Migrating systems to 3.3V power

The growing popularity of 3V logic is presenting designers with new challenges in power supply design. Martin O'Hara writes that a gradual migration from 5V is eminently practical and explains how DC-DC converters provide many of the solutions

Green business ethics and the ever-expanding demand for use-anywhere battery-operated equipment combine to make low-power operation the modern holy grail for electronic system designers. As a result, they are turning to 3V logic families, an approach which offers significant savings in power consumption, but does, however, produce a few design headaches.

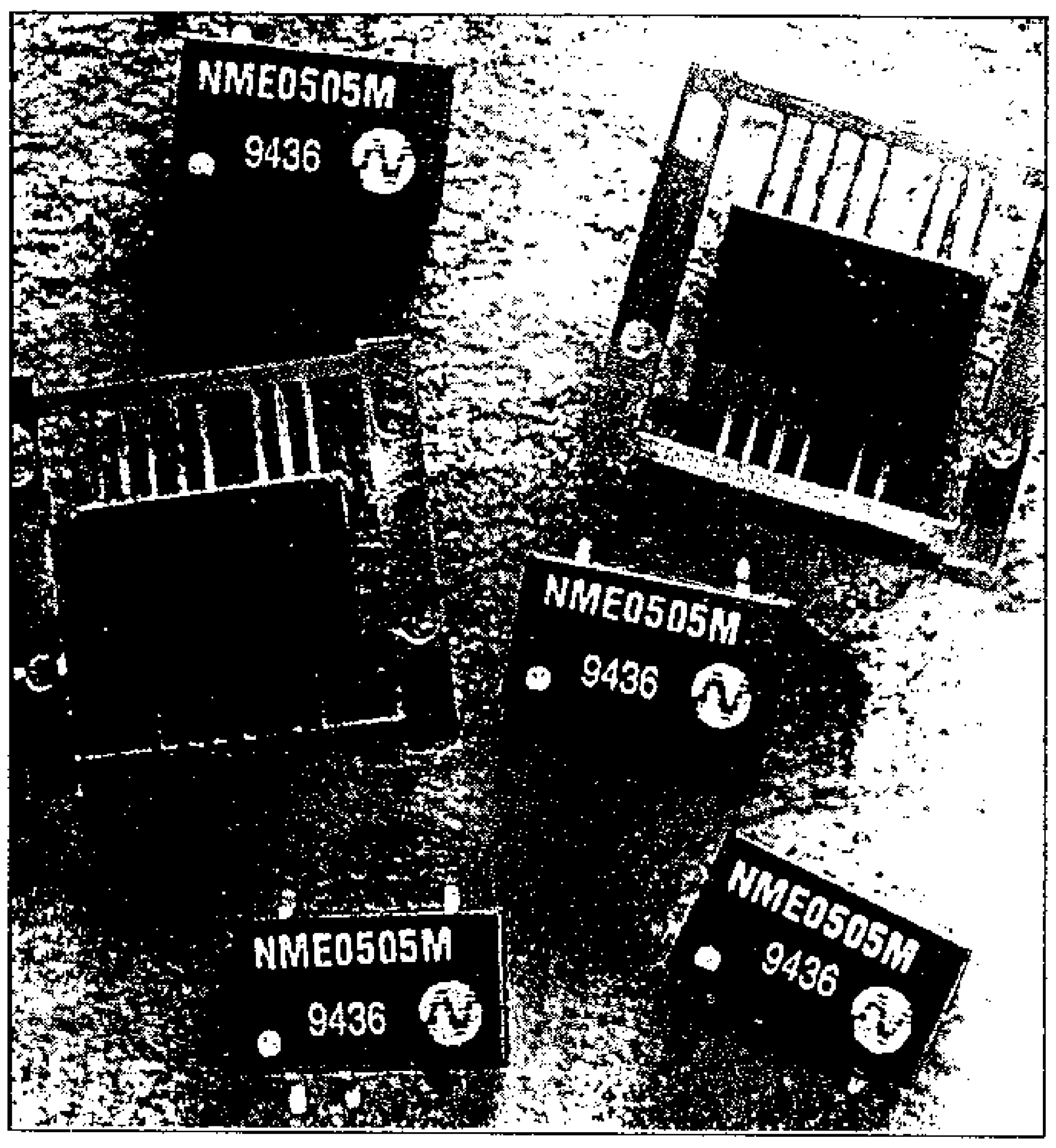
One of the biggest of these headaches is the somewhat restricted range of functions currently covered by 3V devices. Another is that present-day low voltage chips are not able to match the speed of their 5V counterparts. New low-voltage devices which address these limitations are, of course, appearing almost daily but, in today's competitive business environment, few designers can afford to wait. Further, there are some areas, such as displays, RF amplifiers, and analogue systems where 3V operation may never be possible.

For these reasons, designers are turning their attention to mixed-voltage systems using 3V devices where possible to achieve maximum power savings, but combining them with components operating at higher voltages to provide the required features and performance. The challenge is, of course, to supply these mixed voltage systems without sacrificing the power savings of the 3V logic. Series regulators are definitely out!

DC-DC converters offer a versatile, effective and convenient solution for these power supply requirements. 3.3V input converters can be obtained in, for example, 250mW, 500mW and 1W power ratings, with a wide range of output voltages. Many of the devices are available in a choice of DIL, SIL or even surface-mount packages, making them easy to accommodate in even the most compact of equipment.

A good example of the use of DC-DC converters in a low-voltage system is provided by recent application relating to an RS232 interface for a lap-top computer. The interface IC used was the LT1330 which accepts 3V logic levels but, nevertheless, requires a 5V supply. Since the primary supply for the computer was at 3V, the 5V supply was produced with a 250mW low-profile DIL converter occupying only 1.25cm^2 of board space and operating with a conversion efficiency close to 70percent.

The converter used, in common with all Newport Components devices, provides full input/output isolation. In this case, the isolation was not needed and the ground rails of the input and output circuits were tied together to give a common reference point. In many applications, however, isolation is a very definite advantage, since it helps to reduce noise and EMC susceptibility. This is



particularly true when the converter provides isolation of supplies between analogue and digital sections or between high- and low-speed logic.

Another useful application of DC-DC converters in conjunction with 3V logic is the provision of supplies for liquid crystal displays in cellular phones and similar portable equipment. Such displays typically require a -24V bias rail.

The usefulness of dual-output converters is not, of course, limited to providing supplies for displays. The design of analogue systems is often greatly simplified by the use of dual-polarity supplies. It may be impossible to achieve the required performance with a single supply, especially when this is as low as 3V! High-efficiency dual-output converters are the obvious choice in such applications, and bring the added bonus that they allow existing proven analogue circuitry to be incorporated into new 3V designs with very little modification.

Often, however, rather than integrating existing analogue designs with 3V logic, designers require to upgrade an existing 5V system to 3V operation. This may be easy if 3V devices are available for all of the necessary functions, but this is not always the case. An attractive alternative approach, which still offers significant power savings, is a partial upgrade. A block of circuitry is upgraded to use 3V devices, while 5V parts are retained for the remainder, together with the original psu.

Interfacing data signals between 3V and 5V devices is usually straightforward, often requiring little more than the addition of a few resistors, and a step-down DC-DC converter provides an efficient and convenient way of generating a 3.3V rail without modifications to the existing power supplies. A useful bonus, particularly in battery operated equipment, is that the DC-DC converter offers a convenient access point for power-management circuitry. Simply by adding a series transistor, the converter can be switched off, selectively cutting off power to the 3V section during periods when the equipment is idle.

It would be wrong, however, to suppose that dc-dc converters only have a place alongside 3V devices in mixed-supply systems. Where 3V supplies are used alone, converters can be just as useful to provide isolation and as an aid to the efficient transfer of power over long supply lines. The latter application is akin to the philosophy of the National Grid - at the source, step up the voltage for transmission, and then convert back to a low voltage at the load. In addition to greatly reducing I^2R losses, this technique also eliminates supply-line voltage drops which are especially significant with supplies as low as 3V.

For designers, 3V devices have many attractions, the most important of which are power savings and the resulting dissipation reductions. For the majority of applications, however, 3V devices do not offer a complete solution, and need to be used in conjunction with components operating from higher voltage.

Fortunately, high-efficiency DC-DC converters provide a complete, flexible and economical way of bridging the gap.

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