**Body Control Module I4 BMW**

**System Requirements**

1. System shall follow the AUTOSAR standard by using the structure and strategy of making a stable software.
2. System shall follow the C coding style rules to assure quality and stability of the software.
3. System shall perform the initialization sequence needed for the microcontroller used.
4. System shall use the linker file generated by the IDE.
5. System shall use the start-up file generated by the IDE.
6. System shall use any driver, peripheral or library generated or available in the IDE.
7. System shall adapt said available modules to match the requirements.
8. System shall implement the operating system as real time operating system to fulfill the timing requirement.
9. System shall implement watchdog safety mechanism to satisfy the system integrity, timing and safe state requirements.
10. System shall implement error checking in every module that is possible to assure safe state for the system.
11. System shall implement mechanism for data validity in regards to bluetooth communication protocol.
12. System shall perform resets upon defined faults to achieve a safe state.
13. System shall perform diagnostic tests on defined feasible components to satisfy system integrity requirement.
14. System shall implement correct integration of sensors inside the system.
15. System shall implement correct integration of the communication module inside the system.
16. System shall implement correct integration of the LEDs, wires and resistors inside the system.
17. System shall implement diagnostic report upon user request.
18. System shall implement specific bluetooth communication codes.
19. System shall implement conditions for the bluetooth control over the system.
20. System shall implement specific commands for diagnostic report.
21. System shall not overuse the microcontroller resources.
22. System shall implement the central locking using operating system timers.
23. System shall blink the turn signals for 250 miliseconds on and 250 miliseconds off for two times upon unlocking the system and only once upon locking the system.
24. System shall turn on the Follow Me Home concept upon locking and unlocking the system.
25. System shall turn on the exterior lights and interior lights upon Follow Me Home activation.
26. System shall turn on the low beam and the rear position lights at full duty cycle upon the Follow Me Home concept activation.
27. System shall turn on the Follow Me Home concept for 20 seconds and refresh this time period each time the state of the central locking changes.
28. System shall make use of operating system timers for the timer of the Follow Me Home concept.
29. System shall turn on the interior light gradually incresing the duty cycle over time untill reaching full duty cycle during the Follow Me Home concept activation.
30. System shall assure the timing of the low beam, rear position lights and interior lights by using a PWM channel from a hardware timer.
31. System shall assure the timing of the blinking of the turn signals by using an operating system timer.
32. System shall turn on at the same rate as the blinking of the turn signals a buzzer at full duty cycle using the same timing mechanism.
33. System shall turn on a LED, when the central locking is set to active, every 3,75 seconds and keep it active at full duty cycle for 250 miliseconds and repeat this cycle.
34. System shall turn off the LED when the central locking is set to inactive.
35. System shall turn off the security alarm when the central locking is set to inactive.
36. System shall turn on the exterior lighting, regarding low beam and rear position lights, and a buzzer at full duty cycle for 500 miliseconds and at zero duty cycle for 500 miliseconds and repeat this sequence for 10 seconds when the trigger comes from the security alarm.
37. System shall turn on the security alarm when the trigger is calculated to be enough at any time and for as long as it is present.
38. System shall reset the security alarm upon expiration.
39. System shall reset the security alarm upon central locking being set inactive.
40. System shall use different buzzers for security alarm and central locking.
41. System shall set diagnostic trouble codes for any defined system error or component error or fault.
42. System shall measure the sensor values and routing the information inside the system.
43. System shall use the vibration sensor as an input for the security alarm.
44. System shall use the light sensor as an input for the automatic lights.
45. System shall implement the rotary light switch for the states of the exterior lights as bluetooth commands.
46. System shall implement the states of the switch as no lights, position lights, night time lights and automatic lights.
47. System shall turn off the exterior lights when the switch is set as no lights.
48. System shall turn off the low beam and turn on the rear position lights at full duty cycle when the switch is set as position lights.
49. System shall turn on the low beam and the rear position lights at full duty cycle when the light switch is set on night time lights.
50. System shall turn on and off based on the lights switch input the low beam and rear position lights at full duty cycle.
51. System shall interrupt the Follow Me Home concept when any light command is given to the system.
52. System shall implement front fog lights, hazard lights, turn signals, rear fog lights, rear position lights, high beam, low beam, reverse lights, brake lights.
53. System shall turn on and off the front fog lights, rear fog lights, brake lights, high beam and reverse lights at full duty cycle or zero duty cycle based on the bluetooth command.
54. System shall turn on the interior lights on the Follow Me Home concept activation and independently on the bluetooth commands, gradually increasing the duty cycle over time, on both turn on and off, by gradually decreasing the duty cycle over time.
55. System shall control the ultrasonic sensor inputs and use them as outputs for the parking distance controller.
56. System shall measure the distance travelled by the sound to obtain the distance between the sensors and the object in front of the sensors.
57. System shall turn on a buzzer when the distance detected between the sensor and the object is below defined safe distance.
58. The safe distance shall be over 20 centimeters.
59. The buzzer shall be triggered at different periods based on the distance intervals defined.
60. The first safe distance shall be 17 centimeters.
61. The second safe distance shall be 14 centimeters.
62. The third safe distance shall be 11 centimeters.
63. Between the 20 and 17 centimeters of an object, the buzzer shall be triggered for 500 milisecond on and 500 miliseconds off.
64. Between 17 and 14 centimeters of an object, the buzzer shall be triggered for 250 miliseconds on and 250 miliseconds off.
65. Between 14 and 11 centimeters of an object, the buzzer shall be triggered for 125 miliseconds on and 125 miliseconds off.
66. Between 11 and 0 centimeters of an object, the buzzer shall be triggered for 75 miliseconds on and 75 miliseconds off.
67. The distance measured in the parking distance controller shall be 75% of what the timer input capture channel actually measures to assure precision.
68. The buzzer shall be off on when the distance of an object is over 20 centimeters.
69. The parking sensors shall not be active when the reverse lights is not active.
70. The system shall detect any reset reason.
71. The system shall store the reset reason at run-time.
72. The system shall be able to send information to the bluetooth module if requested.
73. The system shall detect any faults defined and report them to the bluetooth module if requested.
74. The system shall perform reset if requested by the bluetooth module.
75. The system shall configure the GPIO unused as GPIO output, which are set to low as default state.
76. The system shall configure the UART baud rate as 9600.
77. The system shall configure the system clock as 100 MHz.
78. The system shall configure the watchdog to have a 128 miliseconds reset threshold.
79. The system shall measure the analog inputs through direct memory access.
80. The system shall use a timebase for the operating system a hardware timer.
81. System shall use 220 Ohms resistor for the LEDs.
82. System shall use jumper wires to connect the components.
83. System shall use 3.3 kOhms resistor as a voltage divider between the transmit line of the controller and the bluetooth module receive line.
84. System shall assure data validity by calculating cyclic redundancy check.
85. System shall use multi-threaded support from operating system strategy of denying locks from interrupts.
86. System shall not have any type of blocking code
87. System shall measure controller temperature.
88. System shall implement analog watchdog with a high threshold of 3000 in case of high temperature of the controller.