Body Control Unit Using The Implementation Of AVR Microcontroller

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Abstract

The vehicle switching system of output loads like horn, headlight etc. is really a messy net of wires. To overcome the problem due to such mess the Body Control Unit is designed and proposed for the vehicles.
Body Control Unit is basically a module that controls the basic switch ON/OFF functions of switches and loads provided with two wheelers. All the switch controls are collectively brought to one location and the corresponding ouput controls are also controlled from one location.Output loads include, head light, park light, horn, self start, indicators,dipper. The heart of the module is a microcontroller which is pre loaded with an algorithm for control of the switches and special protection features.
When a switch is pressed , Body Control Unit gets the signal, the system then analyses the signal and releases the output signal for the corresponding input. Hence a fully controlled, protected and fast mechanism controlling the vehicle switches make the drive much more convenient,safe and reliable.
For the sake of protection, unit continuously monitors the current drawn by the loads which are activated and if the monitored current drawn by the load is above the set limits, then that particular load gets deactivated leaving the other load functions unchanged.
Conventionally the control of switches in two wheelers is done using hard wired direct switches. The motive is to improve the existing method of control in vehicles.

1. Introduction.

Body Control Unit is a modern approach for the better,efficient and protective control of the switches and loads with the vehicle.
It consists of a microcontroller and solid state semiconductor devices mounted on a pcb to which switches and loads are attached. The system recieves input signal from the switches and in turn transmits controlled output to the respective loads provided with the vehicle.The heart of the Body Control Unit is a microcontroller. All the functions are prefed into the microcontroller as a well tested algorithm.
When the microcontroller recieves the signal from the switches, it activates the corresponding load as well as the protection of that load.

For the sake of protection, system continuously monitors the current drawn by the loads which are activated and if the monitored current drawn by the load is above the set limits, then that paritcular load gets deactivated leaving the other load functions unchanged.In conventional system if the load does not get detached, battery supply of the two wheeler also gets short circuited which can be dangerous.

The Appearance of the Body Control Unit.

Block Diagram of the connections of Body Control Unit.

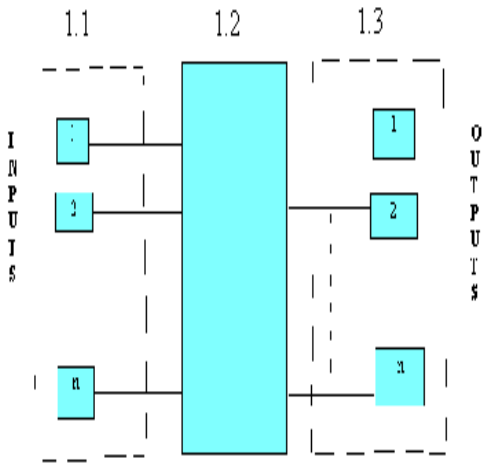


FIGURE.1

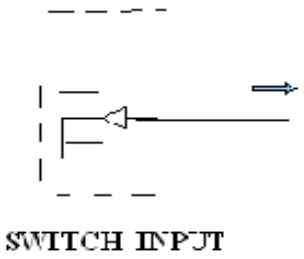


FIGURE.2

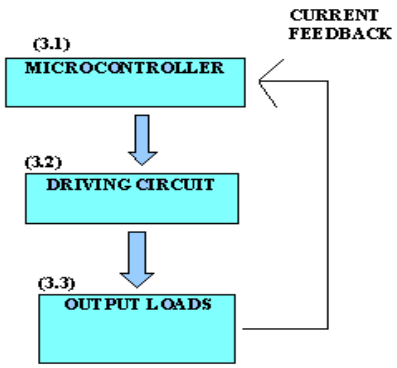


FIGURE.3

Explanation of the block diagram.

Fig.1. It is basically the simplified representation of the complete Body Control Unit.It consists of the follwing subparts:

(1.1) It represents the inputs connected to the microcontroller. The inputs are:

a) Headlight switch
b) Parking light switch
c) Horn switch
d) Passing switch
e) Self Start switch
f) Low/High Beam switch
g) Left Indicator switch
h) Right Indicator switch
i) Automatic Indicator off sensor

(1.2) Microcontroller .

It is the brain of the system ,it senses the input and in return provides the output, also keeps a check on the current drawn by the loads individually. It is fed with a well tested algorithm which controls the outputs corresponding to the input switches also for providing short circuit protection

(1.3) It represents the output for driving various loads.

The loads are as follows:

a) Low beam
b) High beam
c) Park light light
d) Horn
e) Self Start relay
f) Left Indicator
g) Right Indicator

FIG 2) Input Switches

The switches are to provide the input signals to the module so that the particular outputs can be switched ON.

Fig 3) It represents the output section of the Electronic Control System.

(3.1) Microcontroller: After the analysis of the input signal, the output signal is generated by the microcontroller.Also the current of the output load it sensed by the microcontroller for the short circuit and overload protection.

(3.2) Driving circuit: The microcontroller provides output signal to the driving circuit to which the output loads are connected. The need of driving circuit is to provide heavy current to the output loads of the vehicle.

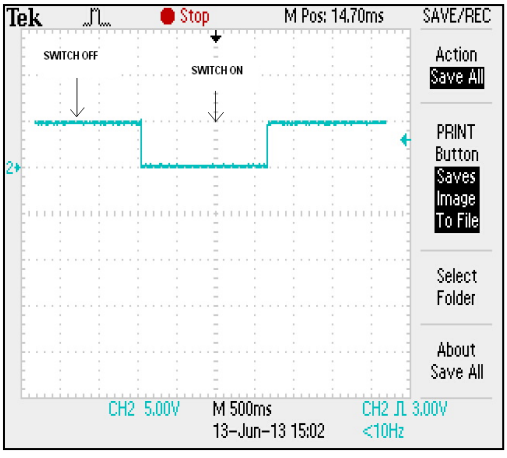
(3.3) Output Loads. These are the outputs which are connected to the driving circuit.

Feedback.

Along with switch ON/OFF of the output load, the microcontroller also keeps a track of the current drawn by the correspondnig loads with the help of feedback circuit.When the cureent consumption of any load exceeds the set value the microcontroller switches OFF that particular output without affecting any other output.

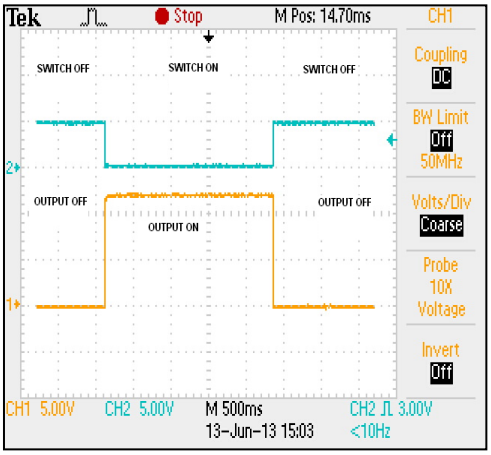
2. Description.

The switches present on the vehicle are collectively brought to one place as inputs to the Body Control Module.
These inputs are then sensed as shown with the help of waveform below.



Sim1. Switch ON and OFF condition

These inputs are than verified and analyzed with the help of AVR. The output of the AVR is provided to the Power source driver i.e. VNQ600A which ultimately sources the output load.
The output driven is shown by the waveform below.

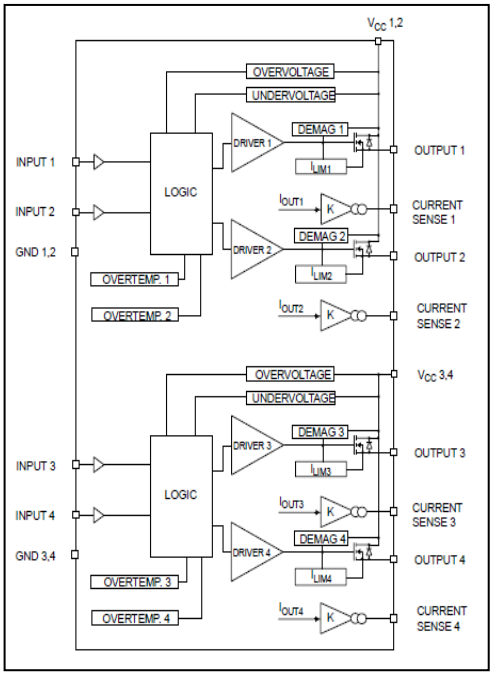


Sim2. Shows Output getting ON when switch is pressed

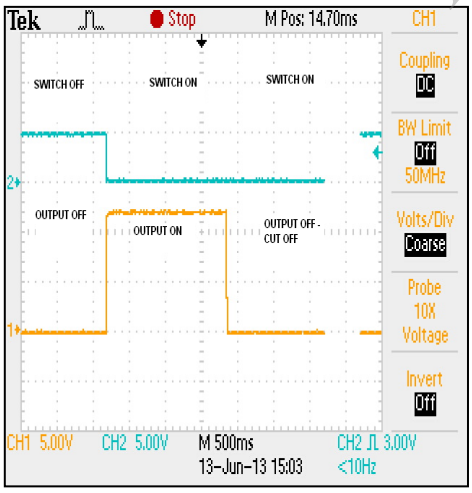
The VNQ600A also converts the current load being supplied to any load into the voltage level. This voltage level is than fed to the AVR for analyses that whether excess current is being sunk by the output or appropriate current.
If proper current that is current below the pre fed critical limit is sunk than out to that load is provided normally.
But if the current sunk by the output is above the pre fed limit than no output to that particular is provided. Hence the diagnose of the problem of output load becomes very easy and also the battery is also safe.

The VNQ600A is intended for driving any type of multiple loads with one side connected to ground. This device has four independent channels and four analog sense outputs which deliver currents proportional to the outputs currents. Active current limitation combined with thermal shut-down and automatic restart protect the device against overload. Device automatically turns off in case of ground pin disconnection.

The Logic Diagram of VNQ600A.



The cut-off condition caused by the Body Control Unit is shown by the help of following waveform.



Sim3. Cut-off condition of the output is if the current sunk by the output is above the pre fed limit

The load conditions are all pre-fed in the module. These conditions can be varied as per the requirement on the vehicle.

The conditions pre-fed presently are as follows.

S.No.	Name of Load	Maximum Load current	Maximum Load Wattage
1	Headlight high beam	4.5 Amperes	54 Watt
2	Headlight high beam	4.5 Amperes	54 Watt
3	Horn	6 Amperes	72 Watt
4	Park light	4 Amperes	48 Watt
5	Left Indicator	2.5 Amperes	30 Watt
6	Right Indicator	2.5 Amperes	30 Watt
7	Self Start	4 Amperes	48 Watt
8	Passing	4.5 Amperes	54 Watt

Table1. The pre-fed values of current in the monitoring section of the Body Control Module.

Cut-off refers to the disconnection of the output load from the module. As shown in the simulation Sim3. The blue wave refers to the switch condition i.e. ON of OFF. When the switch is OFF the blue waveform is at logic 1, and when the blue waveform is at logic 0. When the switch is pressed the output get ON shown by the yellow waveform gets at logic 1 (12V) is supplied to the load. Along with the source the output current is monitored by the module, as the current is above the pre-fed limit the output wave get low even when the switch is in ON state.

3. Some other special features of Body Control Unit.

- **Indicator Flash Rate modification.**

In normal condition condition i.e. the loads connected to the indicators is 10 watt each than the flash rate of the indicators is 90 flashes per minute , if any one of the left indicators is open circuit , or any one of the right indicators is open circuit than the flash rate of the respective indicator is increased which is an indicator of faulty indicator.

- **Auto Off Indicator.**

When the indicator is switched ON once, the indication of the direction of turn is indicated.
Body Control Unit has the feature of automatically switching off the indicator once the turn has been taken. Module gets the signal from the vehicle of the handle turn on one side and when the turn is taken and vehicle handle is again brought to center position this situation is captured by the AVR in unit and the indicator is switched OFF. So the driver need not switch off the indicator after taking the turn, this can be left to the Body Control Unit.

4. Advantages of Body Control Unit over the Conventional Hard wired System.

- **Better Control.**

The efficient control by the use of microcontroller leads to better control and handling of the switches. The contact-less switches also lead to better switch ON/OFF functions.

- **Better Protection.**

Better protection is provided by the algorithm used by the microcontroller. Whenever short circuit is observed in any load that particular load is cut off without affecting other loads.
Also in the case of disconnection of any one of the indicators out of the two of single side (left or right) the flash rate of the indicator of the affected side of indiator is changed.Also if the battery supply is found to be short than the input suppy to the switches is disconnected.

- **Easier Fault Diagnose.**

As input as well as output of all connections are pre fixed and controlled by single unit (microcontroller) the fault diagonsis is easier .

5. Conclusions.

The Body Control Unit solves the problem of complexity caused by the complex wired system in hard wired system of switch control. With the unique feature of monitoring the current consumption i.e. the status of operation of the loads the unit makes the vehicle safe and protects the life of battery. This unit can be made as per the vehicle requirement hence the unit is plug and play type of support.
Hence it is concluded that Body Control Unit provides the ready solution for the problems faced in the hard wired switch control system of complexity , difficult fault diagnose, lesser life, lack of reliability, bad effects on vehicle in case of failure of any load connected to vehicle, ill effects caused on the battery leading to reduced battery life.

6. Refrences.

1) http://www.alldatasheet.com/datasheet-df/pdf/255842/ATMEL/ATMEGA8L-8PU.html
2) William I. Fletcher “An Engineering Approach to Digital Design”
3) J.B. Gupta “Electronic Devices and Circuits””
4) http://en.wikipedia.org/wiki/Body_control_module
5) http://www.bajajauto.com/index.asp
6) http://www.heromotocorp.com/en-in/two-wheeler-motorcycles
7) http://powersports.honda.com/street.aspx
8) http://www.ti.com/lit/an/szza009/szza009.pdf
9) http://pcb.castle-st.com/files/Tutes/TutePart1Schematic.pdf
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