine; 0x80002f4f

1/1 2/1 O2 HEATER RELAY: SCI; xmit: 13-52; sc: Engine; 0x80002f51

1/1 2/1 O2 HEATER RELAY: SCI; xmit: 13-52; sc: Engine; 0x80002f52

2-3 LOCKOUT SOL: SCI; xmit: 13-32; sc: Engine; 0x80002f54

REVERSE LOCKOUT SOL: SCI; xmit: 13-44; sc: Engine; 0x80002f55

ASD FUEL SYSTEM TST: SCI; xmit: 13-1C; sc: Engine; 0x80002f62

ASD FUEL SYSTEM TST: SCI; xmit: 13-1C; sc: Engine; 0x80002f63

ASD FUEL SYSTEM TST: SCI; xmit: 13-1C; sc: Engine; 0x80002f64

MANIFOLD TUNE VALVE: SCI; xmit: 13-2D-00; sc: Engine; 0x80002f76

SHORT RUNNER VALVE: SCI; xmit: 13-46-00; sc: Engine; 0x80002f7c

EGR SOLENOID: SCI; xmit: 13-10-00; sc: Engine; 0x80002f8e

TEST STOPPED: SCI; xmit: 13-00; sc: ECM; 0x80002fa2

P_PCM_NOC_IAC_STEP_DOWN_208: SCI; xmit: 13-3C; sc: Engine; 0x800041a3

P_PCM_NOC_IAC_STEP_UP_207: SCI; xmit: 13-3B; sc: Engine; 0x800041a4

1/2 2/2 O2 HEATER RELAY: SCI; xmit: 13-53; sc: Engine; 0x80004f73

1/2 2/2 O2 HEATER RELAY: SCI; xmit: 13-53; sc: Engine; 0x80004f77

1/2 2/2 O2 HEATER RELAY: SCI; xmit: 13-53; sc: Engine; 0x80004f78

1/2 2/2 O2 HEATER RELAY: SCI; xmit: 13-53; sc: Engine; 0x80004f79

COIL #1: SCI; xmit: 13-01; sc: Engine; 0x80004f81

COIL #1 (CYL 1&6): SCI; xmit: 13-01; sc: Engine; 0x80004f87

COIL #2 (CYL 2&5): SCI; xmit: 13-02; sc: Engine; 0x80004f89

COIL #3 (CYL 3&4): SCI; xmit: 13-03; sc: Engine; 0x80004f8b

COIL #3 (CYL 3&4): SCI; xmit: 13-03; sc: Engine; 0x80004f8c

O2 HEATER TEST: SCI; xmit: 13-40; sc: Engine; 0x800050c4

TRANSFER PUMP: SCI; xmit: 13-00; sc: ECM; 0x80005226

INTAKE HEATER #1: SCI; xmit: 13-28; sc: ECM; 0x8000522c

WAIT TO START LAMP: SCI; xmit: 13-49; sc: ECM; 0x8000522d

O2 HEATER TEST: SCI; xmit: 13-40; sc: Engine; 0x8000545d

O2 HEATER TEST: SCI; xmit: 13-57; sc: Engine; 0x800054f8

O2 HEATER TEST: SCI; xmit: 13-53; sc: Engine; 0x800054f9

O2 HEATER TEST: SCI; xmit: 13-04; sc: Engine; 0x800059b2

DES RAD FAN SOL: SCI; xmit: 13-5A; sc: Engine; 0x80005b01

INTAKE HEATER #2: SCI; xmit: 13-29; sc: ECM; 0x80005b34

RAD FAN CONTROL: SCI; xmit: 13-08-00; sc: Engine; 0x80005cfc

A/C CLUTCH: SCI; xmit: 13-09; sc: ECM; 0x80005ff6

LOW SPEED FAN RELAY: SCI; xmit: 13-2E-00; sc: Engine; 0x800061c0

1/1 O2S HEATER RELAY: SCI; xmit: 13-56; sc: Engine; 0x80006299

1/2 O2S HEATER RELAY: SCI; xmit: 13-5B; sc: Engine; 0x8000629a

A/C CLUTCH RELAY: SCI; xmit: 13-09; sc: Engine; 0x80006705

EXHAUST BRAKE: SCI; xmit: 13-5D; sc: ECM; 0x8000691d

PWM RAD FAN: SCI; xmit: 13-5F; sc: ECM; 0x8000691e

O2 HEATER TEST: SCI; xmit: 13-52; sc: Engine; 0x80006b94

O2 HEATER TEST: SCI; xmit: 13-40; sc: Engine; 0x80006b9e

O2 HEATER TEST: SCI; xmit: 13-52; sc: Engine; 0x80006b9f

O2 HEATER TEST: SCI; xmit: 13-40; sc: Engine; 0x80006ba1

O2 HEATER TEST: SCI; xmit: 13-57; sc: Engine; 0x80006ba3

O2 HEATER TEST: SCI; xmit: 13-40; sc: Engine; 0x80006ba5

O2 HEATER TEST: SCI; xmit: 13-53; sc: Engine; 0x80006ba6

O2 HEATER TEST: SCI; xmit: 13-53; sc: Engine; 0x80006ba8

O2 HEATER TEST: SCI; xmit: 13-40; sc: Engine; 0x80006bca

O2 HEATER TEST: SCI; xmit: 13-40; sc: Engine; 0x80006bcb

O2 HEATER TEST: SCI; xmit: 13-40; sc: Engine; 0x80006bcc

O2 HEATER TEST: SCI; xmit: 13-40; sc: Engine; 0x80006bcd

O2 HEATER TEST: SCI; xmit: 13-56; sc: Engine; 0x80006bce

O2 HEATER TEST: SCI; xmit: 13-56; sc: Engine; 0x80006bcf

O2 HEATER TEST: SCI; xmit: 13-57; sc: Engine; 0x80006bd0

O2 HEATER TEST: SCI; xmit: 13-57; sc: Engine; 0x80006bd1

S/C 12 VOLT FEED: SCI; xmit: 13-2C; sc: Engine; 0x80006bd3

AUTO SHUTDOWN RELAY: SCI; xmit: 13-0A; sc: Engine; 0x80006c10

AUTO SHUTDOWN RELAY: SCI; xmit: 13-0A; sc: Engine; 0x80006c11

FUEL INJECTOR #1: SCI; xmit: 13-04; sc: Engine; 0x80006c12

FUEL INJECTOR #1: SCI; xmit: 13-04; sc: Engine; 0x80006c13

FUEL INJECTOR #2: SCI; xmit: 13-05; sc: Engine; 0x80006c14

FUEL INJECTOR #2: SCI; xmit: 13-05; sc: Engine; 0x80006c15

FUEL INJECTOR #3: SCI; xmit: 13-06; sc: Engine; 0x80006c16

FUEL INJECTOR #3: SCI; xmit: 13-06; sc: Engine; 0x80006c17

FUEL INJECTOR #4: SCI; xmit: 13-1D; sc: Engine; 0x80006c18

FUEL INJECTOR #4: SCI; xmit: 13-1D; sc: Engine; 0x80006c19

FUEL INJECTOR #5: SCI; xmit: 13-1E; sc: Engine; 0x80006c1a

FUEL INJECTOR #5: SCI; xmit: 13-1E; sc: Engine; 0x80006c1b

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FUEL INJECTOR #6: SCI; xmit: 13-1F; sc: Engine; 0x80006c1c
FUEL INJECTOR #6: SCI; xmit: 13-1F; sc: Engine; 0x80006c1d
1/1 2/1 O2 HEATER RELAY: SCI; xmit: 13-52; sc: Engine; 0x80006c1e
1/1 2/1 O2 HEATER RELAY: SCI; xmit: 13-52; sc: Engine; 0x80006c1f
GENERATOR FIELD: SCI; xmit: 13-0D; sc: Engine; 0x80006c20
GENERATOR FIELD: SCI; xmit: 13-0D; sc: Engine; 0x80006c21
LDP SOLENOID: SCI; xmit: 13-3D; sc: Engine; 0x80006c22
LDP SOLENOID: SCI; xmit: 13-3D; sc: Engine; 0x80006c23
1/2 2/2 O2 HEATER RELAY: SCI; xmit: 13-53; sc: Engine; 0x80006c24
1/2 2/2 O2 HEATER RELAY: SCI; xmit: 13-53; sc: Engine; 0x80006c25
AUTO SHUTDOWN RELAY: SCI; xmit: 13-0A; sc: Engine; 0x80006c2d
FUEL INJECTOR #1: SCI; xmit: 13-04; sc: Engine; 0x80006c2e
FUEL INJECTOR #2: SCI; xmit: 13-05; sc: Engine; 0x80006c2f
FUEL INJECTOR #3: SCI; xmit: 13-06; sc: Engine; 0x80006c30
FUEL INJECTOR #4: SCI; xmit: 13-1D; sc: Engine; 0x80006c31
FUEL INJECTOR #5: SCI; xmit: 13-1E; sc: Engine; 0x80006c32
FUEL INJECTOR #6: SCI; xmit: 13-1F; sc: Engine; 0x80006c33
1/2 2/2 O2 HEATER RELAY: SCI; xmit: 13-53; sc: Engine; 0x80006c34
GENERATOR FIELD: SCI; xmit: 13-0D; sc: Engine; 0x80006c35
LDP SOLENOID: SCI; xmit: 13-3D; sc: Engine; 0x80006c36
1/2 2/2 O2 HEATER RELAY: SCI; xmit: 13-53; sc: Engine; 0x80006cee
RAD FAN CONTROL: SCI; xmit: 13-08; sc: Engine; 0x80006e1b
RAD FAN CONTROL: SCI; xmit: 13-08; sc: Engine; 0x80006e1c
1/2 2/2 O2 HEATER RELAY: SCI; xmit: 13-53; sc: Engine; 0x80006e34
O2 HEATER TEST: SCI; xmit: 13-53; sc: Engine; 0x80006e35
O2 HEATER TEST: SCI; xmit: 13-53; sc: Engine; 0x80006e36
TRANSFER PUMP: SCI; xmit: 13-33; sc: ECM; 0x80006e41
FUEL CONTROL: SCI; xmit: 13-5E; sc: ECM; 0x80006f2d
TRANS TC CLUTCH: SCI; xmit: 13-0F; sc: ECM; 0x800075b2
TRANS BATT RELAY: SCI; xmit: 13-43; sc: ECM; 0x800075b3
S/C 12 VLT SOURCE: SCI; xmit: 13-2C; sc: ECM; 0x800075ff
S/C VAC/VENT: SCI; xmit: 13-0C; sc: ECM; 0x80007600
S/C VENT SOLENOID: SCI; xmit: 13-1A; sc: ECM; 0x80007601
S/C VAC SOLENOID: SCI; xmit: 13-1B; sc: ECM; 0x80007602
TRANS O/D SOLENOID: SCI; xmit: 13-16; sc: ECM; 0x80007603
REVERSE LOCKOUT SOL: SCI; xmit: 13-44; sc: Engine; 0x80007952
TOW/HAUL LAMP: SCI; xmit: 13-41; sc: Engine; 0x80007b83
```

Lots of repeating commands are here because some commands are duplicated in multiple modules.

Say I serviced the Idle Air Control valve and before putting it back I'd like to see if the valve moves freely without problem

```
IAC STEPPER MOTOR: SCI; xmit: 13-07; sc: Engine; 0x80000beb
```

```
> dumpconverter 0x80000beb
TYPE:  BINARY_STATE
REC:   00-00-01-B4-01-FF
DSREC: 01-B4-00-00-00-02-00-00-14-B0

FALSE: DENIED
TRUE:  ACTUATING

MASK:  0xFF
OP:    MASK_NOT_ZERO
```

Let’s take a moment to analyze this rule before moving forward. If the controller responds to an actuator test request wi the value 0x00 then the binary operation 0x00 & 0xFF (received byte & mask byte) yields 0x00 as a result. The "OP" (oper tion) states the result should not be zero. If it does then according to the "FALSE" condition the actuator test is "DENIED" some reason (most likely stopped or malfunctioning). If the result is anything other than zero the "TRUE" condition appli and the actuator test is "ACTUATING" as in running. Incidentally the non-zero value that the controller keeps repeating b to the diagnostic scanner is the command byte that was issued in the first place.

```
[Default low speed mode]
TX: 13 07    (IAC STEPPER MOTOR TEST)
RX: 13 07 07 (actuator test begins, stepper motor is cycling between end-positions)
RX: 07       (command byte echoed repeatedly showing that the test is running)
RX: 07
RX: 07
[Some time later]
RX: 07
RX: 07
RX: 07       (okay, I have seen enough, everything seems to be fine)
TX: 13 00    (stop all tests)
RX: 07       (test still running)
RX: 07
RX: 07
TX: 13 00    (try again)
RX: 07       (test keeps running)
RX: 07
RX: 07
RX: 07
RX: 07
TX: 13 00    (try again)
RX: 13 00 00 (actuator test stopped)
```

0x14

This command is the low speed equivalent of the RAM reading in high speed mode. Obviously this is much slower and yc can't get high update rates but it's convenient if you're only interested in a few low resolution parameters. In certain case this is the only command that returns dimensioned and scaled values converted from raw voltages. In high speed mode ery parameter is stored in raw format and high resolution (engine rpm is the multiple of 0.125 for example) but in low speed mode parameters are scaled down to a single byte as an effort to save space (engine rpm is the multiple of 32).

```
> txsearch SCI && xmit: 14-
SLOW_SPEED_RPM: SCI; xmit: 14-11-00; sc: Engine; 0x800004e6
TARGET BOOST: SCI; xmit: 14-1A-00; sc: Engine; 0x800004ee
WASTEGATE DUTY CYCLE: SCI; xmit: 14-28-00; sc: Engine; 0x800004f1
TPS PERCENT: SCI; xmit: 14-46; sc: Engine; 0x800004fd
CALC ENGINE LOAD: SCI; xmit: 14-5C; sc: Engine; 0x80000501
OUTPUT SHAFT SPEED: SCI; xmit: 14-5A-00; sc: Engine; 0x800005b0
GOV PRESS DUTY CYCLE: SCI; xmit: 14-5B-00; sc: Engine; 0x800005b8
OUTPUT SHAFT SPEED: SCI; xmit: 14-5A-00; sc: Engine; 0x800006d0
O2S LEVEL: SCI; xmit: 14-42-00; sc: Engine; 0x800008bc
O2S LEVEL: SCI; xmit: 14-42-00; sc: Engine; 0x800008bd
LF O2S LEVEL: SCI; xmit: 14-42-00; sc: Engine; 0x800008be
RT O2S LEVEL: SCI; xmit: 14-48-00; sc: Engine; 0x800008bf
FRT O2S LEVEL: SCI; xmit: 14-42-00; sc: Engine; 0x800008c0
REAR O2S LEVEL: SCI; xmit: 14-48-00; sc: Engine; 0x800008c1
UPSTREAM O2S LEVEL: SCI; xmit: 14-42-00; sc: Engine; 0x800008c2
L-BANK UP O2S LEVEL: SCI; xmit: 14-48-00; sc: Engine; 0x800008c3
R-BANK UP O2S LEVEL: SCI; xmit: 14-42-00; sc: Engine; 0x800008c4
L-BANK UP O2S LEVEL: SCI; xmit: 14-42-00; sc: Engine; 0x800008c5
R-BANK UP O2S LEVEL: SCI; xmit: 14-48-00; sc: Engine; 0x800008c6
READ_ENG_RPM: SCI; xmit: 14-11-00; sc: Engine; 0x80000965
READ_SET_SYNC: SCI; xmit: 14-2A-00; sc: Engine; 0x80000968
READ_FUEL_FACTOR_NOTLH: SCI; xmit: 14-2E-00; sc: Engine; 0x8000096c
READ_FUEL_FACTOR_LH: SCI; xmit: 14-3E-00; sc: Engine; 0x8000096d
READ_FUEL_SETTING: SCI; xmit: 14-29-00; sc: Engine; 0x8000096e
KEYFT1: SCI; xmit: 14-13-00; sc: Engine; 0x8000096f
KEYFT2: SCI; xmit: 14-1E-00; sc: Engine; 0x80000970
KEYFT3: SCI; xmit: 14-1F-00; sc: Engine; 0x80000971
FUEL LEVEL PERCENT: SCI; xmit: 14-4F; sc: Engine; 0x80000cae
CALC ENGINE LOAD: SCI; xmit: 14-5C; sc: Engine; 0x80000d23
UPSTREAM O2S LEVEL: SCI; xmit: 14-42-00; sc: Engine; 0x80000d78
TPS PERCENT: SCI; xmit: 14-46; sc: Engine; 0x80000d8a
APP PERCENT: SCI; xmit: 14-46; sc: Engine; 0x80002a22
MIN_AIR_FLOW: SCI; xmit: 14-10; sc: Engine; 0x80002b5f
KEYFT1: SCI; xmit: 14-13; sc: Engine; 0x80002b65
KEYFT2: SCI; xmit: 14-1E; sc: Engine; 0x80002b66
KEYFT3: SCI; xmit: 14-1F; sc: Engine; 0x80002b67
1/1 O2S LEVEL: SCI; xmit: 14-42; sc: Engine; 0x80002d4d
2/1 O2S LEVEL: SCI; xmit: 14-48; sc: Engine; 0x80002d4e
```

```
2/1 O2S LEVEL: SCI; xmit: 14-48; sc: Engine; 0x80002d8f
2/1 O2S LEVEL: SCI; xmit: 14-48; sc: Engine; 0x80002d90
TPS  Range: SCI; xmit: 14-46; sc: Engine; 0x800048a8
TPS  Range: SCI; xmit: 14-46; sc: Engine; 0x800048a9
TPS  Range: SCI; xmit: 14-46; sc: Engine; 0x800048aa
READ_ENG_RPM: SCI; xmit: 14-11-00; sc: Engine; 0x80006391
A/C HI SIDE PRESSURE: SCI; xmit: 14-33; sc: ECM; 0x80006964
A/C HI SIDE VOLTS: SCI; xmit: 14-32; sc: ECM; 0x80006965
T-CASE SWITCH VOLTS: SCI; xmit: 14-6D; sc: ECM; 0x80006987
SYNC SENSE: SCI; xmit: 14-12; sc: Engine; 0x80006ae6
TARGET CHARGING VOLTS: SCI; xmit: 14-24; sc: ECM; 0x80006b39
FUEL LEVEL SEN VOLT: SCI; xmit: 14-4E; sc: ECM; 0x80006b3a
FUEL LEVEL PERCENT: SCI; xmit: 14-4F; sc: ECM; 0x80006b3b
FCA CURRENT: SCI; xmit: 14-7A; sc: ECM; 0x80006b3c
BAT TEMP VOLTS: SCI; xmit: 14-01; sc: ECM; 0x80006c2b
OIL TEMP VOLT: SCI; xmit: 14-7C; sc: Engine; 0x80006e51
OIL TEMP DEG: SCI; xmit: 14-7D; sc: Engine; 0x80006e52
OIL TEMP DEG: SCI; xmit: 14-7D; sc: Engine; 0x8000793c
OIL TEMP VOLT: SCI; xmit: 14-7C; sc: Engine; 0x8000793d
```

Say, I'm interested in the oxygen sensor state. Usually if it's not stated this level applies to the sensor before the catalytic converter which is used directly for fuel adjustments.

```
O2S LEVEL: SCI; xmit: 14-42-00; sc: Engine; 0x800008bc

> dumpconverter 0x800008bc
TYPE:  STATE
REC:   20-20-06-94-00-3B
DSREC: 06-94-00-00-00-00-53-0A

DFLT: N/A
0xA0: LEAN
0xB1: RICH
0xFF: CENTER
```

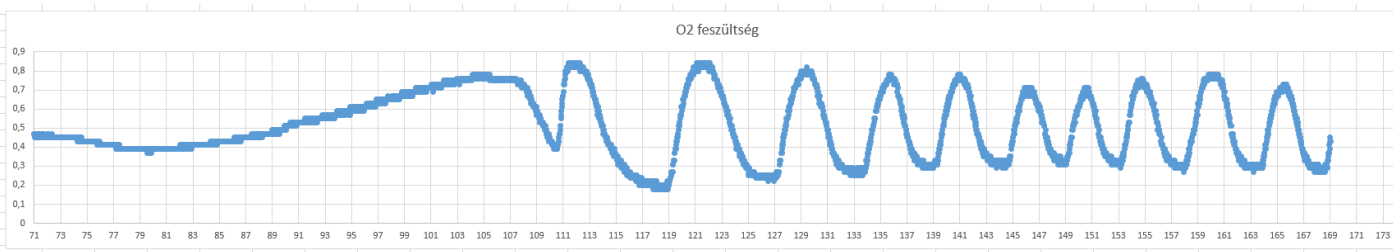
The rule is simple, there are 3 possible responses.

```
[Default low speed mode]
TX: 14 42    (O2S LEVEL)
RX: 14 42 FF (CENTER condition, the air/fuel ratio is neither lean or rich)
TX: 14 42    (O2S LEVEL)
RX: 14 42 A0 (LEAN condition, the air/fuel ratio is lean (too much air))
```

```
TX: 14 42    (O2S LEVEL)
RX: 14 42 B1 (RICH condition, the air/fuel ratio is rich (too much fuel))
```

The lean/rich switching must happen rapidly (several times in a second) to indicate a healthy running engine.

The image below shows the old oxygen sensor in this car fluctuating slowly when the engine is idling. The first elongated part indicates the warm-up period of the engine. Horizontal values are seconds, vertical values are Volts. Notice how the wave oscillates around the CENTER state.



To be continued…

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