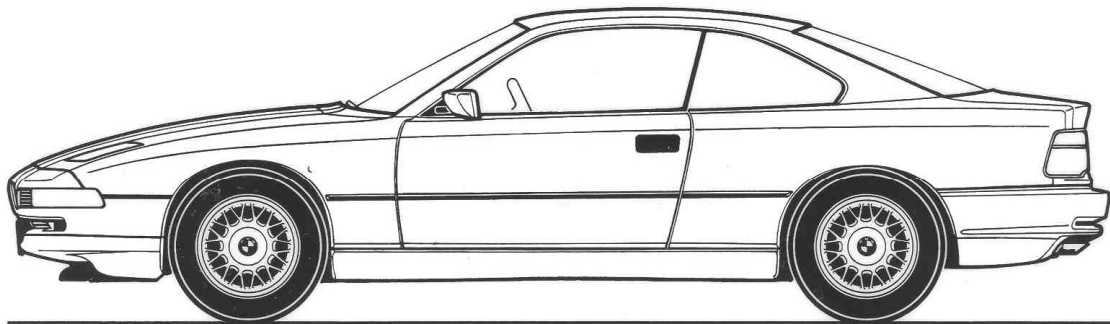# Installation Guide

BMW 8er-Reihe

Window Control Module (Fenstersteuermodul FSM)

For BMW 8er Series (E31) all Years

Version 1.05 / 19. March 2009

Some expertise is required.

All Documents from the Series "BMW E31 Technical Modifications" are available on the Website www.8er.org in the Forum area: "Technical Modifications".

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1 Important Notes

(Only for private usage).

Installation time ca. 1 Hour
The installation time needed may vary dependent upon the condition and equipment of the vehicle.

All Maintenance, Repair, Installation and Adjustment work on Private Vehicles is carried out at your own risk.

Safety Notes

Before carrying out the installation please observe the following Safety Notes:

Make sure that cables or wires used for installation in the vehicle are not bent or damaged, and the clearance to other vehicle components is not impeded.

Disclaimer

Neither the author nor the International 8er Community accept any responsibility nor liability for any damage or defect that may occur through alterations carried out on the vehicle. The information provided is intended merely for illustrative purposes. Furthermore, no responsibility or liability will be accepted for any consequential loss or damage that may arise as a result of installation or imitation of this device. Anyone who carries out an installation with these instructions does so entirely at their own risk.

Copyright

This document including all illustrations is the property of the author. Any copying, alteration, publication on other websites or other media and any sales of this document without the express written permission of the author are forbidden.

Software code

In order to prevent copying and re-sale on eBay or elsewhere, the program memory contained within the controller is protected to prevent download or reading of the code. Any attempt to read or download the code is pointless, this is impossible. With this sole exception, all other information is freely available.

2 Function

The window control module (FSM) is a Microprocessor based Switch which is incorporated within the window control switch block. With this electronic system, the original control signals are intercepted, re-coded and re-sent. The new Switch is thus able to give complete control of all windows.
The switch block consists simply out of a cascaded local Multiplexsystem carrying a 16-Bit code. Each Bit represents a pre-determined Function.

2.1   The FSM Software

The programming language used is "C" and the programming device used was principally the ICT-U (In-Circuit Debugger).
The controller used (PIC 16F88) has a Flash memory which allows a Software Update to be carried out at any time.

2.2   The FSM Functions

2.2.1   Software version FSM88016 (V0.16)

As the Central Locking Switch in the Window combination switch block is relatively little used, it can also be used as a change-over switch. One press on the Central Locking switch will however, send only one Bit and it is therefore unable to assume the "Comfort" function as the switch is unable to tell if is desired to open or close the windows. For this reason, the Central Locking Switch has been given a double function.

1) if the switch is pressed for less than 1 Second the "Comfort" function is activated for 5 seconds. Pressing any "Close" switch during this 5 second period activates the "comfort" closing function. The rear windows will first close (strangely, this was not the case with the original OEM equipment). As soon as the rear windows have reached the mid closing point the front windows start to close. The reverse function is also the case, pressing any "Open" switch during the 5 second period will open all windows.
2) if the switch is pressed for longer than 1 second the Central Locking is activated as normal.

This new Comfort feature is unrelated to the comfort closing function available using the vehicle key, this functionality is unavailable in the window combination switch block meaning that the Sun Roof cannot be controlled in this way.

Pushing any window button in the opposite direction whilst the Comfort function is activated (a period of 5 seconds) immediately stops all window movement. If the Comfort function is no longer active then only the window corresponding to the button used will be stopped.

2.2.2   Software version FSM88022 (V0.23)

In tests using various vehicles a Timing problem became apparent in some few cases. In the Software version V0.16 the timing of 3 modules was identified and hard programmed. Since the receiver scattering is wider than anticipated the software was completely revised. Here are the amendments to the previous software version:

- The Controller continually seeks the Synchronisation pulse in the data flow. This is the longest Pulse which has a duration of at least 1.5ms.
- After this Synchronisation Pulse a further pulse follows which does not carry any information. This secondary pulse identifies the Synchronisation pulse and the pause timing and is exactly measured by the Controller.
- All subsequent pulses are read and re-coded according to the correct input. The „Shift" comprises 50 steps, allowing an extremely exact Timing, therefore the Quartz Oscillator (Clock) frequency had to be increased from 4MHz to 12Mhz.
- The Input signal may have very wide tolerances, twice or half the normal frequency presents no problem as the Controller will automatically synchronise itself.
- With the increase in the clock frequency the internal divider was reset so that it is now possible to move in much finer steps.
- Opening of the rear windows is no longer controlled by the automatic open function, it is now controlled fully manually by the controller. It has been observed that if the automatic open function was operated the vehicle electronic automatically activated a 5 second lock out function. During these 5 seconds the rear windows are locked out and cannot be re-closed.
- The Emergency Stop function now operates in all phases of Window opening or closing.

The new software can be installed using an adaptor, at the same time it is essential that the Quartz oscillator is increased from 4MHz to 12Mhz.

2.3   Hardware

The Hardware consists of a PIC 16F88 PIC Microcontroller unit with the following features:

- Enhanced Flash Microcontroller with nanoWatt Technology
- 0 - 20 MHz (12MHz)
- Capture Compare PWM (CCP) Module
- 10-bit 7-channel analog to digital converter
- Synchronous serial port (SSP) with SPI
- Synchronous and Asynchronous Receiver Transmitter
- Dual Analog Comparator
- Program Memory: Single-Word Instructions 4096, Flash 7168 (14Bit)
- Data Memory: SRAM 368 Bytes, EEPROM 256 Bytes
- 16 I/O Pin
- EEPROM Data Retention > 40 years
- -40°C to + 85°C

The connection to the Controller is identical to the original window control module. The Controller Module is started with a reset controller 8054, this ensures that even with large voltage fluctuations the Controller is always correctly started.

The electrical current needed by the active Module is less than 4 mA.

The complete switch unit has an operating temperature range of -20°C to +70°C (limited by the Quartz oscillator)

2.4   Opening the Window Combination switch unit

The FSM is installed inside the Window Combination switch unit. To do this, the unit must first be dismantled, this can be done easily with a small flat bladed screwdriver.
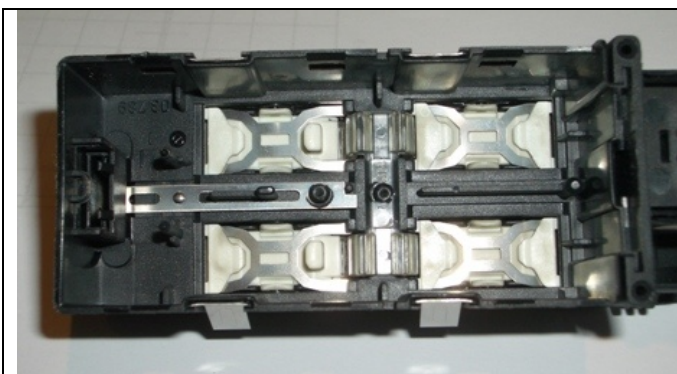
	This is the Window Combination switch unit. It can be split into two parts.

**Figure 1: Window Combination switch unit from E31**

	From the underside the Plastic tongues (shown with the red arrow in Fig. 2) which hold the Window Combination switch unit together. These tongues can be prised open with a flat bladed screwdriver so that the lower white housing can be removed. Note the metal brackets which should re-positioned in the same way when reassembling the unit.

Figure 2: Window Combination switch block (underside view)

|	
	Top view of the switch unit with the buttons removed. Be careful that the springs do not spring out, if this does happen they can be easily reinserted.

Figure 3: Window Combination switch buttons (Interior view)
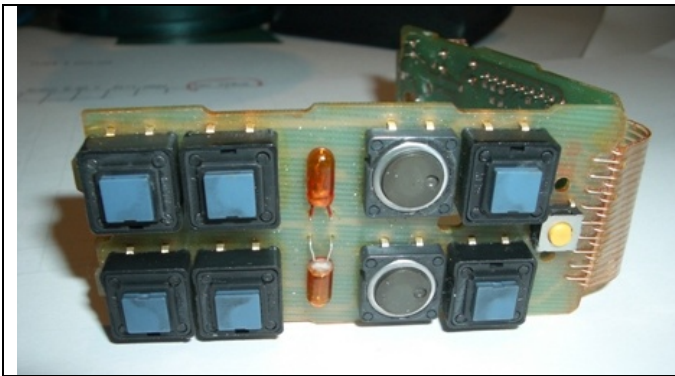
This is the button circuit board. In the middle are the two lamps for the illumination, ordinary bulbs can be used as replacements if these are defective and they are available from Farnell (www.farnell.ch).
The round buttons are the "open" buttons for the rear windows, these do not have double functions. The small round yellow button is for the central locking.
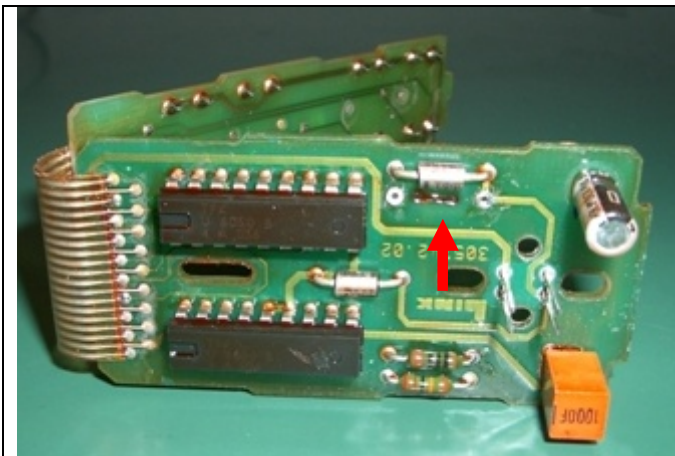
Figure 4: Window Combination switch button circuit board
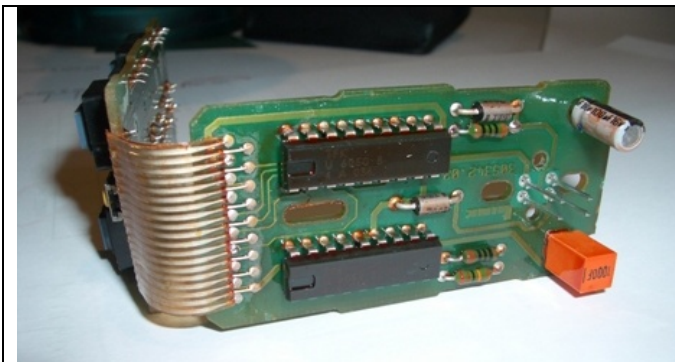
The two circuits hold the two control Telefunken 6050 remote control chips. These chips are available from Conrad Electronic.

Figure 5: Window Combination Switch Remote control chips

2.5   Modification of the Window Combination Switch Unit

Now it comes to the actual Modification. Please ensure that you are always properly earthed to prevent any damage to the circuitry.
If you do not have any proper earth arrangements you should at least earth yourself before attempting any soldering. This can be done by touching any earthed object such as a Radiator.
First, the 100 Ohm Resistor (see red arrow) next to the Diode must be unsoldered and removed.

**Figure 6: 100Ohm Resistor to be unsoldered and removed**
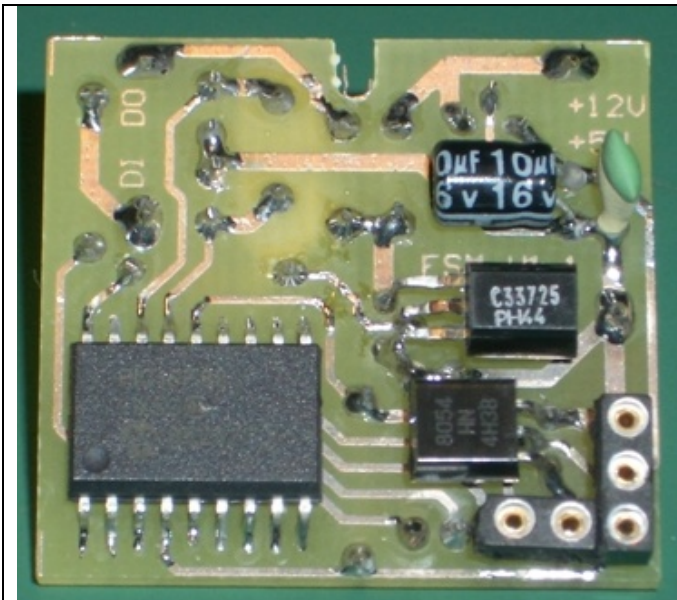
View of the new Controller printed circuit board (PCB) from the component mounting side (top).

Figure 7: Controller printed circuit board from above
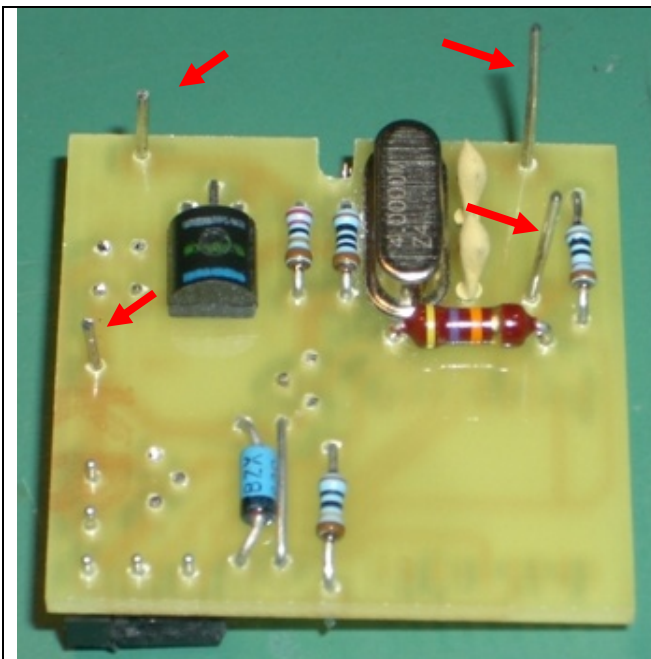
The Controller printed circuit board from below.
The four pins (indicated with red arrows) will eventually be connected to the Window Combination switch unit.

Figure 8: Controller PCB (underside view)
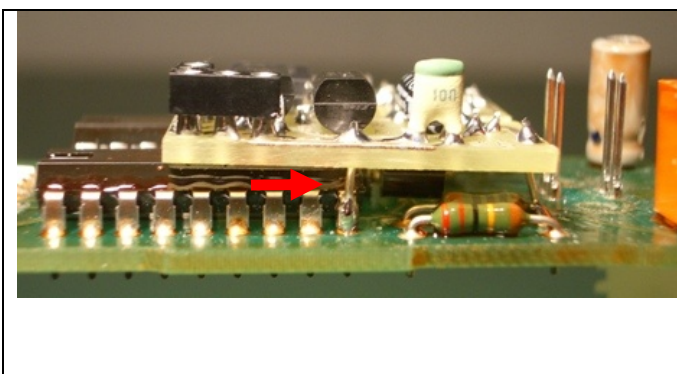
This is how the Controller PCB is mounted onto the Combination switch unit. The two long wires are fed through the holes where the 100Ohm Resistor was earlier removed (see Figure 6 above).
Next the new Controller PCBA is soldered to the last pin on the right hand side of the IC (marked with red arrow). Solder ONLY this wire
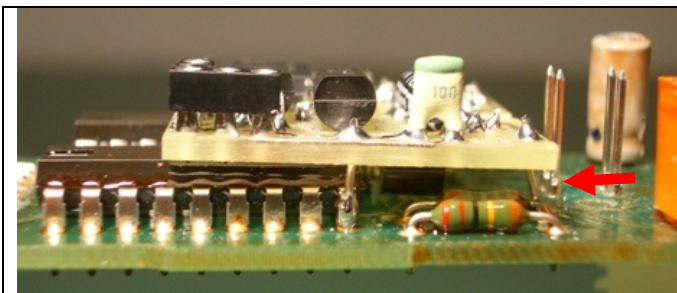
Figure 9: Controller PCB soldered to the Integrated Circuit
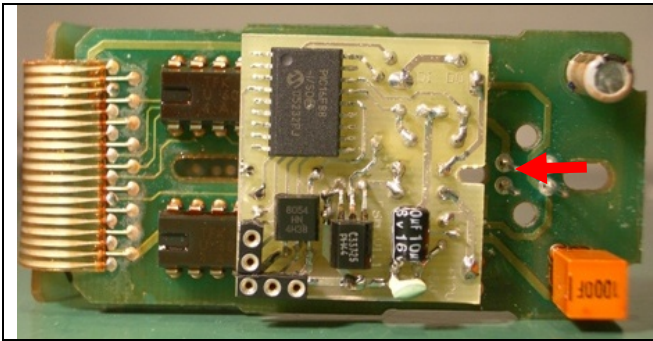
Now the Controller Printed Circuit board needs to be aligned so that it will fit into the housing properly. Note the notch (marked with the red arrow), this notch must be in the middle of the lower cut-out as shown in Figure 10.

Figure 10: Controller PCB alignment

Now this wire is soldered to the inner Resistor (see arrow).

Figure 11: Controller PCB soldered to the inner resistor
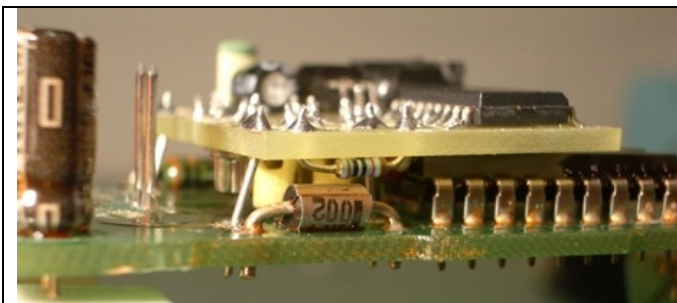
Finally the two longer wires are soldered.

Figure 12: Controller PCB final soldering

The four connecting pins are not and should not be soldered.

Figure 13: The connecting pins for the Combination switch unit

Now everything can be carefully reassembled.

2.6   Testing the Window Control Module

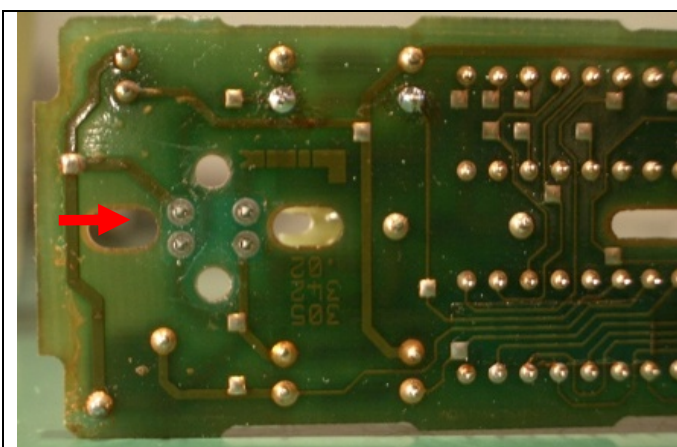For testing outside a vehicle (i.e. not installed), a test module is available which simulates the vehicle control.

2.7   Component List for the Window Control Module FSM

#.	Material FSM	Supplier	Order number
1	PIC Controller 16F88	Farnell	4254041
1	Resetcontroller 8054HN	Fenner	
1	Voltage Regulator 78L05	Farnell	563754
1	Transistor BC 337	Farnell	356967
1	Zenerdiode 4V7	Farnell	3162400
1	Resistor 0E	Farnell	508792
1	Resistor 100E	Farnell	331934
1	Resistor 2k2	Farnell	332094
2	Resistor 10k	Farnell	332173
1	Resistor 100k	Farnell	332290
1	Condenser 10uF 16V	Farnell	3016948
1	Quartz 12 MHz	Distrelec	644796
2	Ceramic condenser 33pF	Farnell	236986
1	Programming socket 6pol		
1	PCB	Distrelec	450714
1	Developer (Printol)	Jaeger AG	6571.27
1	Etching Sulphate (Sodium)	Distrelec	951058
1	Anreibsilber * (liquid silver)	Jaeger AG	6576.25

* Anreibsilber is used to prepare contacts for soldering and to help prevent corrosion

Table 1: Component List for the Window Control Module FSM

3 Installation

3.1 Tools and Material Required:

- Flat blade screwdriver
- Soldering iron, solder
- Pliers / Long-nosed Pliers(for bending contacts)
- Window Combination switch block (Driver's Side)

3.2 Preparation to the Vehicle

- None required

3.3 Assembly in Vehicle

Assemble in the reverse order.

3.4 Function Testing

As soon as the ignition is switched on, it should be possible to control the windows in the normal fashion. Windows that do not move up or down in the correct fashion when the buttons are pressed or move in a jerky motion indicate that the Window Control Module is not functioning with the BMW control unit properly. In this case, it is unfortunately not possible to install the Window Control Module.

4 Appendix

4.1 Glossary

ASC	**ASC-Button from E32**		FSM	Window Control Module
Brm	Brügger Martin		PCB	Printed Circuit Board
LED	Light Emitting Diode			

Table 2: Glossary

4.2 Author

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E-Mail: tbebrm@bluewin.ch

4.3 8er Forum

Website: http://www.8er.org/

Alias: Martin

4.4 Version Listing.

Version	Date	From	Remarks / Type of change
0.47	11.08.2005	Brm	Document Technical E31 Initial version / Draft
1.00	12.08.2005	Brm	Release version
1.01	15.08.2005	Brm	Modification of the Window Combination Switch Unit
1.02	10.12.2005	Brm	Complete Software revision (V0.22) Hardware expanded
1.03	11.12.2005	Brm	Software V0.23 added
1.04	21.10.2007	Brm	Change of address
1.05	19.03.2009	Brm	New installation guide produced