TOSHIBA

Toshiba's motor control driver ICs improve supply chain security for end equipment manufacturers

Introduction

Risk is an inescapable fact of life for purchasing managers tasked with sourcing electronic components for original equipment manufacturers (OEMs). Even though purchasing departments have developed sophisticated strategies to optimize the sourcing of raw materials, unexpected events like natural disasters (earthquakes, floods etc.) or fires have the potential to cause chaos for production schedules, or in a worst-case scenario bring it completely to a halt, potentially threatening the viability of a heretofore healthy business. Another nightmare scenario is where a supplier suddenly issues a product discontinuation notification (PDN) in advance of discontinuing production of a component for which purchasers are already finding it difficult to identify an alternative source. This white paper shows how Toshiba is facilitating second-sourcing strategies for purchasing managers by introducing a new range of drop-in compatible motor driver ICs. These products can provide a lifeline to OEMs experiencing difficulties sourcing components from their existing suppliers on whom they have become too reliant for the survival of their business.

Pace of technology changes creates supply shortages

The speed at which technology is evolving is continuously increasing and next generation process technologies enable smaller and faster device designs which are less expensive to produce. This means component manufacturers can develop products with new features at similar or lower costs than existing products and for these reasons, they may decide to discontinue their production. Another reason why manufacturers obsolete some of their products is because materials or equipment become unavailable in their own supply chain, or because of difficulties with outsourced production steps. Finally, the requirement to comply with increasingly stringent regulations relating to the environmental impact of materials used in component production can increase costs and some manufacturers use this as a reason to shift production to next generation products more quickly than they had originally planned. In some cases, the additional costs (or other strategic factors) may cause them to exit the market for a product completely. While advances in technology are generally to be welcomed, the pace of progress is placing considerable pressure on customers to ‘keep up’ (much like the way new operating systems force consumers to upgrade their mobile phone hardware in order to exploit new software features). The combination of these factors means product life cycles are shortening, making it difficult for purchasing managers to identify alternative suppliers for products and forcing OEMs to make contingencies for changes to their production lines, even for successful end equipment for which design changes are not required.

Approaches to mitigating supply chain risks

OEMs can use various combinations of approaches to mitigate the impacts of component shortages on their supply chain. Redesigning the end product is one such approach but it incurs significant costs associated with design, manufacturing and product qualification. Furthermore, performing a full product redesign every time a single product becomes unavailable is not feasible from an operational perspective, since various components will inevitably become obsolete at different stages over the course of the end-product life cycle. Product design updates need to be planned and therefore this should be adopted as a proactive response to component obsolescence. This approach does not represent a practical reactive solution when components become unavailable at short notice. Another option is to source a component through a ‘lifetime buy’ before the supplier ceases production. However, this approach forces the OEM to procure the component for use over the longer term and then store this inventory for the course of the remaining life cycle of the end product. The quantity of components to purchase depends on the predicted future use of the end product and this can be difficult to determine – an overestimation can result in paying for excess stock which is never used while an underestimate merely delays a return to their original predicament. In addition, lifetime buys increase warehousing costs for OEMs while also exposing the components to moisture, oxidation and dirt if environmental conditions are not optimally maintained (incurring further expense), otherwise component failure rates when they are installed in end products can increase. Another alternative is to use aftermarket distributors to source the obsolete component but in this scenario, OEMs can expect to pay a considerable premium over the cost of the original component. Furthermore, if an unauthorized broker supplies the component, then an OEM could be unwittingly exposed to the vagaries of the 'grey market' in which counterfeit and inferior quality components are regularly traded. The performance of these components, which are sometimes recycled from old equipment, cannot be guaranteed in the field, potentially exposing the manufacturer to litigation if the failure of one of their end equipment causes material loss or injury to a customer.

Identifying a reliable second source reduces risk of disruption while offering other benefits

The most viable approach to second sourcing is to identify components that have the same form factor (pin compatibility) and almost identical electrical specifications as the original component (drop-in compatibility) which other competing suppliers are still actively producing. This approach, commonly referred to as 'second-sourcing', allows an OEM to continue manufacturing the end product with minimal design changes. While second sourcing represents a successful reactive approach to dealing with supply-chain problems, it also has several advantages when used as a proactive tactic. Since production managers know the supply of almost all products is vulnerable to interruption for many reasons other than obsolescence, it makes sense for them to identify one (or more) alternative suppliers at the design stage or initial production planning for the new end equipment. This means that if their 'preferred' component supplier cannot meet an order (due to interruptions in their own supply chain) or issues an unexpected PDN, they have the reassurance of being able to fall back on alternative suppliers. The availability of competing second sources also gives OEMs the advantage of being able to negotiate more favourable pricing terms (price elasticity) from their preferred supplier. Rather than only using a 'second-source' supplier in exceptional circumstances, it makes sense for purchasing managers to place small but regular orders for their components, in order to develop the goodwill associated with an ongoing supplier-customer relationship and ensure that this is maintained. In many instances, an OEM's choice of preferred supplier may be based simply on the fact that they were the first to bring the component to the market (technology leader) or offer the lowest price and they have maintained their position for legacy reasons. However, while their component may perform adequately in an OEM's end-product, this does not always mean it offers the best technology solution. Many companies deliberately adopt the position of being 'technology followers', analysing competitors' products in order to identify their shortcomings so they can offer a product with similar functionality but improved performance which is better able to compete with the incumbent solution in the marketplace. In addition, they understand the pressure OEMs are experiencing in identifying alternative component suppliers and use it as a mutually beneficial strategy by continuing to offer a component even after the incumbent exits the marketplace. For these reasons, a second source component supplier should not necessarily be viewed as second-choice, but as complementary.

Motor drivers from Toshiba outperform existing solutions

The benefits of identifying and using the services of second source suppliers are obvious. However, a limitation of this strategy is that while it can be relatively easily applied to standard digital (logic), analog (amplifiers) and simple mixed signal (data converters) components, second sources for which are readily available, it can be difficult for OEMs to identify second sources for products like drivers for brushed DC and stepper motors. Purchasing managers and designers of some motorized equipment now have added reassurance of supply for some of these products through Toshiba's recently introduced range of motor driver ICs which are ideal for new designs but also represent an excellent alternative to established motor driver solutions for brushed DC and stepper motors, even outperforming them across some metrics.

TB67H450AFNG and TB67H451AFNG brushed DC motor drivers

The TB67H451AFNG is a pulse width modulated (PWM) brushed DC motor H-bridge driver designed for various applications including battery powered and other devices operating from a 5V USB power supply. This IC is also suitable for use in 12-36V industrial devices, home appliances like coffee machines and robotic vacuum cleaners, printers, and electronic door locks requiring a current drive up to 3.5A. The device can operate from a wide range of input voltages, (4.5V to 44V) and has a maximum motor drive output current of 3A (at 44V). It also has several integrated protection features including undervoltage lock out (UVLO), auto-return thermal shutdown (TSD), and non-latching overcurrent shutdown (ISD) to prevent damage to the IC by turning off the output once the output current exceeds a preset threshold.

Toshiba's TB67H450AFNG offers similar functionality to the TB67H451AFNG but features latching overcurrent shutdown (ISD), in which the output is turned off indefinitely until a power cycle is completed or the device enters and leaves a standby mode of operation. By comparison, the TB67H451AFNG is non-latching and resumes function automatically after a programmable recovery time has elapsed once the overcurrent condition is removed. To offer a leading low power consumption which helps to extend battery life, the standby current consumption of these ICs is managed by an integrated power supply circuit, which performs automatic transitions from STOP mode to STANDBY mode and switches off the VCC regulator supplying internal circuitry. These motor drivers are housed in a space-saving 4.9mm × 6.0mm surface-mount HSOP8 package, featuring an underside thermal pad to provide excellent heat dissipation.

Both devices are drop-in compatible with other market players, enabling customers to mitigate supply risks as outlined above.

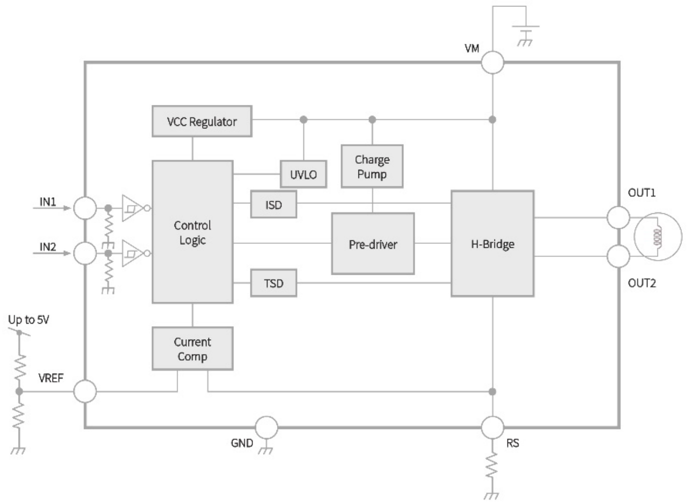

Figure 1 - Functional block diagram of Toshiba's TB67H451AFNG brushed DC motor driver

TB67H480FNG and TB67H481FNG motor drivers for brushed DC and bipolar stepper motors

The TB67H481FNG and TB67H480FNG are constant-current dual H-bridge drivers, featuring a motor output voltage rating up to 50V and an output current rating up to 2.5A. These ICs can be used to power brushed DC motors or bipolar stepper motors. They offer a choice of input interfaces, with the TB67H481FNG featuring a pulse-width modulated (PWM) input while the TB67H480FNG features a PHASE/ENABLE input.

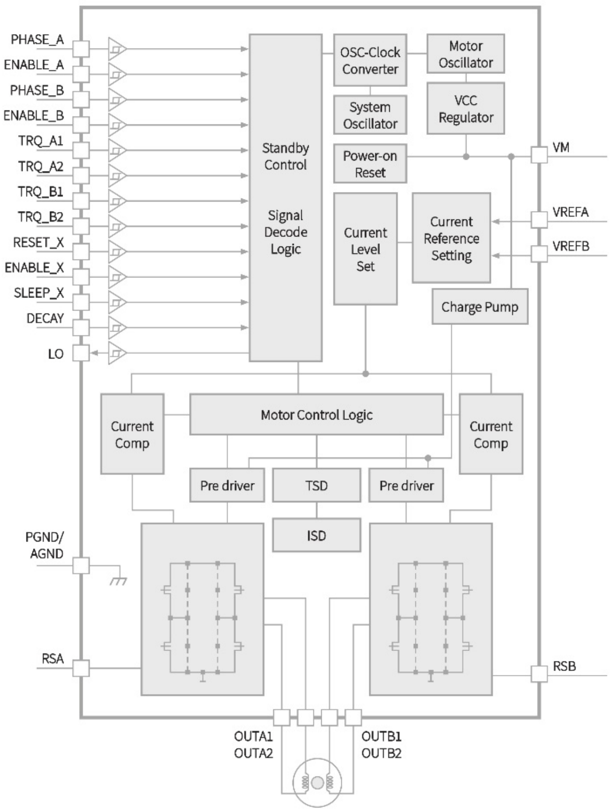

Figure 2 - Functional block diagram of Toshiba's TB67H480FNG motor driver

TB67S580FNG and TB67S581FNG stepper motor drivers

The TB67S581FNG and the TB67S580FNG are two-phase bipolar stepping motor drivers. Both devices have an output voltage rating of 50V, with the TB67S581FNG having an output current rating up to 2.5A and the TB67S580FNG being rated up to 1.6A output current.

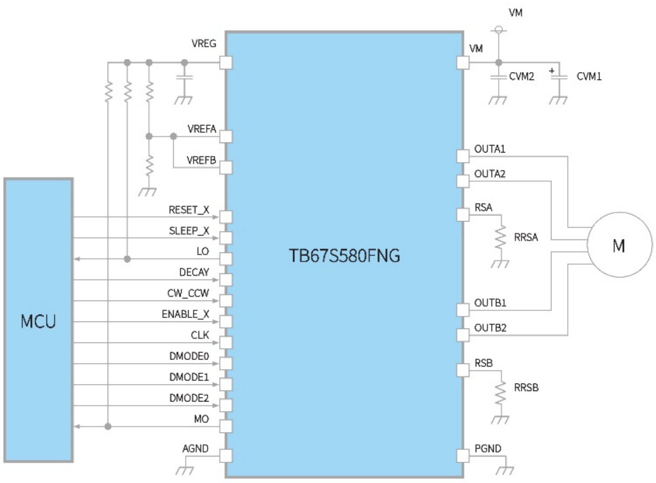

Figure 3 - Typical application circuit for Toshiba's TB67S580FNG stepper motor driver

TB67H481FNG and TB67H480FNG as well as TB67S581FNG and TB67S580FNG feature built-in charge pump capacitors which saves board space and reduces overall system costs. They are housed in 6.4mm x 9.7mm HTSSOP28 packages and can operate from motor power supply voltage levels ranging from 8.2V to 44V and typically consume less than 10µA in sleep mode. Their output on-resistance ($R_{DS(ON)}$) is only 0.4Ω (typical) for both high-side and low-side combined (at 24V for a 2A output current). Safety features of these devices include overcurrent shutdown, thermal shutdown and undervoltage lockout. Motor applications for these drivers include multifunction printers, automatic teller machines (ATMs), surveillance cameras as well as factory automation and robotic machinery.

All four devices are drop-in compatible with popular devices from other manufacturers. Unlike these competing devices. Toshiba's motor driver ICs feature integrated charge pump capacitor, eliminating the need to add them externally, thus reducing BOM and board space. In addition, Toshiba's devices outperform competing devices on a few specification items.

Conclusion

Supply chain risks are a constant source of worry for OEM purchasing managers and unexpected events impacting the ability of favored suppliers to meet orders are among their biggest fears. While there exist various strategies to mitigate the impact this type of event can have on production, each has its respective shortcomings. Identifying a reliable second source for vital components is the most viable option for securing supply chains against unexpected interruptions but these can sometimes be difficult to identify for non-standard products. Toshiba has identified some popular motor driver ICs offered by other market players and developed a range of six drop-in compatible driver ICs that offer similar, or even better, performance than existing solutions.

Contact us to discuss incorporating our products and solutions into your design:
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