

1999 Toyota Avalon ECM (Engine Control Module) Replacement

ECM started throwing faulty DTCs (Diagnostic Trouble Codes) and all reactions taken were ineffective because ECM threw faulty diagnosis results.

Reminder

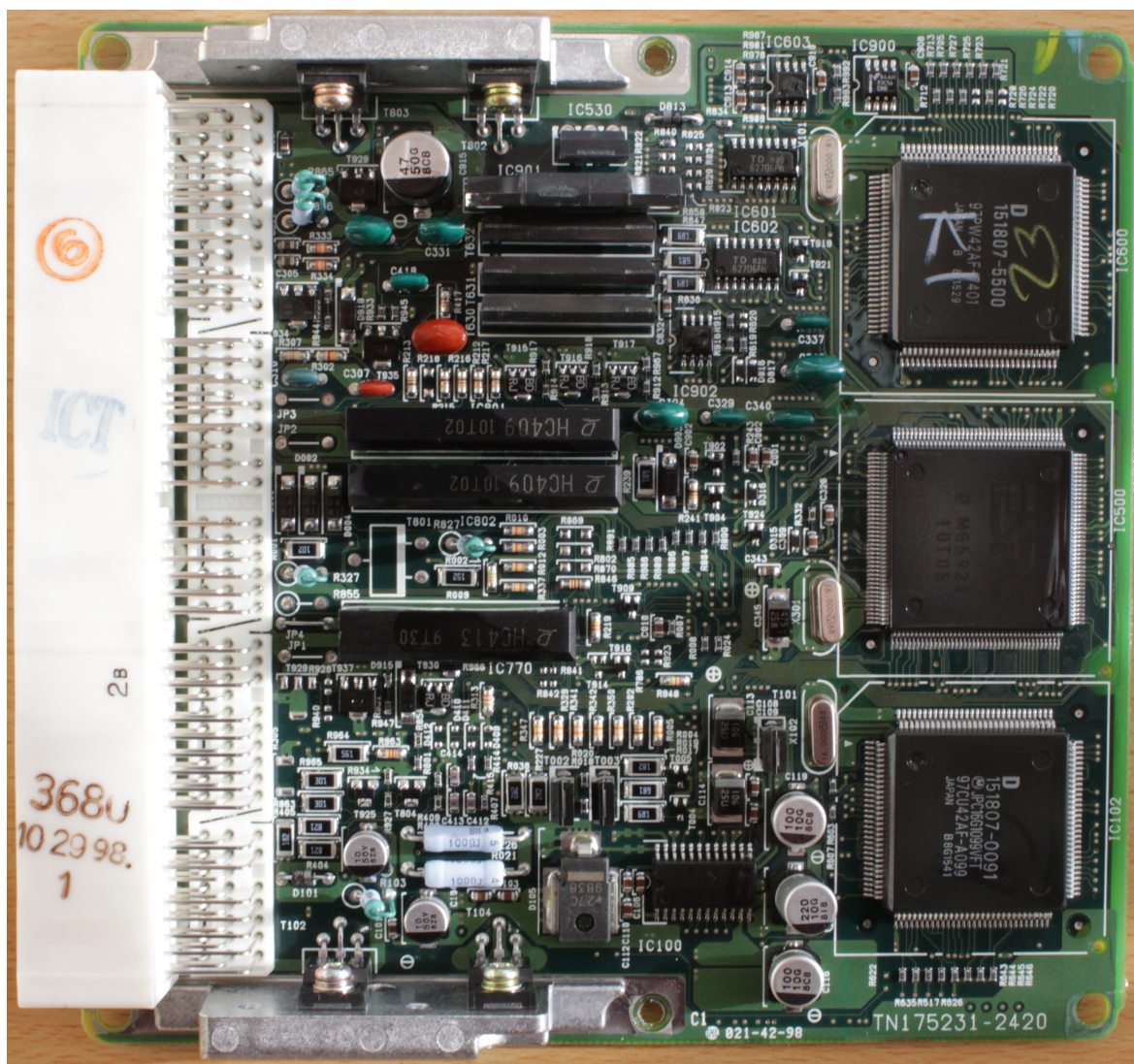
When ECM is replaced, engine never starts due to the immobilizer installed on Avalon throwing DTC of "B2795 (A key with unregistered key code in ECU is inserted into ignition key cylinder)" because ECM key codes stored in 8 pin 2k bit serial EEPROM (FM93C56 tagged as IC900) do not match with ignition keys. In this case, when key is inserted, slight clicking sound generates. The purpose of immobilizer is to guard from car theft using ignition keys mechanically duplicated.

Ignition key code identical with factory ignition key you keep must be programmed in the new ECU to verify if right ignition keys, not duplicated, is under use.

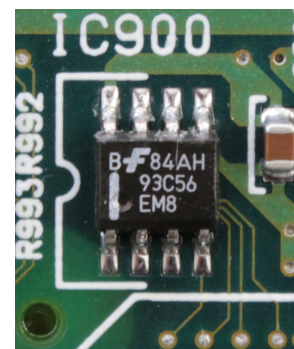
There are two ways to work around the immobilizer issues.

(A) Replacing an 8 pin serial flash memory ("FM93C56", parts tag "IC900"), from old ECM to new ECM.

This is the best and stable way. You need to have a sophisticated soldering skill, though.



ECM (Front)

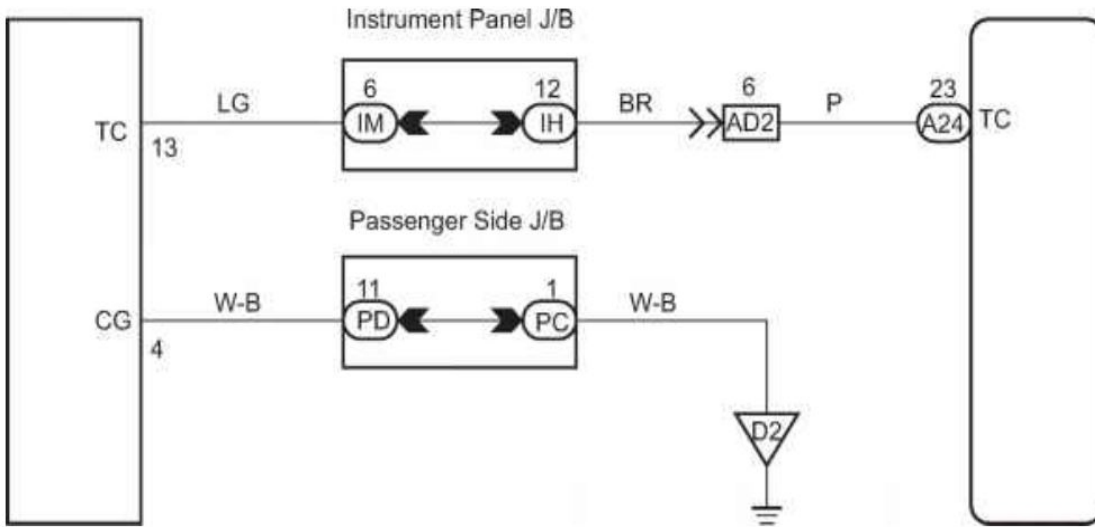


FM93C56 (IC900)

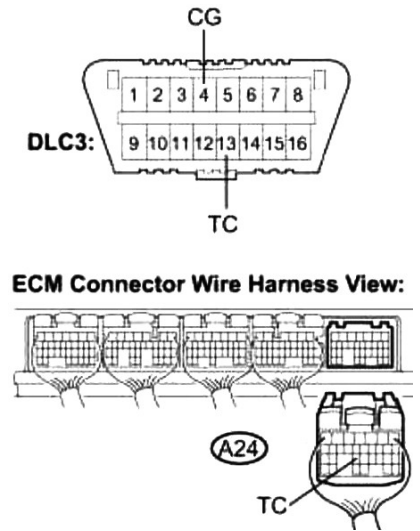
(B) Reprogramming through OBD2 (On-Board Diagnosis 2) / DLC3 (Data Link Connector 3) plug shorting pin 4 (CG; Chassis Ground) and pin 13 (TC).

Connecting terminals TC and CG of the DLC3 (Data Link Connector 3) causes the system to enter self-diagnostic mode.

The way did not work because there was no metal female tab to vendor option pin 13 (TC). (See photo below)



Schematic



DLC3 & ECM

Pin #	Description	Pin #	Description
1	Vendor option	9	Vendor option
2	J1850 Bus +	10	J1850 Bus
3	Vendor option	11	Vendor option
4	Chassis Ground (CG)	12	Vendor option
5	Signal Ground (SG)	13	Vendor option (TC)
6	CAN (J-2234) High	14	CAN (J-2234) Low
7	ISO 9141-2 K-Line	15	ISO 9141-2 Low
8	Vendor option	16	Battery Power

OBD II scanner (DLC 3) connector

(1) Short pin 4 (CG; Chassis Ground) & 13 (TC) of OBD2 (DLC3) connector (Using OBD2 extension cable with male and female plugs is recommended because some pins of OBD2 plug installed on Avalon may not have been fully installed contact metals in surface).

(2) Power ON, some console lights flashing (if not, pins are not properly shorted), stay for 30 minutes.

(3) Power OFF, detach OBD2 connector or short pin terminals.



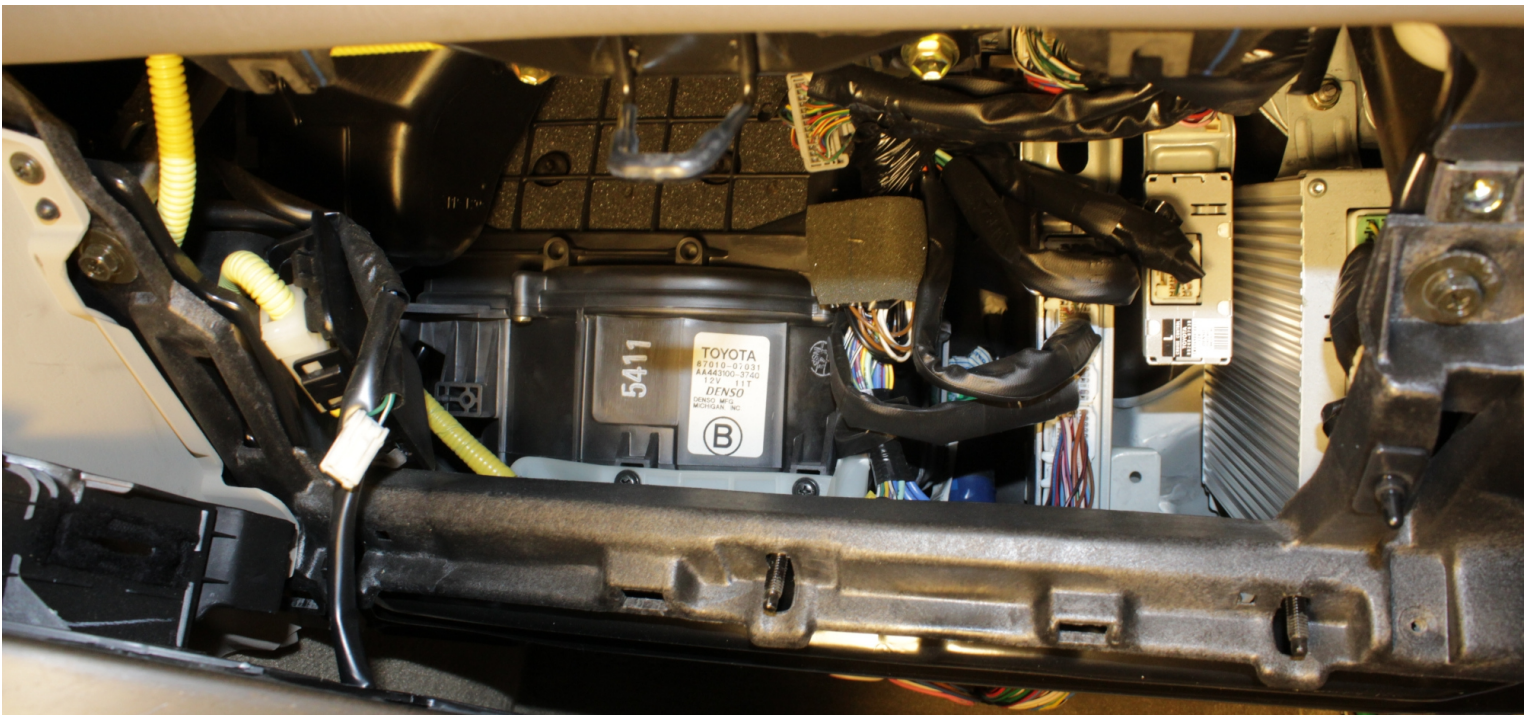
OBD2 extension cable with male and female plugs



OBD2 Connector on Avalon (P13 has no female tab)



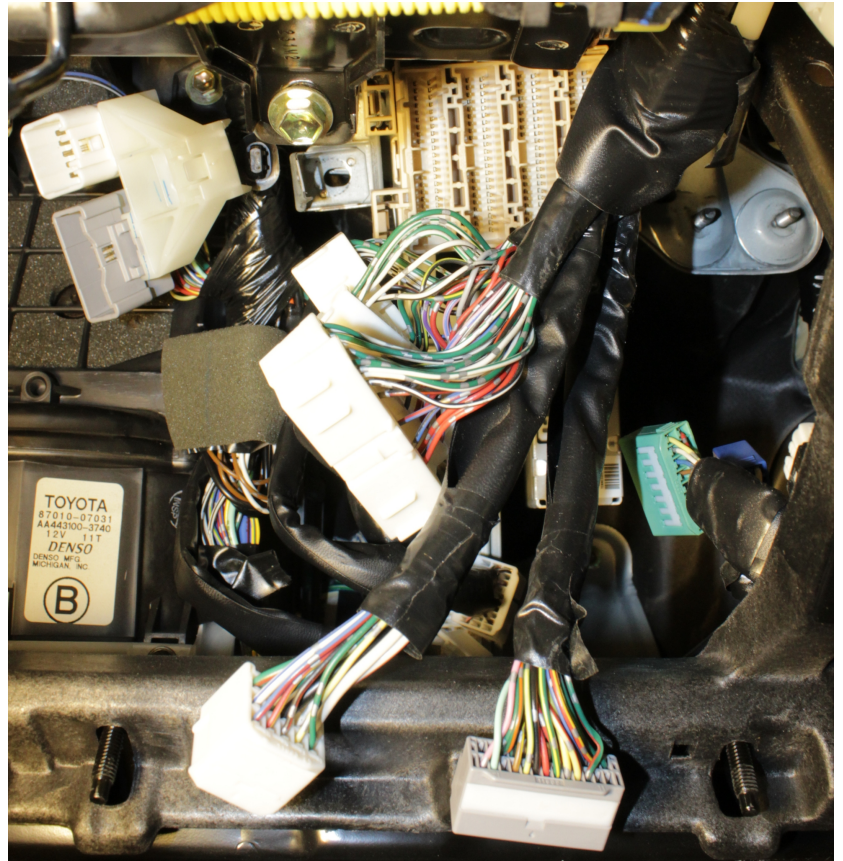
Removed glove box and etc.



Opening (Three aluminum cases from left, ECM, Cruise control, Radio amplifier)



Removing 1



Removing 2



Removing 3



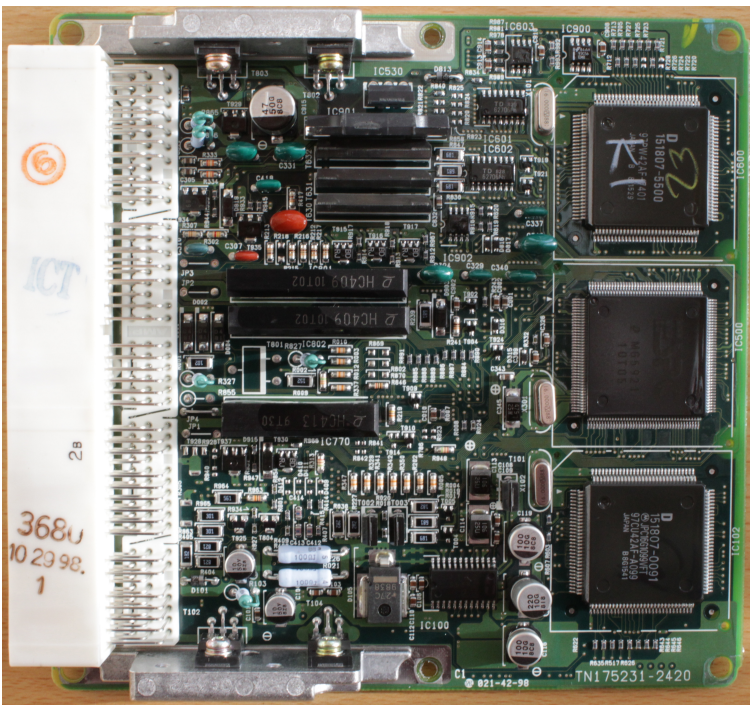
Old ECM (Left) Removed



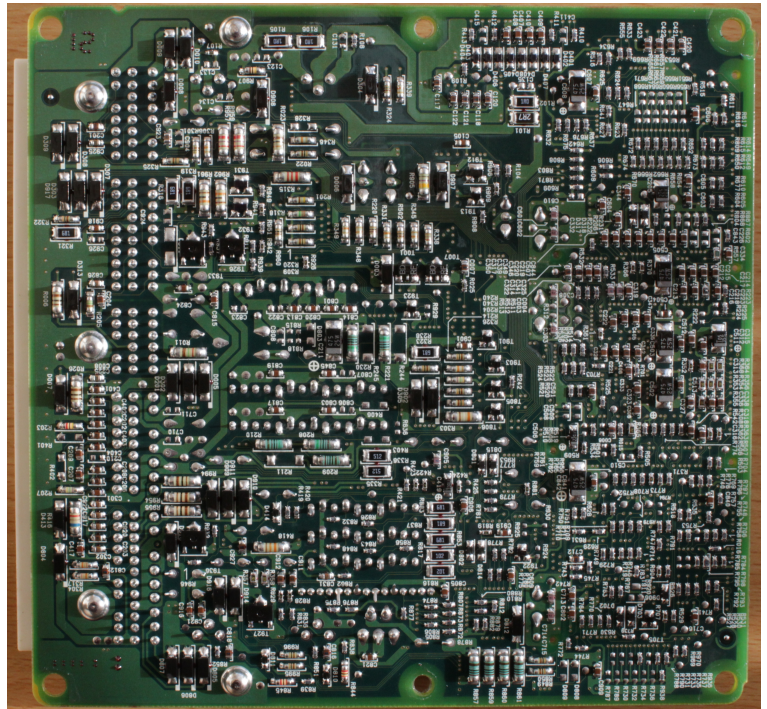
New ECM (Left) & Old ECM (Right)



New ECM with bracket (Up) & Old ECM (Down)



ECM (Front)

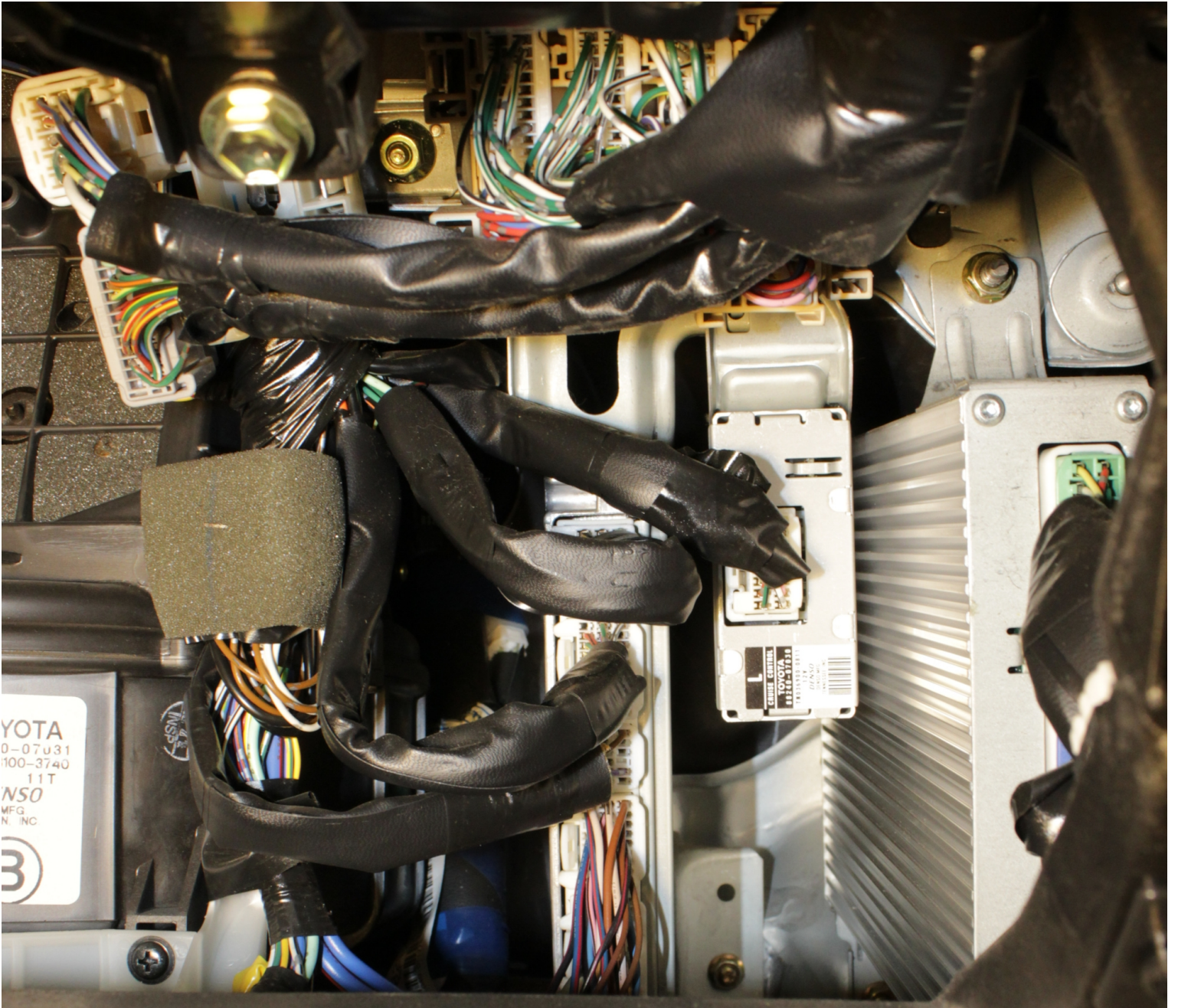


ECM (Rear)

Zoom up!



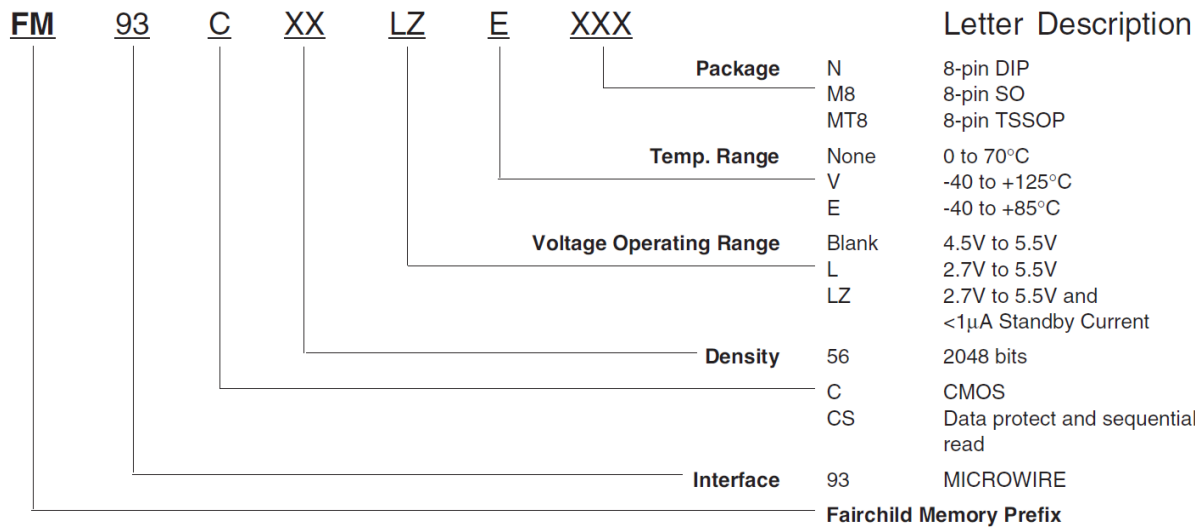
Hex bolts replaced Philips head bolts factory used to make it easy detaching/attaching ECM next time



New ECM Reinstalled

Dump FM93C56

FM93C56 (Fairchild) installed on ECM of Toyota vehicles



DC and AC Electrical Characteristics $V_{CC} = 4.5V$ to $5.5V$ unless otherwise specified
 SK Clock Frequency | (Note 3) | 1 | MHz

DC and AC Electrical Characteristics $V_{CC} = 2.7V$ to $4.5V$ unless otherwise specified.
 SK Clock Frequency | (Note 3) | 0 | 250 | KHz

FM93C56 data sheet claims "Wide Vcc 2.7V – 5.5V" at page 1 although maximum 1 MHz clock frequency is guaranteed only at Vcc = 5V, not 2.7V.

However, product name printed on surface, "FM93C56 EM8", specifies the Voltage Operating Range "4.5V to 5.5V".

This is a sort of gimmick. Be aware of it.

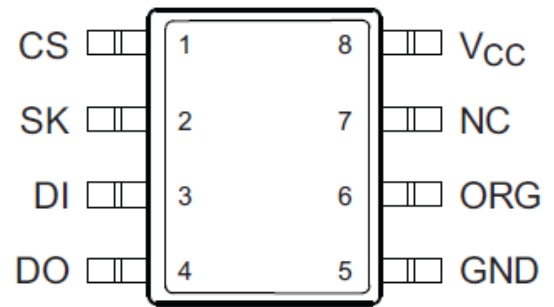
	<p>← Vcc</p> <p>← Vss</p> <p>← Vss</p>	<p>Fairchild FM93C56 (128 x 16 configuration only) Pin connection</p> <p>SK = CLK (Shift Clock)</p>
<p>↑ D O</p> <p>↑ D I</p> <p>↑ C L K</p> <p>↑ C S</p>	<p>Test Points</p>	<p>Features</p> <p>■ Wide V_{CC} 2.7V - 5.5V</p>

AT93C56B (Atmel)

Features

- Low-voltage Operation
 - $V_{CC} = 1.7V$ to $5.5V$
 - 2MHz Clock Rate (5V)

$V_{CC} = 5.0V$	Read at 1.0MHz			
	Write at 1.0MHz			
SK Clock Frequency	$4.5V \leq V_{CC} \leq 5.5V$	0	2	MHz
	$2.5V \leq V_{CC} \leq 5.5V$	0	1	MHz
	$1.7V \leq V_{CC} \leq 5.5V$	0	250	kHz

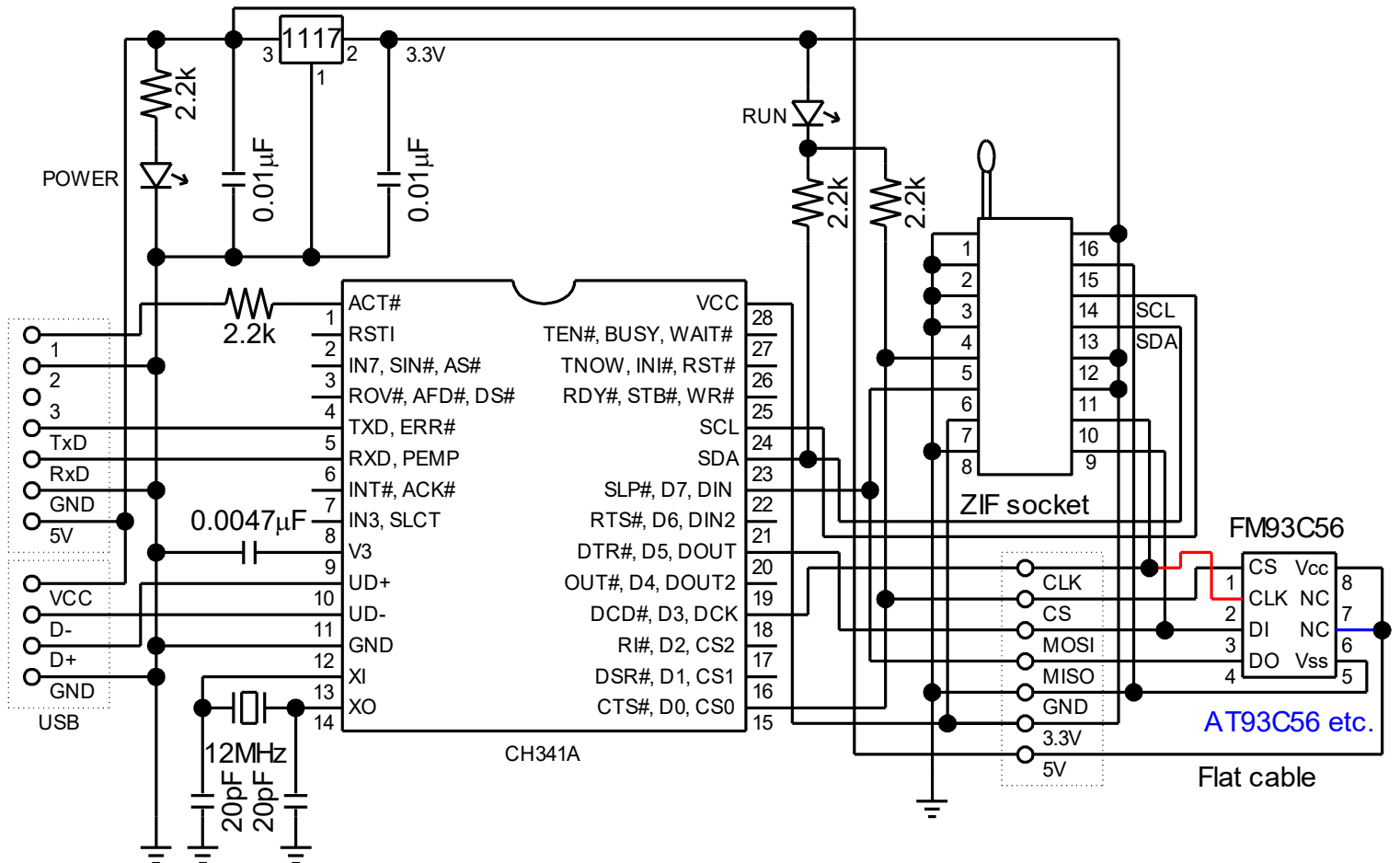


Note: When the ORG pin is connected to V_{CC} , the x16 organization is selected. When it is connected to ground, the x8 organization is selected. If the ORG pin is left unconnected, and the application does not load the input beyond the capability of the internal $1M\Omega$ pull-up resistor, then the x16 organization is selected.

AT93C56B data sheet claims "Wide Vcc 1.7V - 5.5V" at page 1 boasting wider Vcc range than FM93C56 although maximum 2 MHz clock frequency is guaranteed only at Vcc = 5V, not 1.7V.

Furthermore, "ORG" pin functional specification is ambiguous ("If the ORG pin is left unconnected and"). When "ORG" is left unconnected, 128 x 16 configuration does not work. It had to be connected to 5V. This is a sort of gimmick. Be aware of it.

Atmel AT93C56 seems trying to hide its incompatibility with FM93C56.

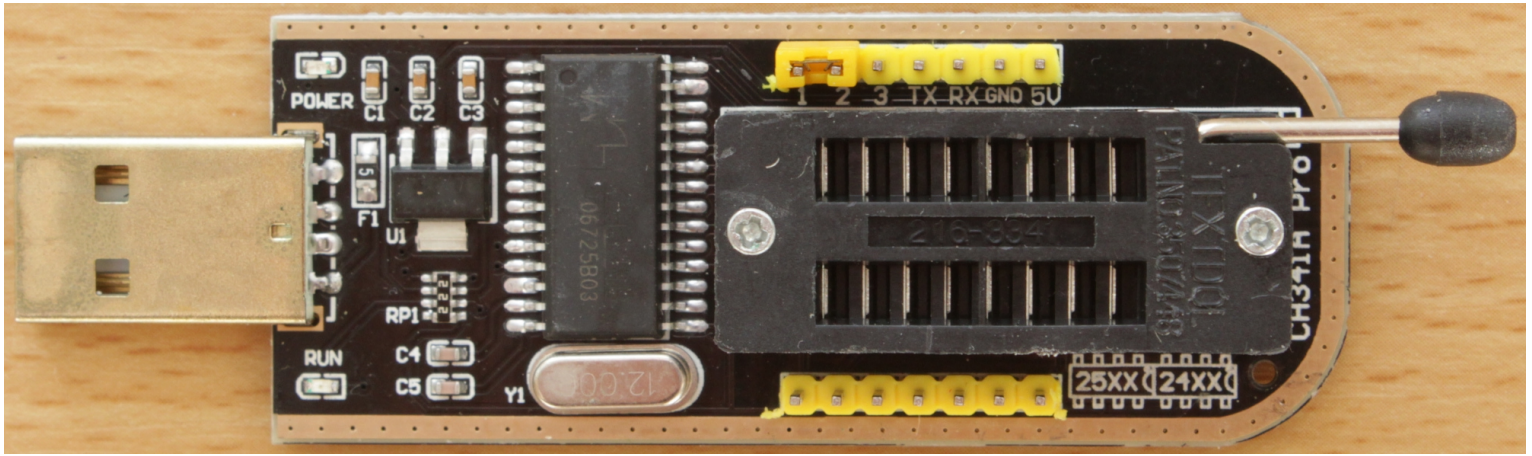


CH341A EEPROM Programmer to FM93C56 Connection

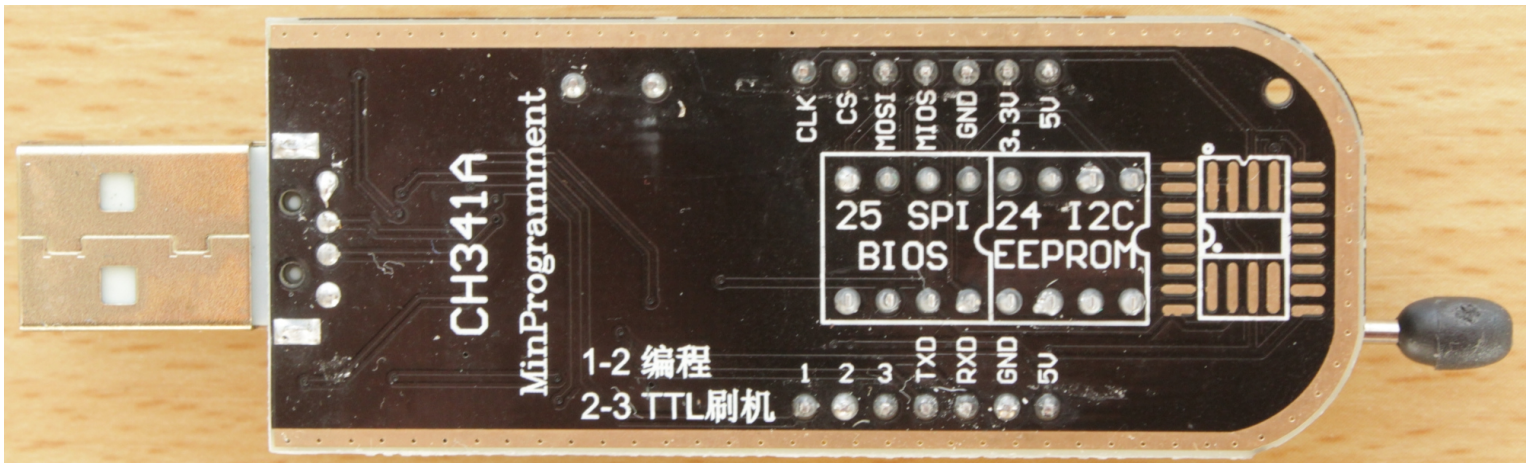
CH341A chip is an excellent USB to UART (Universal Asynchronous Receiver Transmitter RS232, RS422, RS485), parallel, EPP/MEM parallel, 2-wire and 4-wire synchronous serial interface bridge LSI.

CH341A programmer is achieving such various serial/parallel interfaces all in one with superb design approach.

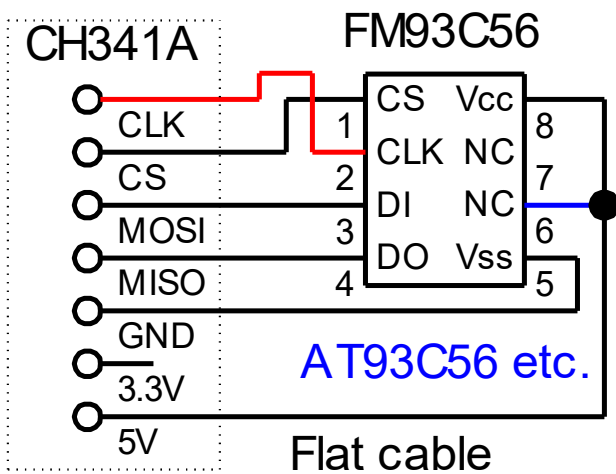
CH341A Programmer



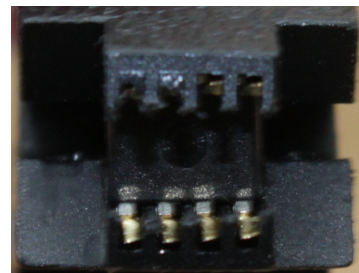
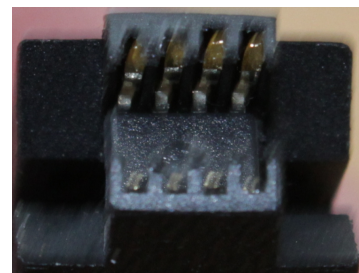
C	M	M			
L	O	I	G		
K	S	S	N	5	
↓	↓	↓	↓	↓	↓
					V



CH341A Serial EEPROM Programmer

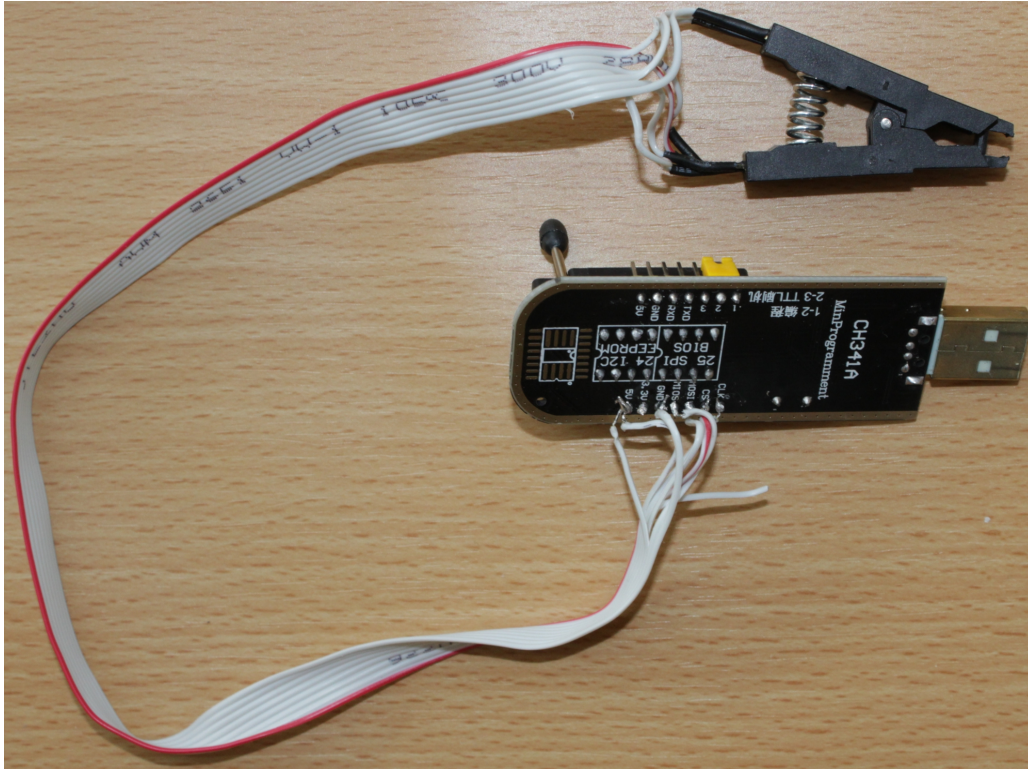


128 x 16 configuration



- (1) Solder 6 wires to test pins on CH341A using flat cable with 8 pin SOIC IC clip attached other end.
- (2) Pin 6 is NC in FM93C56 implemented on Denso ECM but needs to be connected to 5V in Atmel AT93C56.
- (3) Remove FM93C56 from ECM and carefully clip it by IC clip making sure the contacts are all intact.

- (1') Download "AsProgrammer".
 - (2') Extract the contents.
 - (3') Run "\\Drivers\CH341A\SETUP.EXE" to install drivers.
 - (3) Remove FM93C56 from ECM and carefully clip it by IC clip making sure the contacts are all intact.
 - (4) Connect CH341A programmer to Windows PC through USB.
 - (5) Run "AsProgrammer (2.2.0.7)".
 - (6) Specify "IC > Microwire > Microchip > M93C56_16bits".
- (No dependency of windows version (11, 10, 8, and 7) was observed)

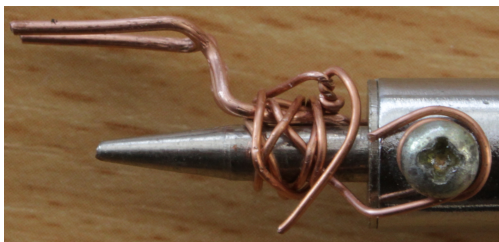


Wiring between FM93C56 and CH341A

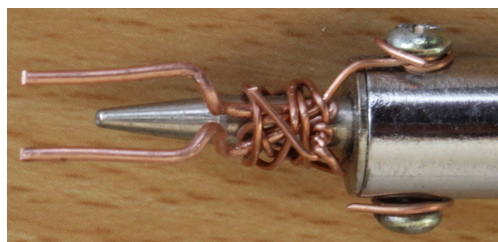
In-circuit programming does not work because IC clip cannot perfectly clip on-board FM93C56, and etc.. Remove FM93C56 from ECM all the time, clip it by IC clip, and read/program by CH341A programmer.



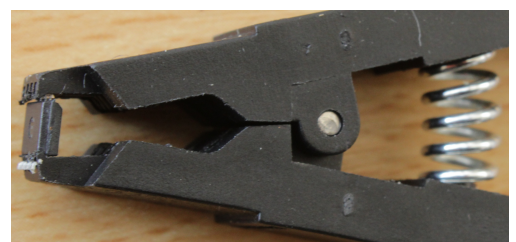
8 pin SOIC IC Remover I made



Side view



Bottom view



FM93C56 clipped by IC clip

Dump Results of FM93C56

(A) Dump result of FM93C56 on original ECM of 1999 Toyota Avalon XLS (128 x 16 configuration)

AsProgrammer

File IC Options Hardware Scripts Language Buffer ?

Device		Main Memory															
93C56 16bits [5.0V]		00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
Type: MICROWIRE		0x00000000	15	A1	00	00	00	00	00	12	E5	00	00	10	10	00	00
BitSize: 2 Kbits		0x00000010	15	A1	00	00	10	69	00	00	00	00	00	00	00	00	00
Manuf: GENERIC		0x00000020	15	A1	00	00	10	69	00	00	12	E5	00	00	FF	00	00
Size: <input type="text" value="256"/> Bytes		0x00000030	12	E5	00	00	10	69	00	00	00	DF	FB	00	00	00	00
<input type="button" value="Search"/> <input type="button" value="Detect"/>		0x00000040	00	00	00	00	00	00	00	00	00	00	00	00	03	00	00
		0x00000050	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
		0x00000060	00	00	00	00	00	00	00	00	00	00	00	00	FF	00	00
		0x00000070	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
		0x00000080	02	2A	00	00	00	00	00	02	2A	00	00	00	10	00	00
		0x00000090	02	2A	00	00	02	2A	00	00	00	00	00	00	00	00	00
		0x000000A0	02	2A	00	00	02	2A	00	00	02	2A	00	00	FF	00	00
		0x000000B0	02	2A	00	00	02	2A	00	00	00	69	5A	00	00	00	00
		0x000000C0	00	00	00	00	00	00	00	00	00	00	00	00	FF	00	00
		0x000000D0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
		0x000000E0	00	00	00	00	00	00	00	00	00	00	00	00	FF	00	00
		0x000000F0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

(Buffer) Size: 256 Original.bin

```

Programmer for MCU, AVR, SPI FLASH/EEPROM, I2C, Microwire, 2.2.0.7 (6/4/2021)
chiplist.dat Version: 5/20/2021
<<93C56 16bits [5.0V]>>
Current programmer: CH341a
20:20:25
Reading memory... Main Memory
Success
Execution time: 00:00:00.157
CRC32 = 0xE1816139
Done
    
```

Dump result of FM93C56 (128 x 16 configuration) assembled on original ECM
 (Matches with key codes stored on own keys) (Immobilizer is not asserted) (Engine cranks and starts)

	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
00	15	A1	00	00	00	00	00	00	12	E5	00	00	10	10	00	00
10	15	A1	00	00	10	69	00	00	00	00	00	00	00	00	00	00
20	15	A1	00	00	10	69	00	00	12	E5	00	00	00	FF	00	00
30	12	E5	00	00	10	69	00	00	00	00	DF	FB	00	00	00	00
40	00	00	00	00	00	00	00	00	00	00	00	00	00	03	00	00
50	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
60	00	00	00	00	00	00	00	00	00	00	00	00	00	FF	00	00
70	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
80	02	2A	00	00	00	00	00	00	02	2A	00	00	00	10	00	00
90	02	2A	00	00	02	2A	00	00	00	00	00	00	00	00	00	00
A0	02	2A	00	00	02	2A	00	00	02	2A	00	00	00	FF	00	00
B0	02	2A	00	00	02	2A	00	00	00	00	69	5A	00	00	00	00
C0	00	00	00	00	00	00	00	00	00	00	00	00	00	FF	00	00
D0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
E0	00	00	00	00	00	00	00	00	00	00	00	00	00	FF	00	00
F0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

- 12-E5-02-2A; Master #1 key code
- 15-A1-02-2A; Master #2 key code
- 10-69-02-2A; Valet key code
- 03; Number of keys programmed
- DF-FB-69-5A; Valet key lockout code
- 10-10-10; Virginize keys

(B) Dump result of FM93C56 on new ECM of 1999 Toyota Avalon XLS (128 x 16 configuration)

AsProgrammer

File IC Options Hardware Scripts Language Buffer ?



Device
93C56 16bits [5.0V]

Type: MICROWIRE
BitSize: 2 Kbits
Manuf: GENERIC
Size: Bytes

Search Detect

Microwire
Swap <-->

Adapter scheme

	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
0x00000000	FE	F2	00	00	00	00	00	00	FE	C1	00	00	10	10	00	00
0x00000010	FE	F2	00	00	FE	1A	00	00	00	00	00	00	00	00	00	00
0x00000020	FE	F2	00	00	FE	1A	00	00	FE	C1	00	00	00	FF	00	00
0x00000030	FE	C1	00	00	FE	1A	00	00	00	00	DF	FB	00	00	00	00
0x00000040	00	00	00	00	00	00	00	00	00	00	00	00	00	03	00	00
0x00000050	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0x00000060	00	00	00	00	00	00	00	00	00	00	00	00	00	FF	00	00
0x00000070	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0x00000080	02	CF	00	00	00	00	00	00	02	CF	00	00	00	10	00	00
0x00000090	02	CF	00	00	02	CF	00	00	00	00	00	00	00	00	00	00
0x000000A0	02	CF	00	00	02	CF	00	00	02	CF	00	00	00	FF	00	00
0x000000B0	02	CF	00	00	02	CF	00	00	00	00	69	5A	00	00	00	00
0x000000C0	00	00	00	00	00	00	00	00	00	00	00	00	00	FF	00	00
0x000000D0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0x000000E0	00	00	00	00	00	00	00	00	00	00	00	00	00	FF	00	00
0x000000F0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

(Buffer) Size: 256 New ECM (does not match own keys)

Execution time: 00:00:00.171
CRC32 = 0x0D47E2E2
Done

Dump result of FM93C56 (128 x 16 configuration) assembled on new ECM
(Does not match with key codes stored on own keys) (Immobilizer is asserted) (Engine cranks but not starts)

	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
00	FE	F2	00	00	00	00	00	00	FE	C1	00	00	10	10	00	00
10	FE	F2	00	00	FE	1A	00	00	00	00	00	00	00	00	00	00
20	FE	F2	00	00	FE	1A	00	00	FE	C1	00	00	00	FF	00	00
30	FE	C1	00	00	FE	1A	00	00	00	00	DF	FB	00	00	00	00
40	00	00	00	00	00	00	00	00	00	00	00	00	00	03	00	00
50	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
60	00	00	00	00	00	00	00	00	00	00	00	00	00	FF	00	00
70	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
80	02	CF	00	00	00	00	00	00	02	CF	00	00	00	10	00	00
90	02	CF	00	00	02	CF	00	00	00	00	00	00	00	00	00	00
A0	02	CF	00	00	02	CF	00	00	02	CF	00	00	00	FF	00	00
B0	02	CF	00	00	02	CF	00	00	00	00	69	5A	00	00	00	00
C0	00	00	00	00	00	00	00	00	00	00	00	00	00	FF	00	00
D0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
E0	00	00	00	00	00	00	00	00	00	00	00	00	00	FF	00	00
F0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

- FE-C1-02-CF; Master #1 key code
- FE-F2-02-CF; Master #2 key code
- FE-1A-02-CF; Valet key code
- 03; Number of keys programmed
- DF-FB-69-5A; Valet key lockout code
- 10-10-10; Virginize keys

Virgin code of FM93C56 (128 x 16 configuration) for 1999 Toyota Avalon

	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
10	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
20	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
30	00	00	00	00	00	00	00	00	00	00	DF	FB	00	00	00	00
40	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
50	00	00	00	00	00	00	00	00	00	00	00	00	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	00	00	00	00	00	00	00	00	00	00	00	00	00	00
90	00	00	00	00	00	00	00	00	00	00	00	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	69	5A	00	00	00	00
C0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
D0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
E0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
F0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

- 00-00-00-00; Master #1 key code
- 00-00-00-00; Master #2 key code
- 00-00-00-00; Valet key code
- 00; Number of keys programmed
- DF-FB-69-5A; Valet key lockout code
- 00-00-00; Virginize keys

To make a virgin FM93C56 for reprogramming keys, put all zeros except "Valet key lockout code".



Device

93C56 16bits [5.0V]

Type: MICROWIRE

BitSize: 2 Kbits

Manuf: GENERIC

Size: Bytes

Search Detect

Microwire

Swap <-->

Adapter scheme

Main Memory

	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
0x00000000	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0x00000010	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0x00000020	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0x00000030	00	00	00	00	00	00	00	00	00	00	DF	FB	00	00	00	00
0x00000040	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0x00000050	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0x00000060	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0x00000070	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0x00000080	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0x00000090	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0x000000A0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0x000000B0	00	00	00	00	00	00	00	00	00	00	69	5A	00	00	00	00
0x000000C0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0x000000D0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0x000000E0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0x000000F0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

(Buffer) Size: 256 Virgin.bin

Current programmer: CH341a
 10:38:40
 Erasing memory...
Success
 Execution time: 00:00:00.047
 Current programmer: CH341a
 10:38:40
 Erasure control...
Success
 Execution time: 00:00:00.297
 Current programmer: CH341a
 10:38:40
 Programming memory... Main Memory
Success
 Execution time: 00:00:00.523
 Verify memory...
Success
 Execution time: 00:00:00.234
 Current programmer: CH341a
 10:38:46
 Reading memory... Main Memory
Success
 Execution time: 00:00:00.266
 CRC32 = 0x86EACC2E

"Load - Erase - Blank - Write - Verify - Read" all succeeded on FM93C56 virgin code

Key code programming through ignition lock cylinder using virgin code programmed FM93C56

Seq.	Status	Operation	Security light
	Normal	No key in ignition lock cylinder	Blinking
1	Entering program	Insert #1 key into ignition lock cylinder and remove immediately	Blinking → Stay on
2-1	Program	Insert #1 key into ignition lock cylinder	Stay on → Blinking
2-2		After 4 seconds, remove #1 key	Blinking → Stay on
3-1		Insert #2 key into ignition lock cylinder	Stay on → Blinking
3-2		After 4 seconds, remove #2 key	Blinking → Stay on
4-1		Insert #3 key into ignition lock cylinder	Stay on → Turn off
4-2		After security light off, remove #3 key	Turn off → Blinking
5		Exiting program	Wait 30 seconds

#1 key = MASTER 1, #2 key = MASTER 2, #3 key = VALET

When inserting MASTER key, the security light stops blinking.

When inserting VALET key, the security light stays on for 2 seconds and turns off.

When inserting key, if the security light does not stop blinking, the key is not programmed properly.

Conclusion

The simplest way to make new ECM functional

- (1) Remove FM93C56 (#1) from original ECM.
- (2) Remove FM93C56 (#2) from new ECM.
- (3) Solder FM93C56 (#1) on new ECM.

ECM Replacement on other vehicles

- [1993 Mercury Sable Wagon](#)
- [2007 Pontiac Vibe](#)