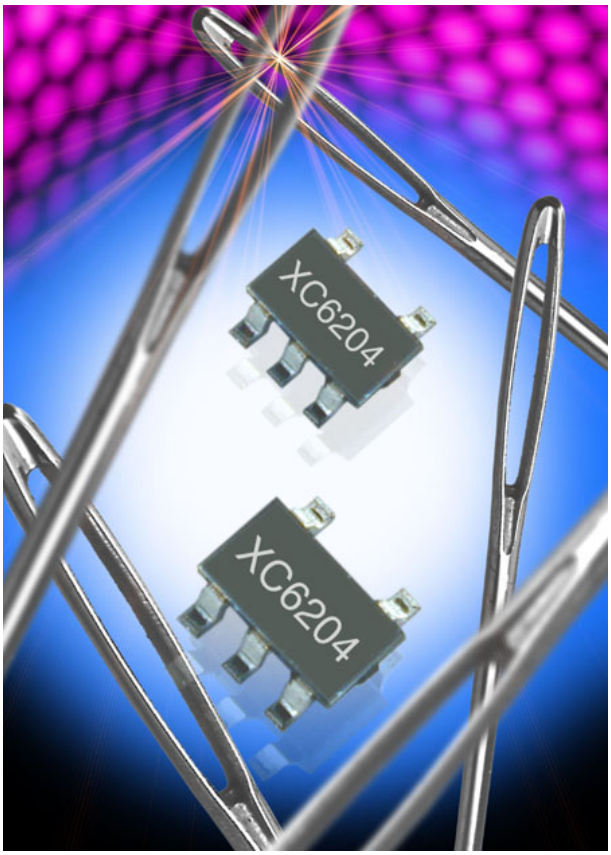
QUIET, STABLE & COMPACT VOLTAGE REGULATOR IS IDEAL FOR RF APPLICATIONS

'Make it smaller and lighter' are the constant demands of engineers working on portable equipment designs. This applies to all parts of the application but one area in particular has been seen as something of a 'roadblock' to miniaturisation - the power circuit. This is due to the large-sized capacitors required by the power circuit to achieve the low noise, high speed and low ripple characteristics that are essential to designs. The latest power ICs however, such as the new XC6204 LDO voltage regulator from Torex Semiconductor, can utilise smaller, lighter ceramic capacitors, thereby providing the long awaited solution.



The XC6204 combines a standard voltage source, an error correction amplifier, a current limiter, a phase compensation circuit and a driver transistor into an ultra small SOT-25 package. Based on a new amplifier core, the XC6204 series architecture (Fig 1) employs a phase compensation feedback system to provide a very stable output, allowing low ESR capacitors to be used. The voltage divided by resistors R1 and R2

is compared with the internal reference voltage by the error amplifier. The p-channel pass element, which is connected to the Vout pin, is then driven by the subsequent output signal. The output voltage at the Vout pin is controlled and stabilised by a system of negative feedback. Thus it is possible to achieve a stable output of 150mA by simply adding a ceramic capacitor of 1μF to the output.

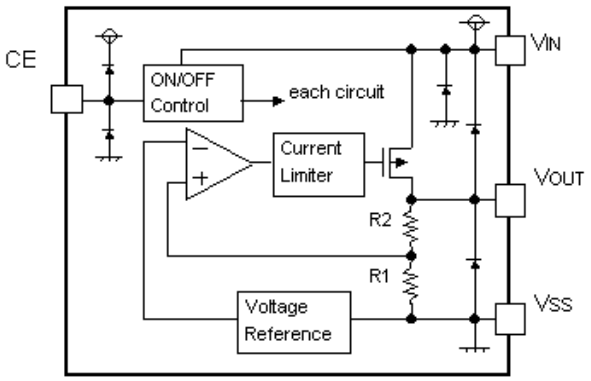


Fig.1: A phase compensation feedback system provides a very stable output, allowing low ESR capacitors to be used.

RF applications such as mobile phones make stringent demands on low noise performance. In order to achieve the excellent output noise figures demanded, the majority of high-speed voltage regulators available today require the addition of an external bypass capacitor. Not so the XC6204 which doesn't require a bypass capacitor to achieve an impressive output noise density (Fig. 2) of 0.15μV/√Hz at a frequency of 10kHz and an output noise of 30μVrms over a bandwidth of 300Hz to 50kHz.

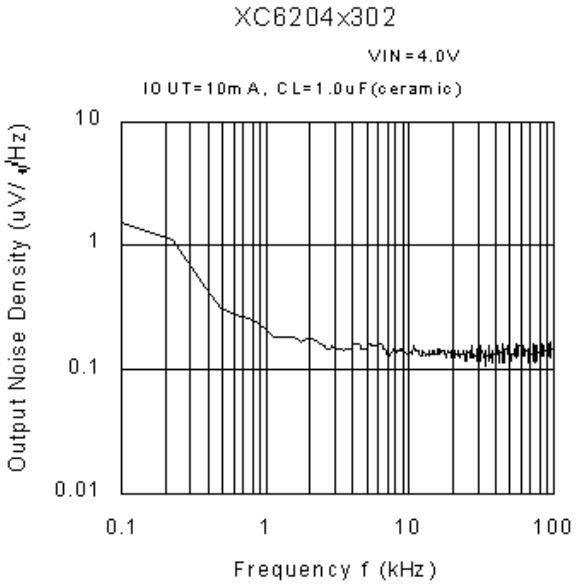


Fig.2: Output noise density.

RF devices also require very rapid transient response times to deal with the wide fluctuations in input and output voltages such as during the burst of a mobile telephone for example. Usually, a fast transient response time is gained at the cost of power efficiency. The XC6204 series gets around this problem by using a design which optimises current consumption and distribution, resulting in a market-leading low power consumption of typically 70μA, while still retaining excellent transient response performance.

The XC6204's CE function enables the output to be turned off and since the bypass capacitor has been eliminated, a very fast rise speed of 30μs (typ.) when switching ON/OFF from the CE terminal can be achieved. This means that power can be very quickly switched off from each block of the system thus saving energy and significantly contributing to more efficient use of the battery. On standby, current

consumption is less then 0.1μA. An output current of 0-150mA can be achieved at a low dropout.

The XC6204 series' current limiter and circuit protection is activated by a combination of a fixed current limiter circuit and a foldback circuit. When the load current reaches the current limit level, the fixed current limiter circuit operates and output voltage drops. As a result of this drop in output voltage, the foldback circuit operates, output voltage drops further and output current decreases. This system of combining a dropdown limiter with a foldback circuit produces only small changes in temperature characteristic resulting in stable current control of typically 300mA (Fig. 3) and excellent short circuit protection. When the output pin is shorted a current of about 60mA flows.

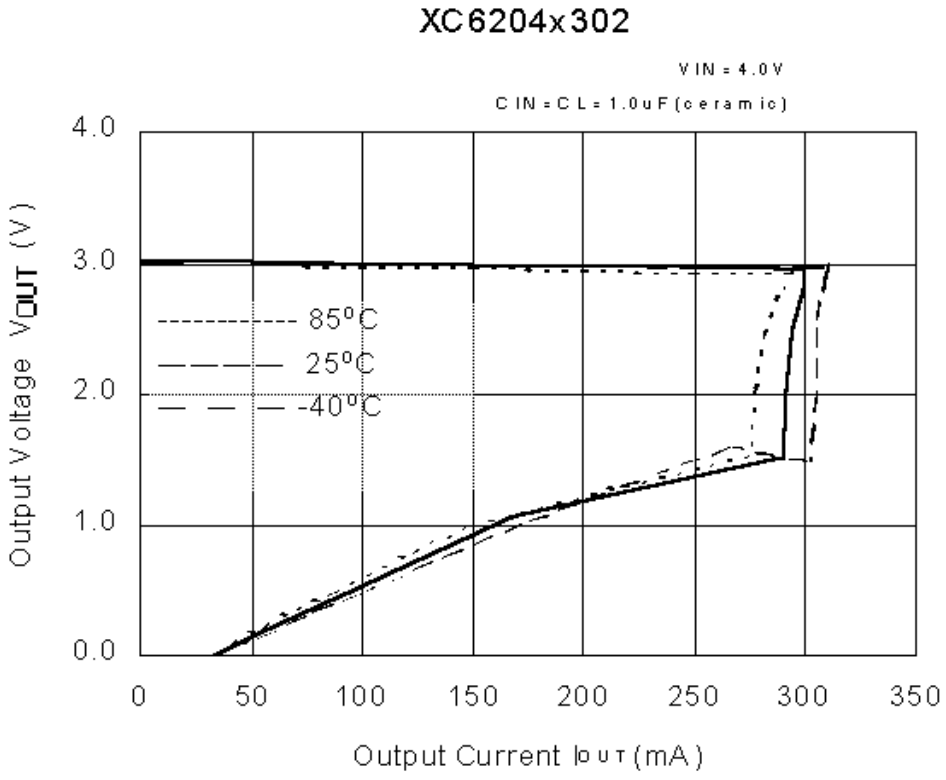


Fig.3: Small changes in temperature characteristic result in stable current control of typically 300mA.

The output voltage is selectable in 0.05V increments within a range of 1.8V to 6.0V at an accuracy of ± 2%. Output voltage can be easily set externally and the device's

option of a low voltage output make it an ideal power source for digital ICs. Maximum input voltage is 10V. The XC6204 has a very low dropout voltage of 200mV at 100mA and 60mV at 30mA output.

Ripple rejection (PSRR) is a very important characteristic in high speed LDO regulators and Fig.4 shows the market-leading figures achieved by the XC6204. At 4V in/ 3.0V out, the XC6204 has an unmatched PSRR of 90dB at 10kHz. At 3.3V in/3.0V out, PSRR is approximately 70dB at 10kHz and compares very favourably with devices from other leading manufactures which struggle to achieve ripple rejection of around 50 to 60dB at this frequency. Even then, these competing devices require an external bypass capacitor, not used by the XC6204, to achieve this figure.

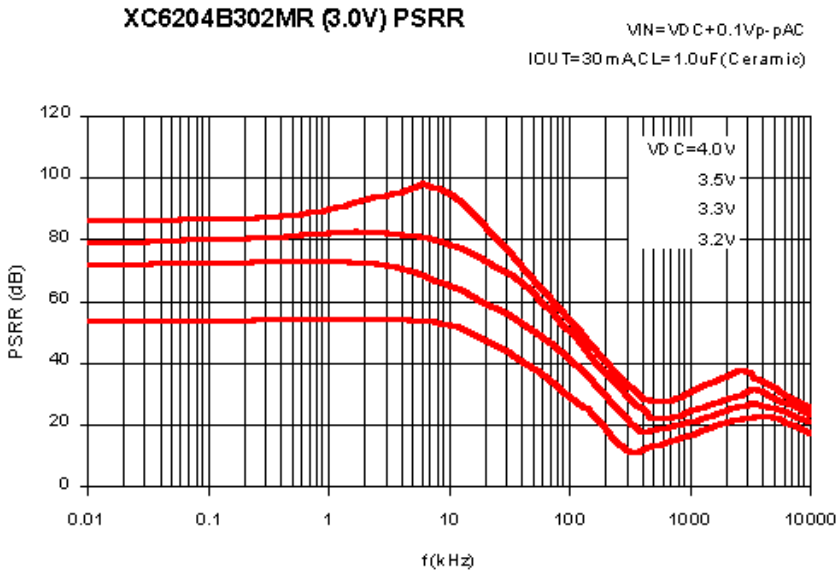


Fig.4: Ripple rejection (PSRR) is very important in high sped LDO regulators.

Although primarily intended for low noise RF circuits, the XC6204's high specification makes it equally suited to a wide range of portable, battery-powered equipment such as cameras, video recorders and hand-held games.

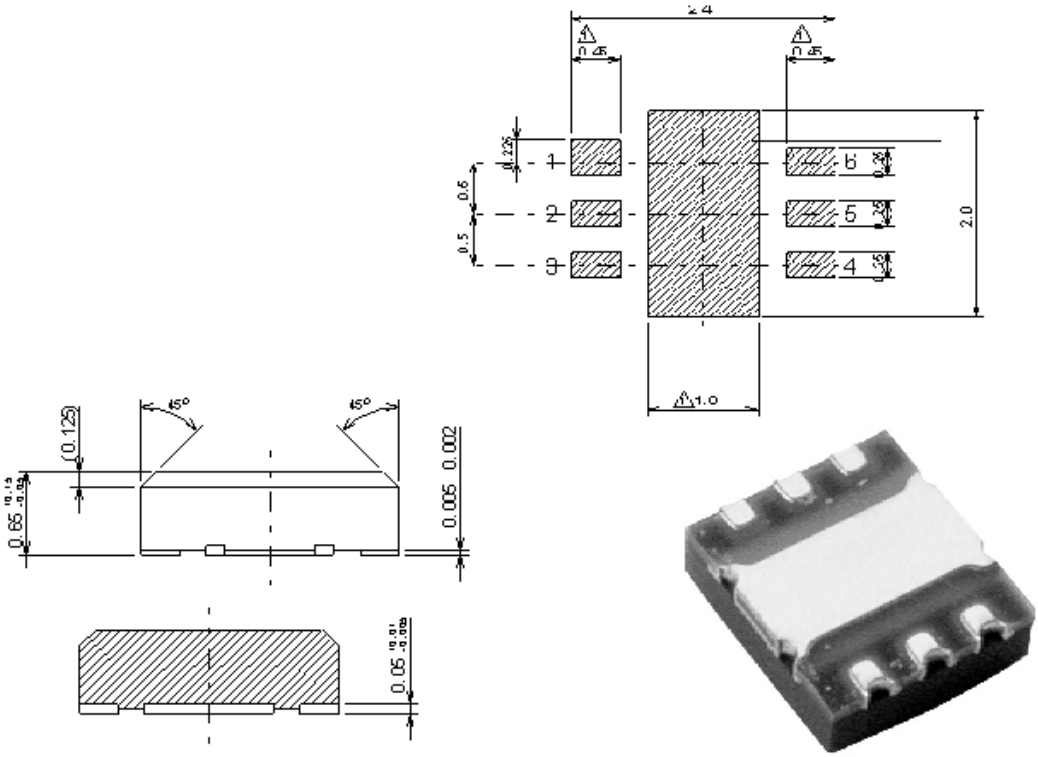


Fig.5: The USP-6B package.

The XC6204 series is available in an SOT-25 package, however, with the increasing demand for smaller devices, Torex has responded with the development of a 0.65mm thick, chip scale USP-6B package (Fig.5), measuring just 2.0mm x 1.8mm x 0.65mm. Samples of the XC6204 in this USP-6B package are now readily available.