

|                |  |
|----------------|--|
| Structure      | Silicon Monolithic Integrated Circuit  |
| Product Series | 6ch Power Driver for Car Audio   |
| Type           | <b>BD8210EFV</b>   |
| Feature        | <ul style="list-style-type: none"> <li>• The SPINDLE driver and the SLED driver can highly effective drive with PWM drive system.</li> <li>• The actuator driver and the loading driver are linear BTL drive and are achieving a low noise power.</li> </ul> |

Absolute maximum ratings(Ta=25 )

| Parameter   | Symbol                      | Limits    | Unit |
|---|-----------------------------|-----------|------|
| POWER MOS power supply voltage                                    | SPVM, SPRNF, SLRNF          | 15 #1     | V    |
| Pre-block / BTL / Loading driver power-block power supply voltage | Vcc, VMFCRNF, VMTKRNF, VM_S | 15        | V    |
| Input terminal voltage1   | VIN1 #2                     | VCC       | V    |
| Input terminal voltage2   | VIN2 #3                     | VM_S      | V    |
| Power dissipation   | Pd                          | 2.0 #4    | W    |
| Operating temperature range                                       | Topr                        | -40 ~ 85  |      |
| Storage temperature   | Tstg                        | -55 ~ 150 |      |
| Junction temperature  | Tjmax                       | 150       |      |

#1 POWER MOS output terminals are contained.

#2 It shows each terminal of CTL1 , CTL2 , Vc , LDVc , LDIN , TINN , and FINN.

#3 It shows each terminal of HU+ , HU- , HV+ , HV- , HW+ , HW- , SL1INN , SL2INN , SPIN , SPVM , and VM\_S.

#4 Ta=25 , PCB (70mm x 70mm x 1.6mm,occupied copper foil is less than 3%,glass epoxy standard board) mounting.  
Reduce power by 16mW for each degree above 25 .

Operating conditions (Ta=-40 ~ +85 )

(Set the power supply voltage taking allowable dissipation into considering.)

| Parameter   | Symbol             | MIN | TYP | MAX  | Unit |
|---|--------------------|-----|-----|------|------|
| Pre-block / Loading driver power-block power supply voltage | Vcc                | 6   | 8   | 10   | V    |
| PWM-part Pre-block power supply voltage                     | VM_S               | 6   | 8   | Vcc  | V    |
| Spindle driver powerblock power supply voltage              | SPVM, SPRNF        | 6   | 8   | VM_S | V    |
| Sled motor driver powerblock power supply voltage           | SLRNF              | 6   | 8   | VM_S | V    |
| Actuator driver powerblock Power supply voltage             | VMFCRNF<br>VMTKRNF | 4   | 8   | Vcc  | V    |

Install detect resistance between SPVM, SPRNF, SLRNF and VM\_S, and between VMFCRNF, VMTKRNF and AVM.

Status of this document

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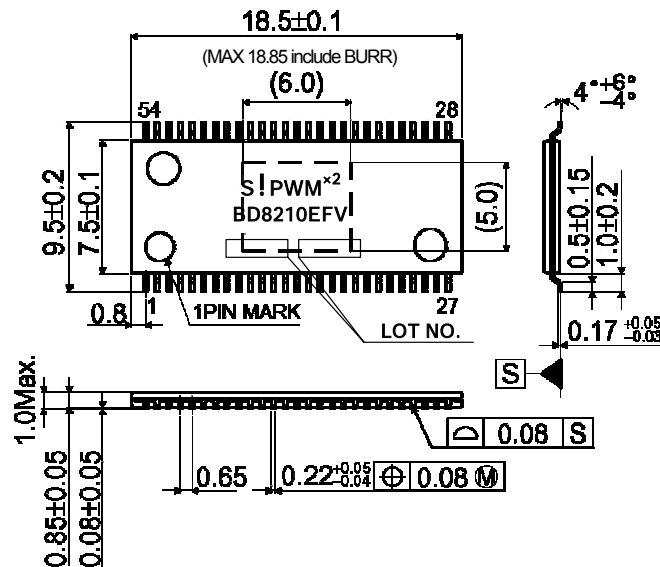
A radiation is not designed.

**Electrical characteristics**

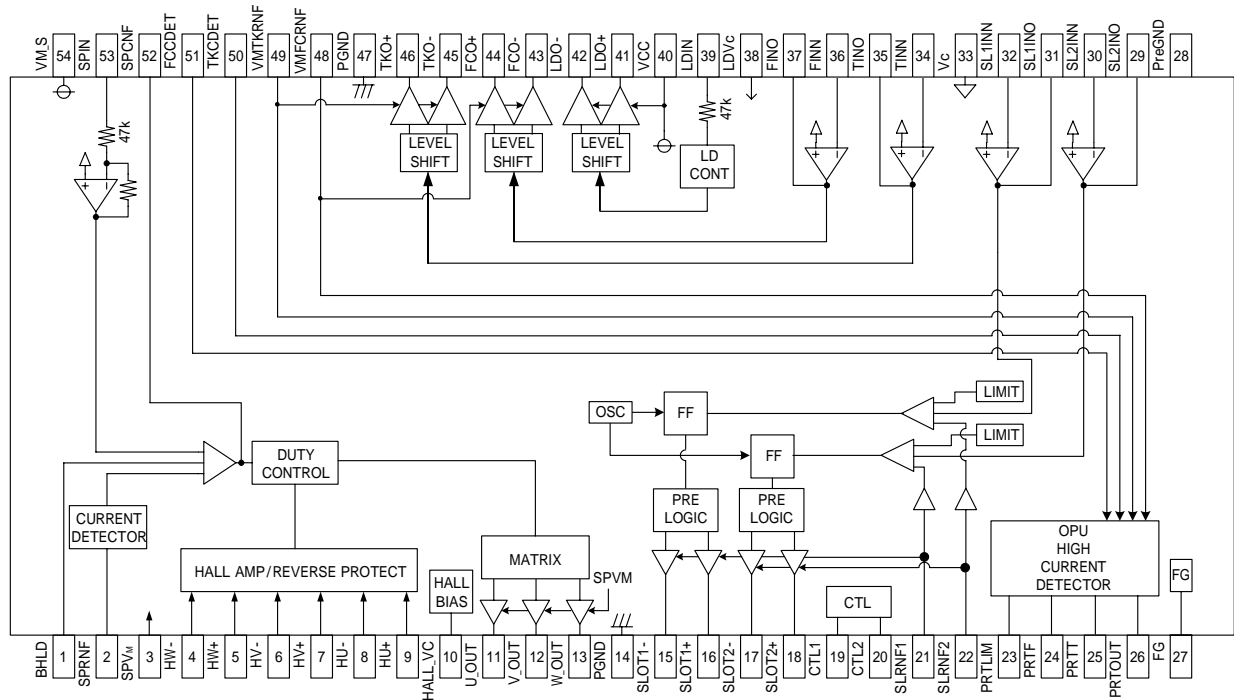
(Unless otherwise noted, Ta=25 , Vcc=SPVM=SLVM=8V, AVM=5V, Vc=LDVC=1.65V, RL=8 , RLSP=2 , SPRNF=0.25 , SLRNF=0.5 )

| Parameter                           | Symbol                                       | MIN.                                  | TYP.    | MAX. | Unit | Condition |                     |                     |
|-------------------------------------|--|---------------------------------------|---------|------|------|-----------|---------------------|---------------------|
| Circuit current                     | Quiescent current 1                          | IQ1                                   | -       | 18   | 25   | mA        | High gain mode      |                     |
|                                     | Quiescent current 2                          | IQ2                                   | -       | 18   | 25   | mA        | Low gain mode       |                     |
|                                     | Standby-on current 1                         | IST1                                  | -       | 0.7  | 1.0  | mA        | Standby mode        |                     |
| Spindle driver Block                | Hall bias                                    | Voltage of hall bias                  | VHB     | 0.45 | 0.9  | 1.35      | V                   | IHB = 10mA          |
|                                     |  | Input bias current                    | IHB     | -5   | -    | 5         | μA                  |                     |
|                                     | Hall AMP                                     | Input level                           | VHIM    | 50   | -    | -         | mVpp                |                     |
|                                     |  | Common mode input range               | VHICM   | 1    | -    | 6         | V                   |                     |
|                                     | Torque instruction I/O                       | Input dead zone 1 (one side)          | VDZSP1  | 0    | 10   | 40        | mV                  | High gain mode      |
|                                     |  | Input dead zone 2 (one side)          | VDZSP2  | 0    | 10   | 40        | mV                  | Low gain mode       |
|                                     |  | Input output gain 1                   | gmSP1   | 0.8  | 1.00 | 1.20      | A/V                 | High gain mode      |
|                                     |  | Input output gain 2                   | gmSP2   | 0.16 | 0.20 | 0.24      | A/V                 | Low gain mode       |
|                                     |  | Output On resistor (Vertical harmony) | RONSP   | -    | 1    | 1.8       | Ω                   | IL = 500mA          |
|                                     |  | Output limit current                  | ILIMSP1 | 1.05 | 1.32 | 1.58      | A                   | All mode commonness |
|                                     |  | Input impedance                       | RiSP    | 35   | 47   | 59        | kΩ                  |                     |
|                                     | FG output                                    | Pulse frequency                       | fosc    | -    | 100  | -         | kHz                 |                     |
| Low voltage                         |  |                                       | VFGL    | -    | 0.1  | 0.3       | V                   | 10KΩ Pull-up (3.3V) |
| Stepping motor driver Block         | Input dead zone (one side)                   | VDZSL                                 | 5       | 15   | 30   | mV        |                     |                     |
|                                     | Input output gain                            | gmSL                                  | 425     | 500  | 575  | mA/V      |                     |                     |
|                                     | Input offset voltage                         | VIOSL                                 | -5      | -    | 5    | mV        |                     |                     |
|                                     | Input bias current                           | IBIASL                                | 10      | 50   | 300  | nA        |                     |                     |
|                                     | Output On resistor (Vertical harmony)        | RONSL                                 | -       | 22   | 37   | Ω         | IL = 500mA          |                     |
|                                     | Output limit current                         | ILIMSL                                | 672     | 800  | 928  | mA        |                     |                     |
|                                     | Pulse frequency                              | fosc                                  | -       | 100  | -    | kHz       |                     |                     |
| Actuator driver Block               | Input offset voltage                         | VIOACT                                | -5      | -    | 5    | mV        |                     |                     |
|                                     | Input bias current                           | IBIASACT                              | 10      | 50   | 300  | nA        |                     |                     |
|                                     | Output offset voltage                        | VOFFT                                 | -50     | 0    | 50   | mV        |                     |                     |
|                                     | Output saturation voltage (vertical harmony) | VOFT                                  | -       | 0.9  | 1.6  | V         | IL = 500mA          |                     |
|                                     | Voltage gain                                 | GVFT                                  | 105     | 12   | 135  | dB        |                     |                     |
| Loading driver Block                | Output offset voltage                        | VOFLD                                 | -50     | 0    | 50   | mV        |                     |                     |
|                                     | Output saturation voltage (vertical harmony) | VOLD                                  | -       | 1.5  | 2.3  | V         | IL = 500mA          |                     |
|                                     | Input impedance                              | RiLD                                  | 35      | 47   | 59   | k         |                     |                     |
|                                     | Voltage gain                                 | GVLD                                  | 13      | 15   | 17   | dB        |                     |                     |
| Picking up protection circuit Block | PRTT/PRTF Default voltage                    | VPRTRF                                | 1.00    | 1.06 | 1.12 | V         |                     |                     |
|                                     | PRTT/PRTF Protection detection voltage       | VPRTDET                               | 282     | 300  | 318  | V         |                     |                     |
|                                     | PRTLIM Voltage                               | VPRTLIM                               | 500     | 530  | 560  | mV        |                     |                     |
|                                     | DETAMP Input offset voltage                  | VOFDET                                | -5      | 0    | 5    | mV        |                     |                     |
| Picking up protection reset Block   | L output voltage                             | VOL                                   | -       | 0.1  | 0.3  | V         | 33KΩ Pull-up (3.3V) |                     |
|                                     | H input voltage                              | VH                                    | 2       | -    | -    | V         |                     |                     |
|                                     | L input voltage                              | VIL                                   | -       | -    | 0.8  | V         |                     |                     |
| CTL1,CTL2                           | L input voltage                              | VIL                                   | -       | -    | 0.8  | V         |                     |                     |
|                                     | H input voltage                              | VH                                    | 2       | -    | -    | V         |                     |                     |
|                                     | Highlevel input current                      | IcTH                                  | -       | 50   | 100  | μA        | CTL = 3.3V          |                     |
| Function                            | Vc drop muting Voltage of mute               | VMVc                                  | 0.4     | 0.7  | 1    | V         |                     |                     |
|                                     | Vcc drop muting Voltage of mute              | VMVcc                                 | 3.4     | 3.8  | 4.2  | V         |                     |                     |
|                                     | LDVc drop muting Voltage of mute             | VMLDVc                                | 0.4     | 0.7  | 1    | V         |                     |                     |
|                                     | Vc input current                             | IVC                                   | -       | 4    | 8    | μA        |                     |                     |
|                                     | LDVc input current                           | ILDVC                                 | -       | 4    | 8    | μA        |                     |                     |

Package outlines : HTSSOP-B54



(UNIT : mm)



About input / output polarity, FCO+=L, FCO-=H at FINO > Vc.  
Same applies to SL1INO, SL2INO, TINO.

Pin description

| No. | Symbol  | Description                               | No. | Symbol  | Description                                   |
|-----|---------|---|-----|---------|---|
| 1   | BHLd    | Spindle driver current sense bottom hold  | 54  | VM_S    | Spindle / Sled control block power supply     |
| 2   | SPRNF   | Spindle driver current sense              | 53  | SPIN    | Spindle driver input                          |
| 3   | SPVM    | Spindle driver power supply               | 52  | SPCNF   | Spindle driver loop filter                    |
| 4   | HW-     | Hall amp.W negative input                 | 51  | FCCDET  | Drive current detect for Focus drive          |
| 5   | HW+     | Hall amp.W positive input                 | 50  | TKCDET  | Drive current detect for Tracking drive       |
| 6   | HV-     | Hall amp.V negative input                 | 49  | VMTKRNF | Tracking driver power supply                  |
| 7   | HV+     | Hall amp.V positive input                 | 48  | VMFCRNF | Focus driver power supply                     |
| 8   | HU-     | Hall amp.U negative input                 | 47  | PGND    | Act / LD driver power ground                  |
| 9   | HU+     | Hall amp.U positive input                 | 46  | TKO+    | Tracking driver positive output               |
| 10  | HALL Vc | Hole bias                                 | 45  | TKO-    | Tracking driver negative output               |
| 11  | U_OUT   | Spindle driver output U                   | 44  | FCO+    | Focus driver positive output                  |
| 12  | V_OUT   | Spindle driver output V                   | 43  | FCO-    | Focus driver negative output                  |
| 13  | W_OUT   | Spindle driver output W                   | 42  | LDO-    | Loading driver negative output                |
| 14  | PGND    | Spindle & SLED driver block power ground  | 41  | LDO+    | Loading driver positive output                |
| 15  | SLO1-   | Sled driver 1 negative output             | 40  | Vcc     | BTL pre and Loading power supply              |
| 16  | SLO1+   | Sled driver 1 positive output             | 39  | LDIN    | Input for Loading driver                      |
| 17  | SLO2-   | Sled driver 2 negative output             | 38  | LDVc    | Reference voltage input for Loading driver    |
| 18  | SLO2+   | Sled driver 2 positive output             | 37  | FINO    | Output for Focus driver pre-op amp            |
| 19  | CTL1    | Driver logic control input 1              | 36  | FINN    | Inverted input for Focus driver pre-op amp    |
| 20  | CTL2    | Driver logic control input 2              | 35  | TINO    | Output for Tracking driver pre-op amp         |
| 21  | SLRNF1  | Sled driver 1 current sense               | 34  | TINN    | Inverted input for Tracking driver pre-op amp |
| 22  | SLRNF2  | Sled driver 2 current sense               | 33  | Vc      | Reference voltage input                       |
| 23  | PRTLIM  | Droop current setting for Pick-up protect | 32  | SL1INN  | Inverted input for Sled driver 1 pre-op amp   |
| 24  | PRTF    | Protect Time setting for Focus            | 31  | SL1INO  | Output for Sled driver 1 pre-op amp           |
| 25  | PRTT    | Protect Time setting for tracking         | 30  | SL2INN  | Inverted input for Sled driver 2 pre-op amp   |
| 26  | PRTOUT  | Protect output                            | 29  | SL2INO  | Output for Sled driver 2 pre-op amp           |
| 27  | FG      | FG output                                 | 28  | PreGND  | Pre block ground                              |

## Cautions in using the IC

### 1. Absolute maximum ratings

We are careful enough for quality control about this IC. So, there is no problem under normal operation, excluding that it exceeds the absolute maximum ratings. However, this IC might be destroyed when the absolute maximum ratings, such as impressed voltages or the operating temperature range, is exceeded, and whether the destruction is short circuit mode or open circuit mode cannot be specified. Please take into consideration the physical countermeasures for safety, such as fusing, if a particular mode that exceeds the absolute maximum rating is assumed.

### 2. Reverse polarity connection

Connecting the power line to the IC in reverse polarity (from that recommended) will damage the part. Please utilize the direction protection device as a diode in the supply line and motor coil line.

### 3. Power supply line

Due to return of regenerative current by reverse electromotive force, using electrolytic and ceramic suppress filter capacitors (0.1 $\mu$ F) close to the IC power input terminals (Vcc and GND) are recommended. Please note the electrolytic capacitor value decreases at lower temperatures and examine to dispense physical measures for safety.

### 4. GND line

Please keep the GND line the lowest potential always, and check the GND voltage when transient voltages are connected to the IC.

### 5. Thermal design

Do not exceed the power dissipation (Pd) of the package specification rating under actual operation, and please design enough temperature margins. This product has exposed the frame to the back side of the package, but please note that it is assumed to use heat radiation efficiency by the heat radiation for this part. Please take the heat radiation pattern on not only the surface of the substrate but also the back of the substrate widely.

### 6. Short circuit mode between terminals and wrong mounting

Do not mount the IC in the wrong direction and displacement, and be careful about the reverse-connection of the power connector. Moreover, this IC might be destroyed when the dust short the terminals between them or GND.

### 7. Radiation

Strong electromagnetic radiation can cause operation failures.

### 8. ASO (Area of Safety Operation)

Do not exceed the maximum ASO and the absolute maximum ratings of the output driver.

### 9. TSD (Thermal Shut-Down)

The TSD is activated when the junction temperature (Tj) exceeds Tjmax, and the output terminal is switched to OPEN.

The guarantee and protection of set are not purpose. Therefore, please do not use this IC after TSD circuit operates, nor use it for assumption that operates the TSD circuit.

### 10. Capacitor between output and GND

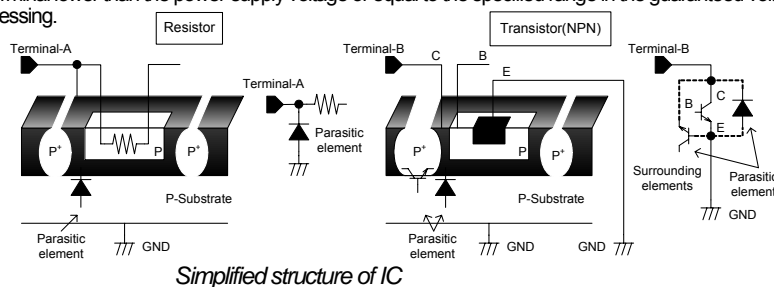
If a large capacitor is connected between the output and GND, this IC might be destroyed when Vcc becomes 0V or GND, because the electric charge accumulated in the capacitor flows to the output. Please set said capacitor to smaller than 0.1 $\mu$ F.

### 11. Inspection by the set circuit board

The stress might hang to IC by connecting the capacitor to the terminal with low impedance. Then, please discharge electricity in each and all process. Moreover, when attaching or detaching from jig in the inspection process, please turn off the power before mounting the IC, and turn on after mounting the IC, and vice versa. In addition, please take into consideration the countermeasures for electrostatic damage, such as giving the earth in assembly process, transportation or preservation.

### 12. Input terminal

This IC is a monolithic IC, and has P<sup>+</sup> isolation and P substrate for the element separation. Therefore, a parasitic PN junction is formed in this P-layer and N-layer of each element. For instance, the resistor or the transistor is connected to the terminal as shown in the figure below. When the GND voltage potential is greater than the voltage potential at Terminal A on the resistor, at Terminal B on the transistor, the PN junction operates as a parasitic diode. In addition, the parasitic NPN transistor is formed in said parasitic diode and the N layer of surrounding elements close to said parasitic diode. These parasitic elements are formed in the IC because of the voltage relation. The parasitic element operating causes the interference of circuit operation, then the wrong operation and destruction. Therefore, please be careful so as not to operate the parasitic elements by impressing to input terminals lower voltage than GND (P substrate). Please do not apply the voltage to the input terminal when the power-supply voltage is not impressed. Moreover, please impress each input terminal lower than the power-supply voltage or equal to the specified range in the guaranteed voltage when the power-supply voltage is impressing.



Simplified structure of IC

### 13. Earth wiring pattern

If small signal GND and large current GND exist, disperse their pattern. In addition, for voltage change by pattern wiring impedance and large current not to change voltage of small signal GND, each ground terminal of IC must be connected at the one point on the set circuit board. As for GND of external parts, it is similar to the above-mentioned.

### 14. Reverse-rotation braking

In the case of reverse-rotation braking from high-speed rotation, pay good attention to reverse electromotive force. Furthermore, fully check output current and consider the revolutions applied to the reverse-rotation brake.

### 15. About the capacitor between SPVM and PGND

The capacitor between SPVM and PGND absorbs the change in a steep voltage and the current because of the PWM drive, as a result, there is a role to suppress the disorder of the SPVM voltage. However, the effect falls by the influence of the wiring impedance etc, if the capacitor becomes far from IC. Please examine the capacitor between SPVM and PGND to arrange it near IC.

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