

HIGH-VOLTAGE MONOLITHIC IC

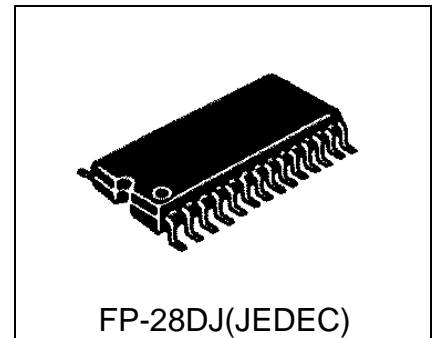
ECN3054

ECN3054 is a single chip driver IC which has 6 MOS-Gated devices for its output. It is suitable for controlling 3-phase brushless DC motors and 3-phase induction motors.

Functions

- Lower arm Over current (OC) Protection
- Under voltage Protection
- Fault Output function

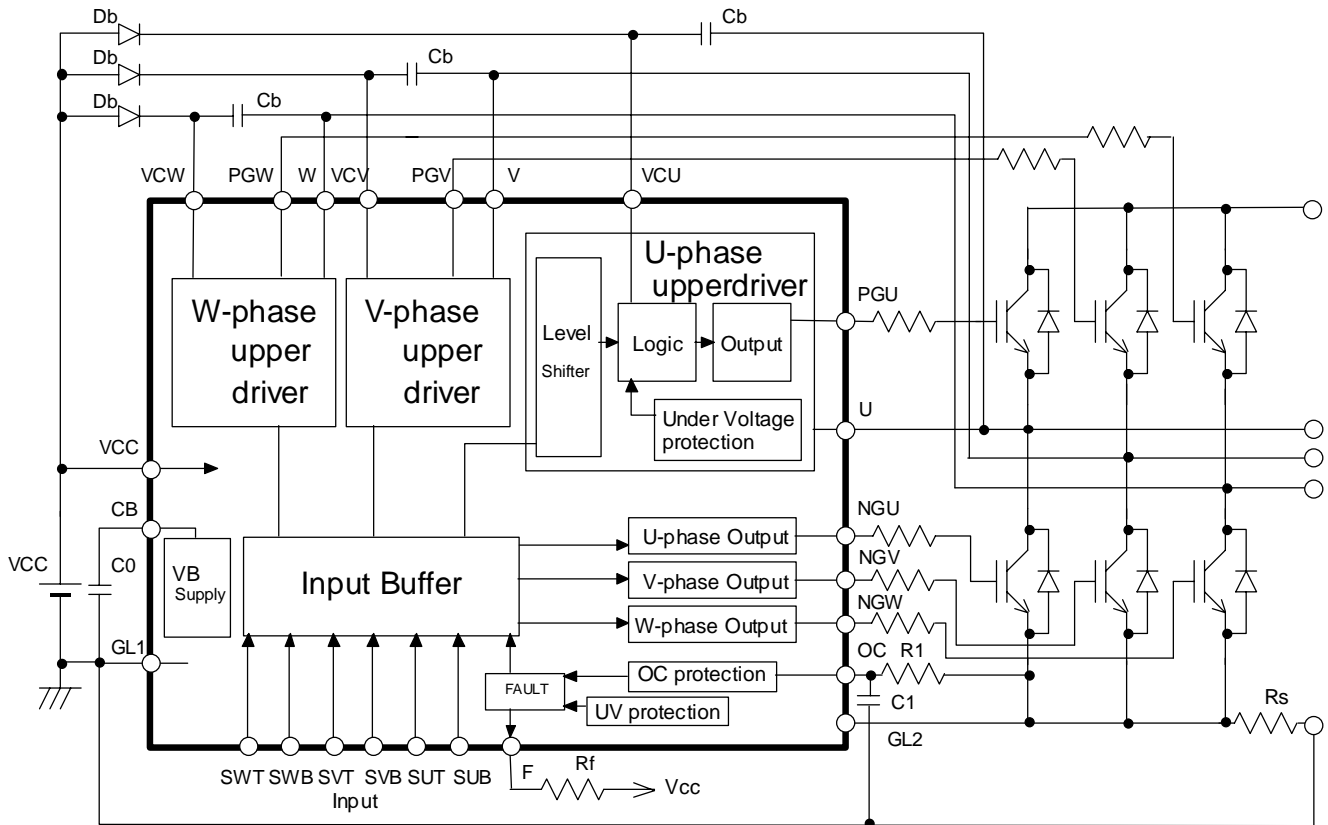
Package



Features

- It can be controlled by PWM with 6 inputs from an external microprocessor.
- 6 logic inputs are compatible with 5V CMOS.

Block Diagram



Block diagram

ECN3054

1. General

This specification shall be applied to the following semiconductor integrated circuits.

- 1) Type : ECN3054F
- 2) Application : 3-phase Brushless DC Motor, 3-phase Induction Motor
- 3) Structure: Monolithic IC
- 4) Package : FP-28DJ (JEDEC)

2. Maximum Allowable Ratings (Ta=25 °C)

| No. | ITEMS | SYMBOLS | VALUES | UNIT | CONDITIONS |
|-----|---------------------------------|---------|--------------|------|-----------------------|
| 1 | Output Device Breakdown Voltage | Vbv | 620 | V | Between VCU,V,W & GL1 |
| 2 | GL2 terminal voltage | Vgl2 | -5~Vcc | V | Vcc=18Vmax at GL2=-5V |
| 3 | U,V,W terminal Voltage | Vu,v,w | -5~600 | V | |
| 4 | Supply voltage | Vcc | 20 | V | |
| 5 | Input voltage | Vin | -0.5~Vcc+0.5 | V | |
| 6 | Operating Junction Temperature | Tjop | -20~125 | °C | |
| 7 | Storage Temperature | Tstg | -40~150 | °C | |

Note 1 : Thermal resistance Rja

| PACKAGE | FP-28DJ | UNIT |
|------------|------------------|------|
| Single | 121 | °C/W |
| Mounted | 84 | °C/W |
| PCB size * | 120x21x1.6 (30%) | (mm) |

* This figure varies depending on the mounting condition.

3. Recommended Operating Conditions

| No. | ITEMS | SYMBOLS | VALUES TOL. | UNIT | CONDITIONS |
|-----|------------------------|---------|-------------|------|------------|
| 1 | U,V,W terminal Voltage | Vu,v,w | -3 ~ 400 | V | |
| 2 | Supply Voltage | Vcc | 13.5 ~ 16.5 | V | |

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4. Electrical Characteristics

Unless otherwise noted, Ta=25°C, Vu,v,w to GL1=374V, Vcc=15V. (suffix T=top, B=bottom arm)

| No | ITEMS | SYMBOLS | MIN | TYP | MAX | UNIT | CONDITIONS |
|----|-----------------------------------|------------------|------|------|---------|------|---|
| 1 | Stand-by current | Is1 | - | 6.5 | 10 | mA | Vin=H or L , Between Vcc-GL1 |
| | | Is2 | - | 15 | 30 | μA | Between VCU-U,VCV-V,VCW-W 15V, Vin=H or L |
| 2 | Input Voltage (Output is L) | VIH | 3.5 | - | - | V | Input=H or L |
| | Input Voltage (Output is H) | VIL | - | - | 1.5 | V | |
| 3 | Output Source Current | Io+ | 0.2 | 0.25 | - | A | VCU-PGU,VCV-PGV,VCW-PGW=15V, Vcc-NGU,V,W =15V PW<10μs |
| 4 | Output Sink Current | Io- | 0.4 | 0.5 | - | A | PGU-U,PGV-V, PGW-W =15V, NGU,V,W -GL2=15V PW<10μs |
| 5 | High level Output Voltage | VOH | - | - | 100 | mV | VCU,V,W-PGU,V,W & Vcc-NGU,V,W Vin=0V, Io=0A |
| 6 | Low level Output Voltage | VOL | - | - | 100 | mV | PGU,V,W-U,V,W & NGU,V,W-GL2 Vin=5V,Io=0A |
| 7 | Leakage Current at HV terminal | IL | - | - | 50 | μA | VCU,V,W=U,V,W=600V |
| 8 | Input Current | IIL | -200 | - | - | μA | Vin=0V Internal Pull up R=200kΩ |
| 9 | Input Current | IIH | -120 | - | - | μA | Vin=5V Internal Pull up R=200kΩ |
| 10 | Vcc Under Voltage | Negative Going | Vuvb | 9.5 | 10.5 | 11.6 | V |
| | | Reset Hysterisis | Vrhb | 0.1 | 0.4 | 0.9 | V |
| 11 | Vcu,v,w Under Voltage | Negative Going | Vuvt | 8.9 | 10.5 | 12.1 | V |
| | | Reset Hysterisis | Vrht | 0.1 | 0.4 | 0.9 | V |
| 12 | OC Input Positive Going threshold | Voc | 0.44 | 0.49 | 0.54 | V | |
| 13 | Fault Output On Resistance | Ronf | - | 300 | 400 | Ω | F-GL1=0.5V |
| 14 | Turn On Delay Time | ton | - | 0.8 | 1.5 | μs | CL=1000pF RL=0Ω |
| 15 | Turn Off Delay Time | toff | - | 0.5 | 1.2 | μs | CL=1000pF RL=0Ω |
| 16 | OC Output Shutdown Delay | toc | - | 0.7 | 1.7 | μs | CL=1000pF RL=0Ω |
| 17 | Fault Output Delay | tflt | - | 0.6 | 1.6 | μs | CL=1000pF RL=0Ω |
| 18 | Fault Reset Delay Time | tflrs | 6.5 | 10 | 20 | μs | CL=1000pF RL=0Ω |
| 19 | Fault output terminal voltage | Vflt | -0.5 | - | Vcc+0.5 | V | |
| 20 | Fault output sink current | Iflt | 4 | - | - | mA | Vcc=15V,F-GL=2V |
| 21 | VB output Voltage | VB | 6.8 | 7.5 | 8.2 | V | Output current=0mA |
| 22 | VB output current | IB | 15 | 20 | - | mA | DeltaVload=0.2V |

Note 1: Vuvb, Vrhb, Vuvt and Vrht are defined and shown in Fig. 1

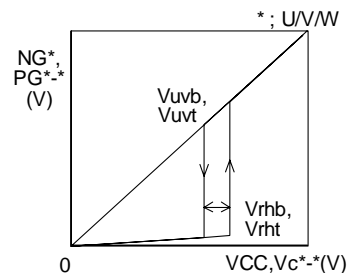


Fig 1. Negative going and reset voltage and hysteresis for the top and bottom arm under voltage circuit

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5. Truth Table

| INPUT | | OC Input | U phase | | V phase | | W phase | | |
|---------|---|----------|---------|---------|---------|---------|---------|---------|-----|
| | | | Top arm | Bot.arm | Top arm | Bot.arm | Top arm | Bot.arm | |
| SUT | L | L | ON | - | - | - | - | - | |
| | H | | OFF | - | - | - | - | - | |
| SUB | L | | - | ON | - | - | - | - | |
| | H | | - | OFF | | | | - | |
| SVT | L | | - | - | ON | | | - | |
| | H | | - | - | OFF | | | - | |
| SVB | L | | - | - | - | ON | | - | |
| | H | | - | - | - | OFF | | - | |
| SWT | L | | - | - | - | - | ON | - | |
| | H | | - | - | - | - | OFF | - | |
| SWB | L | | - | - | - | - | - | ON | |
| | H | | - | - | - | - | - | OFF | |
| - | - | | H | OFF | OFF | OFF | OFF | OFF | OFF |
| SUT,SUB | L | | L | OFF | OFF | - | - | - | - |
| SVT,SVB | L | | L | - | - | OFF | OFF | - | - |
| SWT,SWB | L | | L | - | - | - | - | OFF | OFF |

Note 1: Fault output level is referenced Low when over current or under voltage for Vcc is detected.

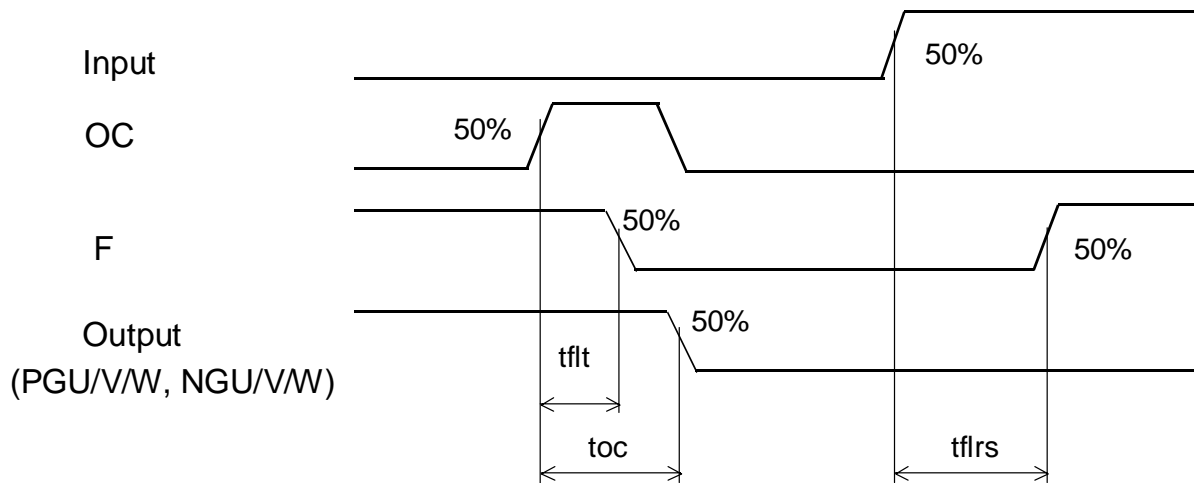
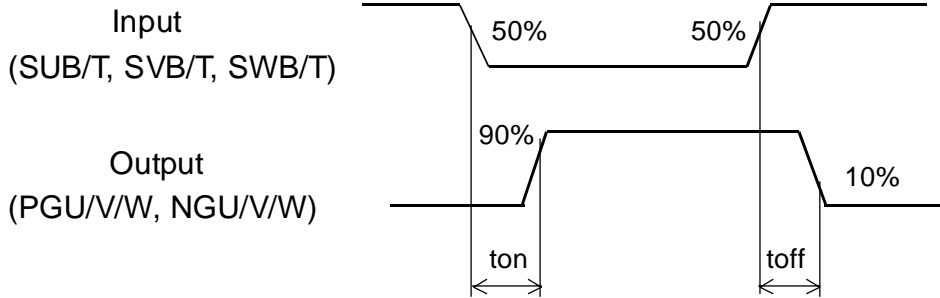
Note 2: Over current protection works when the voltage drop of the external sensing resistor exceeds the threshold voltage Voc. In this case all six outputs are turned off and Fault output level becomes low.

Reset after detection is done by feeding high signal to all six inputs or re-supplying Vcc voltage.

Note 3: The output signal for Fault is reset by feeding high signal to all six inputs.

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6. Definition of switching delay



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7. Standard Application

| No. | ITEMS | SYMBOLS | VALUES TOL. | UNIT | CONDITIONS |
|-----|------------------------------|---------|--|------|--------------------------|
| 1 | PWM Frequency | fpwm | 1 ~ 20 | kHz | |
| 2 | VB Smoothing Capacitor | Co | 0.22 ± 20% | μF | Stress voltage:VB |
| 3 | Boot Strap Capacitor | Cb | 3.3 ± 20% | μF | Stress voltage:Vcc |
| 4 | Boot Strap Diodes | Db | Hitachi DFG1C6 DFM1F6 or equivalent | - | 600V/1.0A trr ≤ 0.1μs |
| 5 | Sensing Resistor | Rs | Note 1 | Ω | |
| 6 | OC Filtering Resistor | R1 | Note 2 | Ω | |
| 7 | OC Filtering Capacitor | C1 | Note 2 | μF | |
| 8 | Load resistor for F terminal | Rf | 5.6 ± 20% | kΩ | |

Note 1. Over-current detection level is determined by the following equation

$$I_{oc} = V_{oc} / R_s \text{ (A)}$$

Note.2 This IC has filters of 0.4us for noise reduction.

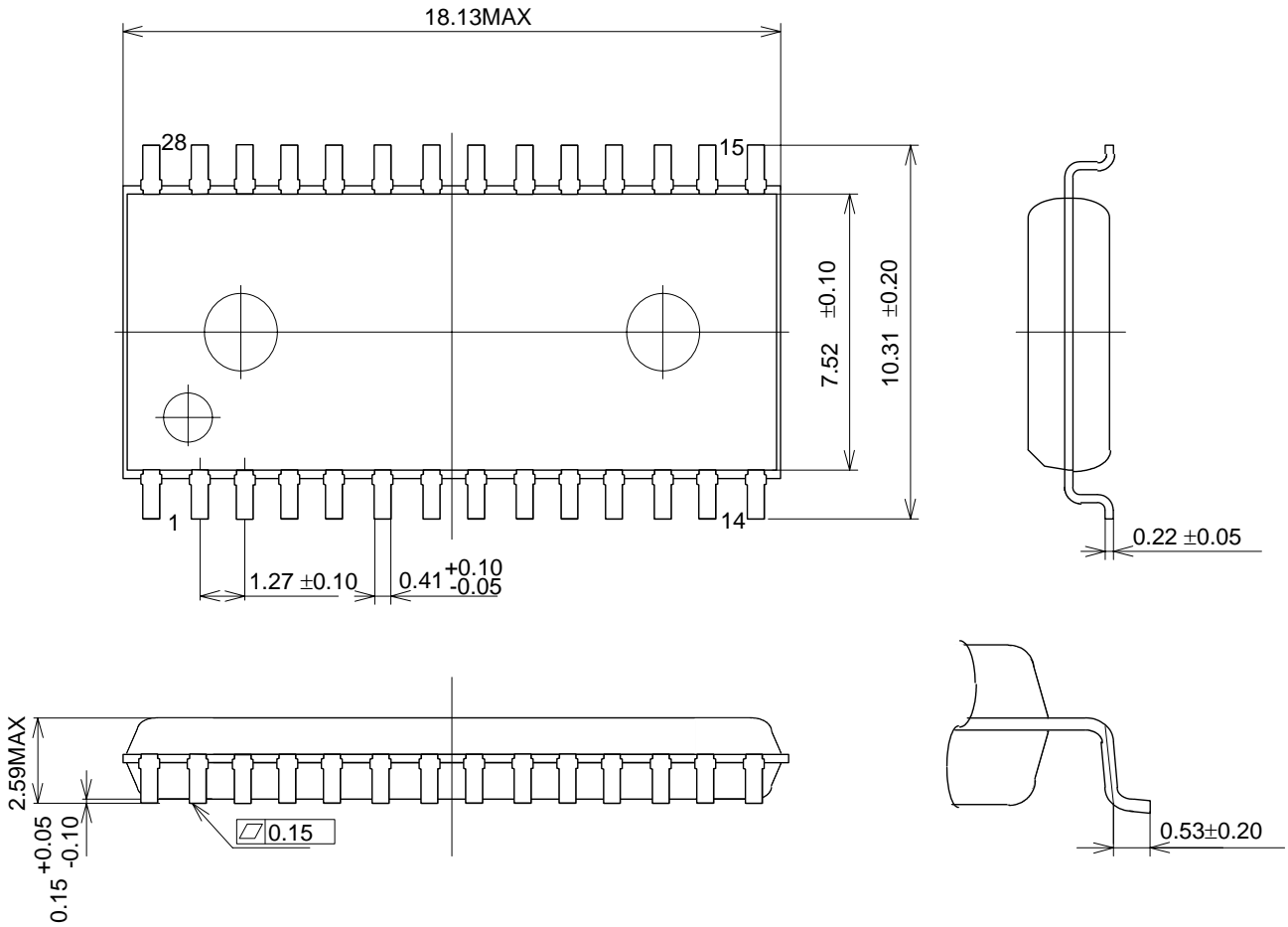
But appropriate R1, C1 should be added when noise can not be removed.

8. Pin Assignment

| | | | |
|----|-----|-----|----|
| 1 | VCC | VCU | 28 |
| 2 | SUT | PGU | 27 |
| 3 | SVT | U | 26 |
| 4 | SWT | N.C | 25 |
| 5 | SUB | VCV | 24 |
| 6 | SVB | PGV | 23 |
| 7 | SWB | V | 22 |
| 8 | F | N.C | 21 |
| 9 | OC | VCW | 20 |
| 10 | CB | PGW | 19 |
| 11 | N.C | W | 18 |
| 12 | GL1 | N.C | 17 |
| 13 | GL2 | NGU | 16 |
| 14 | NGW | NGV | 15 |

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9. Outline Drawing



HITACHI POWER SEMICONDUCTORS

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