

Module solution with Integrated Shunt for GPI, General Purpose Inverter: Shunt embedded Econo module

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Abstract

For General Purpose Inverter dedicated in Motor drive, this market is blood market due to low market price. So, developing engineer must consider the cost reduction plan and do action. This inverter always needs to measure current and shunt solution can be one of cost reduction solution.

Home appliances Vs Industrial drives

Industrial drives have many kinds of applications.

Standard & compact drives are used in Packing & Automation General Purposed Applications. High power drives is used in big Pump & fan (refer to Fig. 1)

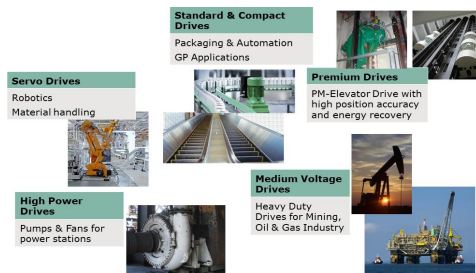


Fig.1 Verity of industrial drives

By depending on power capacity, there are different priorities. For high power drives, reliability is no.1 priority. But, for low power drives application, cost reduction is no. 1 target to developing engineer (Refer to Fig.2).

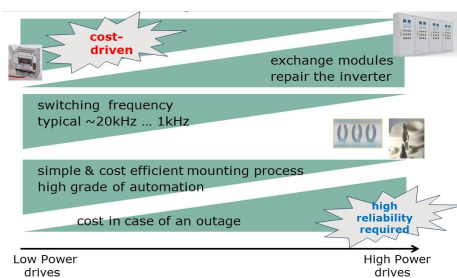


Fig.2 different priority on different power capacity

In home appliances, shunt has been used for measuring current. By depending application in detail, one shunt is used in Fridge application and legged shunt is used in others, in general. The reason for using Shunt as a measuring current is one of cost reduction solution. In this case, shunt resistor mounted on PCB in general.

But, for industrial drive, hall current sensor is used in general. Hall current sensor is more expensive solution than shunt solution. For hall current sensor mounted on PCB, it needs more PCB space. For hall current sensor mounted on bus-bar, it needs connection cable. For more current flows, current sensor mounted on bus-bar is in general. One of reason for choosing current sensor in industrial drives is that shunt has a limitation relayed on power losses in shunt resistor. By depending on current, power losses are different on shunt. For example, if 10A Current is flowed in 5.0mΩ shunt, its power losses is 0.5W ($=I^2 \times R = 10 \times 10 \times 0.005$). If current is 100A in 0.5mΩ shunt, its power losses are 5W ($=I^2 \times R = 100 \times 100 \times 0.0005$) on shunt. It makes a limitation on PCB design.

Cost reduction for industrial drive

If shunt is embedded on IGBT module inside, the limitation relayed on power loss can be solved.

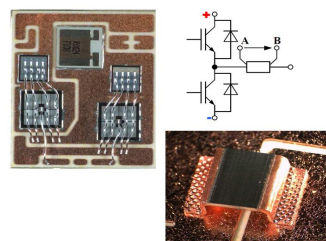


Fig.3 shunt mounted on DCB, IGBT module inside

As example, if 300A 1200V module, FF300R12ME4 is operated with $V_{dc} = 513[V]$, $I_{out} = 120[A]$, $T_a = 50[^\circ C]$ & $F_s/w = 5[kHz]$, each IGBT chip's power loss is 127[W] and each diode's power loss is 30.76[W] in 2 level space vector control. These power losses can be exhausted through heat-sink and junction temperature is under junction temperature with enough margins. It means 5W losses on shunt mounted on DCB inside of IGBT module can be exhausted through heat-sink without problem.

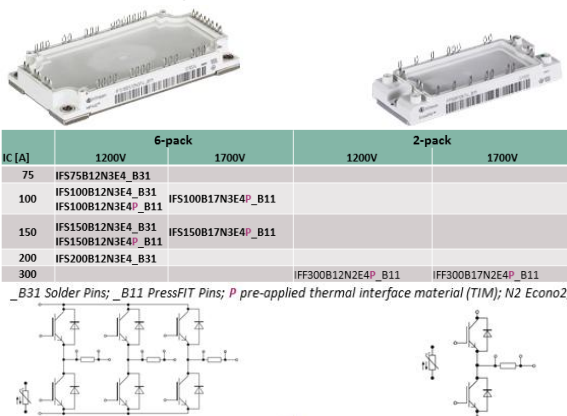


Fig.4 Shunt embedded Econo module

Infineon provides 75A, 100A, 150A, 200A 1200V 6-pack with shunt embedded Econo module to customer. Also, 1700V 100A & 150A 6-pack with shunt embedded Econo module are supplied to customer. Recently, 300A dual s/w IGBT for both 1200V & 1700V are possible (refer to Fig. 4).

Shunt mounted on output side needs isolation interface into controller. $\Sigma\Delta$ modulator can be used as isolation interface item. Especially Infineon controller XMC4400 has $\Sigma\Delta$ demodulator inside and it doesn't need external $\Sigma\Delta$ demodulator additionally.

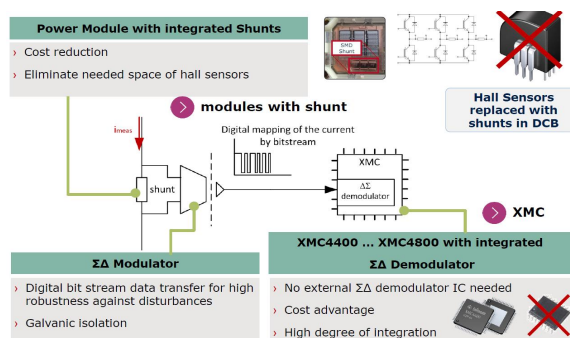


Fig.5 interface for Shunt embedded Econo module

Conclusion

For General Purpose Inverter dedicated in Motor drive, developing engineer needs to do cost reduction due to low market price always. Shunt embedded module can be one of cost reduction solution. Infineon supplies 75A, 100A, 150A, 200A & 300A 1200V module to customer with shunt embedded module. For 1700V module, 100A, 150A & 300A with shunt embedded module are possible to be supplied to customer. For interfacing with shunt, XMC4400 control IC with $\Sigma\Delta$ demodulator could be useful item to customer, also.

[Reference]

- [1] LMP-Products tuned to emerging requirements presentation file
- [2] Web Infineon module Simulator: <https://infineon.transim.com/iposim/>