MITSUBISHI ELECTRIC

Changes for the Better

Power Devices HIVC series

Meets User Needs for Driving Power MOSFET/IGBT

HVIC series

HVIC series

Mitsubishi has utilized its excellent advanced high-voltage process technology and drive protection circuit technology to accurately transmit the microcomputer control signal to the power MOSFET/IGBT with high speed and high reliability without a photo-coupler.

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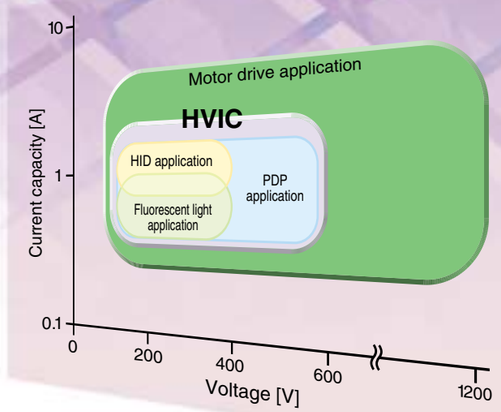
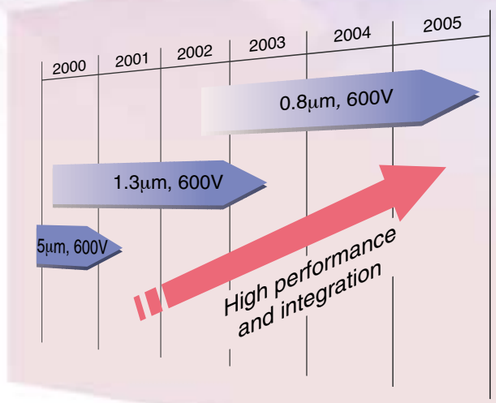
■Application fields



■HVIC road map



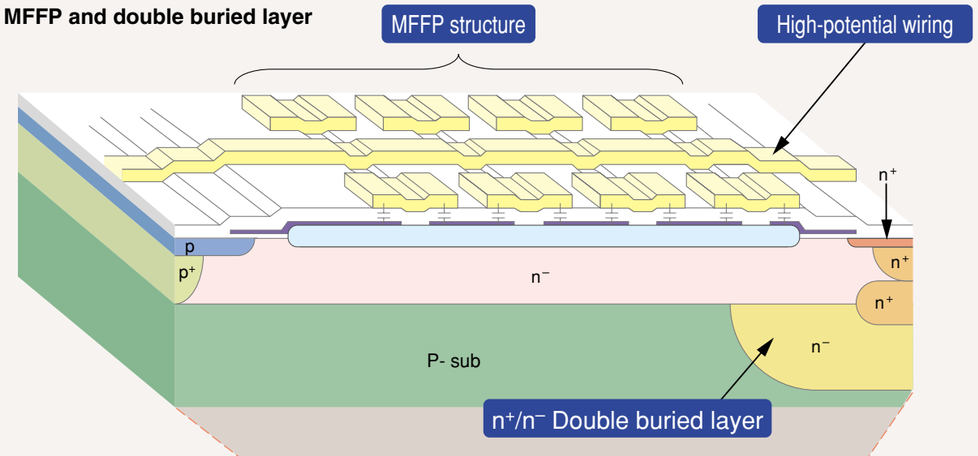
HVIC technology

Technology of high voltage devices integration

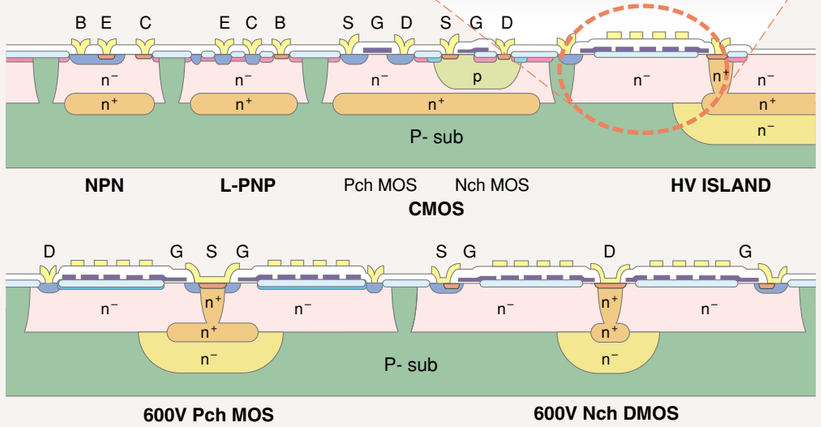
HVIC include junction isolated 600V devices and 5/15V devices

- MFFP (Multiple Floating Field Plate) structure : It is composed of one poly-silicon layer and one aluminum layer , and it is a new electric field relaxation technique.
- Double buried layer structure : High voltage isolation structure with N^+/N^- double buried layer stabilizes breakdown voltage because avalanche position shifts surface of the n- epitaxial layer to the substrate.

■ **MFFP and double buried layer**



■ **600V BiCMOS/DMOS structure**

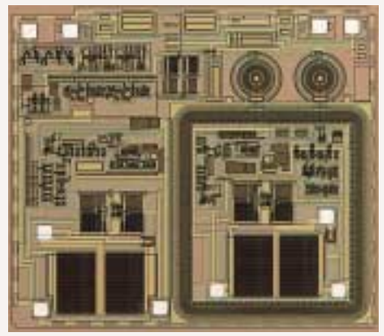


Control circuit technology for analog/digital signal

HVIC is formed high/low side driver, 600V level-shift and under voltage protection. More over the oscillator is embedded in the HVIC.
MCU is able to control MOSFET or IGBT by using HVIC (half bridge driver or full bridge driver) without photo coupler.

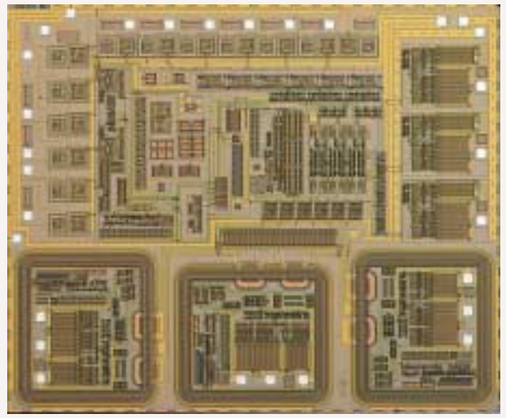
Half bridge driver

Half bridge driver chip

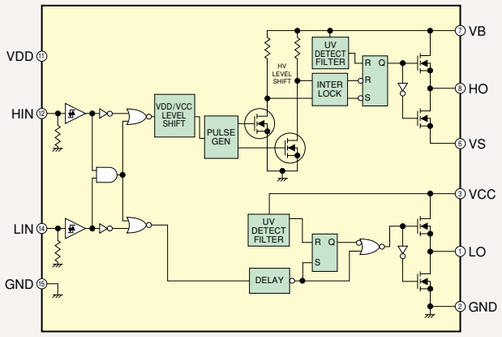


3-phase bridge driver

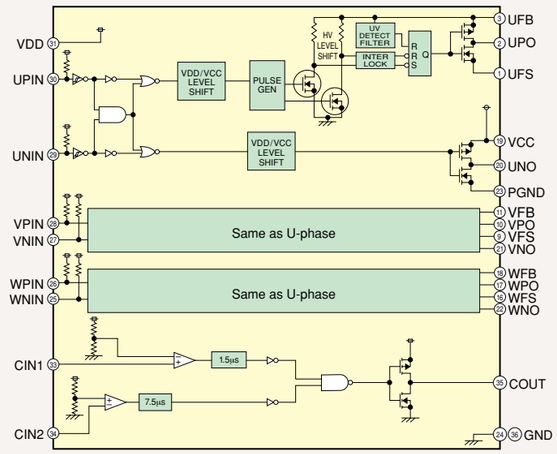
3-phase bridge driver chip



■ **Example half-bridge driver circuit configuration**



■ **Example 3-phase bridge driver circuit configuration**

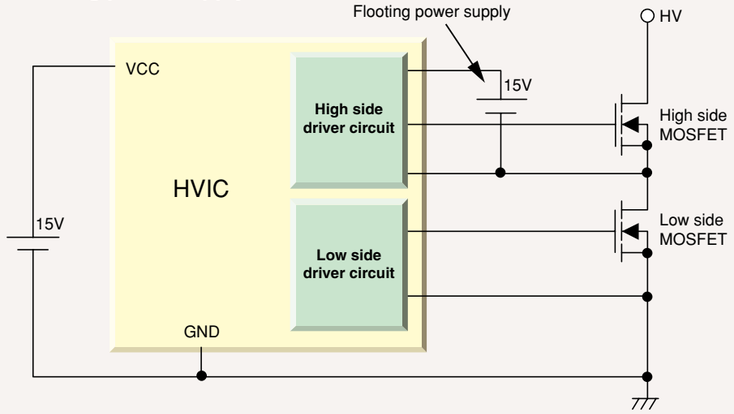


How to use

1 Floating power supply method

The source voltage of high side MOSFET shifts ground level to HV level.
Therefore in order to drive high side MOSFET, the power supply of high side driver needs one VCC up to source voltage of high side MOSFET.
One solution is floating power supply method.
Typical connection of floating power supply method is shown as follow.

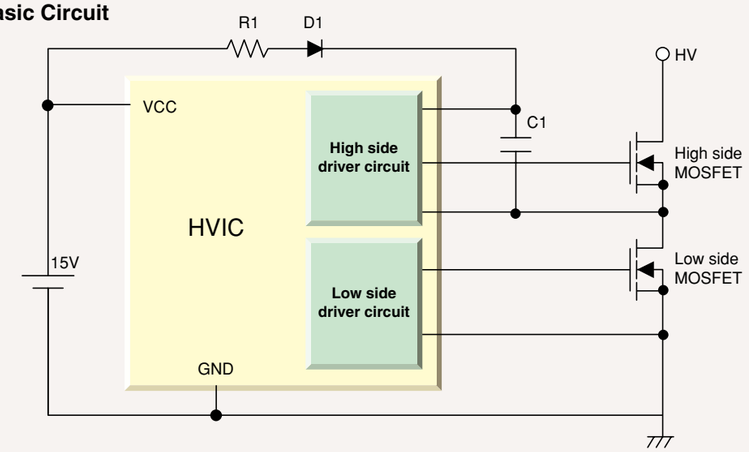
■ High side driver flooting power supply method



2 Boot strap circuit method & basic operation

Another solution is bootstrap circuit method. This method is the use of low side power supply, bootstrap diode D1, resister R1 and bootstrap capacitor C1.
C1 is charged through R1, D1 from VCC. Circuit diagram are shown as follow.

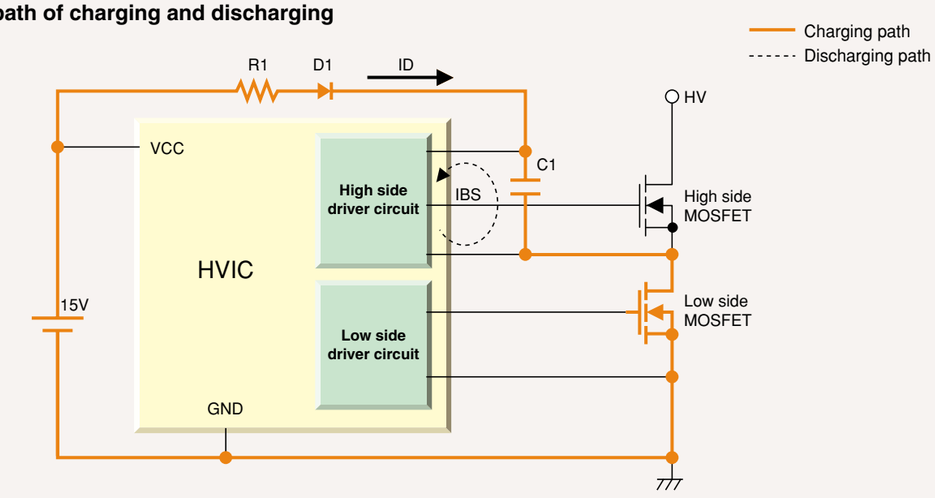
■ Boot strap basic Circuit



3 Current path of charging and discharging during HVIC stationary operation.

Current path of charging and discharging during HVIC stationary operation are shown as follow.

■ Current path of charging and discharging



■ Setting example of boot strap capacitor value

Initial charged voltage of boot strap capacitor

At first low side MOSFET is switched ON mode. Boot strap capacitor is charged by this.
Charging current ID is given by

$ID = (VCC/R1)e^{-t/(R1 \cdot C1)}$ Initial condition t=0

$ID = VCC/R1$

When charged voltage VC1 of boot strap capacitor C1 can be expressed as (1)

$VC1 = VCC - VF - VDS \cdots (1)$

VF : Forward voltage of diode D1
VDS : drain-source voltage of low side MOSFET

Simplified calculation of boot strap capacitor value

Boot strap capacitor value can be expressed as (2)

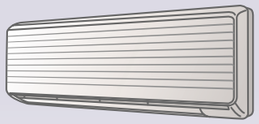
$C1 = IBS \times T1/\Delta V +$ (Margin : 2～3 times of $IBS \times T1/\Delta V$) $\cdots (2)$

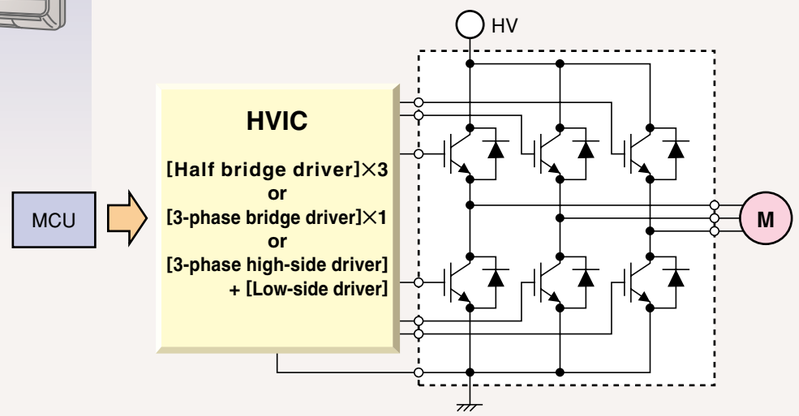
T1 : maximum time of high side MOSFET is ON (or maximum time of high side MOSFET and low side MOSFET are OFF)
IBS : High side Consumption current (consider Temperature characteristic and Frequency characteristic)
ΔV : maximum voltage when C1 discharges electricity

C1 is calculated by (1) (2), expression
This setting example is only calculation, so you should design with investigation of your actual set.

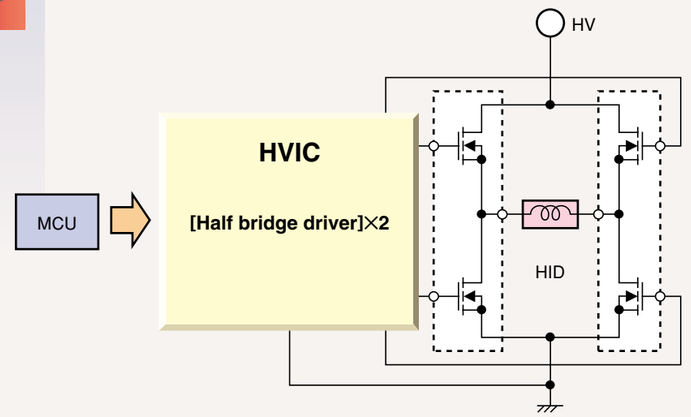
Application examples

Example motor drive configuration

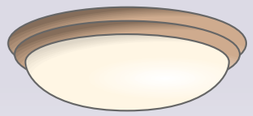


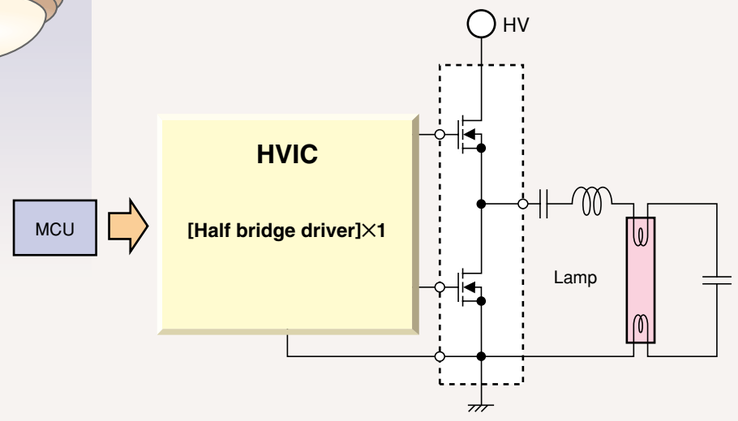


Example HID drive configuration

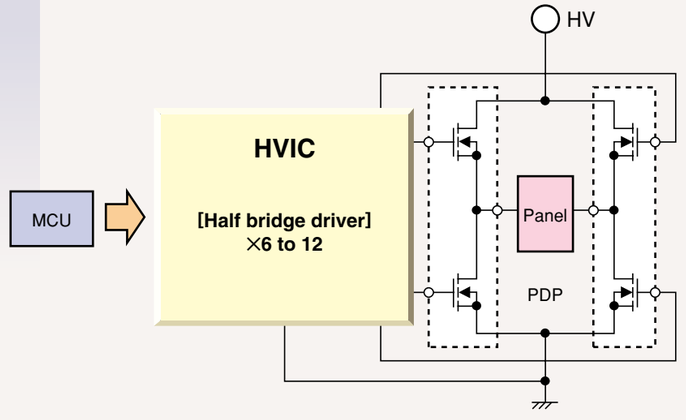


Example fluorescent light drive configuration





Example PDP drive configuration



Quick referrence

Quick referrence

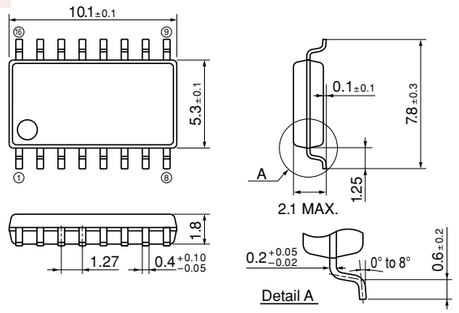
Type name	Floating supply voltage (V)	Output current (A)	Driving method	Number of Input-signal	Ded-time control	Remarks	Pakage outline
M63991FP	600	0.5	Half bridge	2	Input-signal	With interlock function	16P2N ①
M63992FP		2.0					
M63993FP		0.3	3-phase bridge	2X3(6)			36P2R ②
M63994P		0.5	Half bridge	1	Inside	–	8P4 ③
M63994FP							8P2S ④
M63954P				–		Built-in oscillator	16P4 ⑤
M81700FP ★		2.0	Half bridge	2	Input-signal	With SD/interlock function	16P2N ①
M81701FP ★						With interlock function	
M81702FP ★						With SD function	
M81703FP ★						–	
M81704P ★		0.3	3-phase high side	1X3(3)	–	–	18P4 ⑥
M81705FP ★			1-phase high side	1			8P2S ④
M63975FP	20	0.5	1-phase low side	1	–	–	10P2N ⑦

★ : Under development

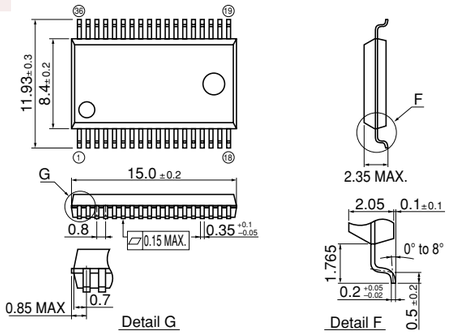
Pakage outline

(Unit : mm)

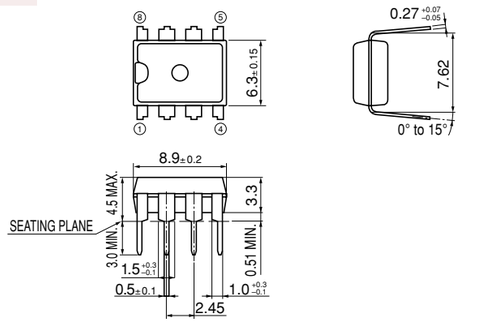
① TYPE 16P2N 16pin 300mil SOP



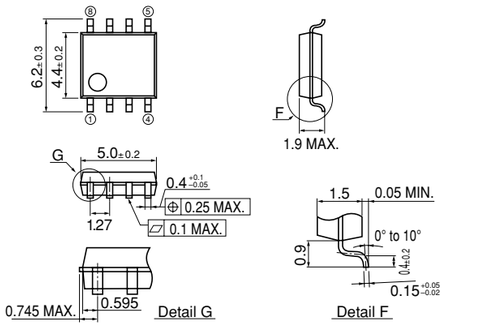
② TYPE 36P2R 36pin 450mil SSOP



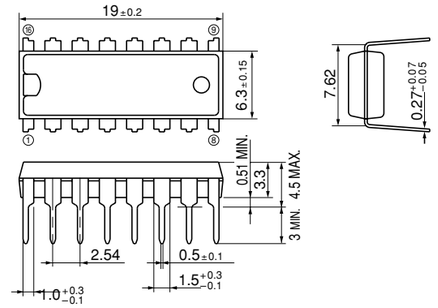
③ TYPE 8P4 8pin 300mil DIP



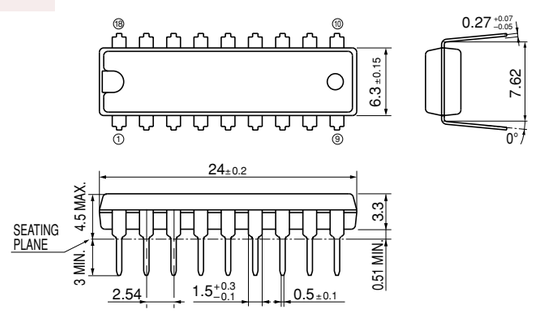
④ TYPE 8P2S 8pin 225mil SOP



⑤ TYPE 16P4 16pin 300mil DIP



⑥ TYPE 18P4 18pin 300mil DIP



⑦ TYPE 10P2N 10pin 300mil SOP