TI's TCS family of “antenna-to-applications” wireless chipset solutions gives mobile device manufacturers a platform for each market segment from voice-centric handsets to high-end multimedia smartphones and PDAs. And, because each chipset comes with a complete, manufacturing-ready hardware and software reference design, as well as worldwide technical support from wireless design experts, time-to-market is drastically reduced. With the newest GSM/GPRS additions to the TCS family, the TCS2600, TCS2200 and TCS2010, manufacturers of cell phones, smartphones, PDAs, Internet appliances and other types of wireless devices are able to quickly bring new 2.5G products to market today and take advantage of a seamless migration path to 3G functionality in the future.
TI's TCS chipset family has established a reputation in the wireless industry for the lowest bill-of-materials (BOM) costs, high communications and applications performance, and low power consumption for longer battery life. The TCS family's software suite includes complete protocol stacks, mobile operating system support, and a host of ready-to-deploy embedded software applications and development tools that simplify the task of product differentiation.

With the introduction of many new advanced wireless applications and services, the issue of security has taken on heightened importance. The new members of the TCS chipset family are the most secure platforms in the industry because they are the first to offer a comprehensive set of hardware-based security features, along with the software libraries and services to enable manufacturers and wireless operators to add enhanced protection to their handsets and services. And without hardware-based protection, a wireless device can never be truly secure.
Leveraging the success of the TCS2500 chipset and TI’s OMAP wireless platforms, the TCS2600 chipset solution is the industry’s most highly optimized and integrated smartphone chipset. The centerpiece of the TCS2600 chipset is TI’s new OMAP730 smartphone processor with integrated Class 12 GSM/GPRS digital baseband and dedicated ARM 926 application processor operating at up to 200 MHz.
The OMAP platform advantage

TI’s popular OMAP family of processors includes both stand-alone application processors and highly integrated communication processors with a dedicated application processor. The OMAP710 and OMAP73x processors are the most highly integrated smartphone processors with a GSM/GPRS baseband subsystem and dedicated ARM application processor, all on a single chip. The OMAP710 and OMAP730 processors are featured in the TCS2500 and TCS2600 chipsets, respectively. The OMAP310, OMAP1510 and OMAP161x application processors can be paired with other TCS wireless chipsets for advanced multimedia application processing support. It's unique combination of high-performance processing capabilities, low power consumption and space-saving integration has made it the platform of choice for prominent mobile device manufacturers such as Nokia, NEC, HTC, Palm, and others.

The OMAP family of wireless processors provides a powerful and open platform for mobile devices. OMAP processors support the most advanced mobile operating systems such as Linux, Palm OS, Symbian OS, Series 60, Microsoft Windows CE, Microsoft Smartphone, and Microsoft Pocket PC, as well as their development tools. In addition, the TCS2600 offers accelerated Java applications with Java Jazelle™. All OMAP processors can draw on the extensive resources of the OMAP Developer Network, a group of third-party software developers who are creating compelling applications for 2.5G and 3G mobile devices. Time-to-market for mobile device manufacturers can be reduced significantly by the expert design support provided worldwide by the Independent OMAP Technology Centers (OTC). All the OTC have many years of experience in wireless system design and integration, and several are experts in certain technologies such as multimedia codecs, wireless local area networking (WLAN), Bluetooth and others.

Of course the 200 MHz speed of the OMAP730’s dedicated ARM 926 processor accelerates application processing significantly, but other capabilities are just as critical to the system’s overall performance. For example, the enhanced direct memory access (DMA) facility with its four physical and 17 logical channels is capable of transferring 2D graphics up to 2.5x faster. In addition to the 1.6 M b of internal SRAM, the device has a 100-MHz interface to as much as 128 M b of low-power mobile SDRAM and a 50-MHz interface to up to 256-M b of flash memory, with support for both high-speed burst NOR flash, and high-capacity, low-cost NAND flash. For space-saving applications with reduced power consumption, a mobile SDRAM stacking option is also available.

The TCS2600 chipset adds significant features to an already rich product family allowing for significant reduction in system part count and BOM cost. First, the OMAP7xx family capitalizes on the OMAP shared memory

**OMAP Development Tools**

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<td>Microsoft Windows CE.Net</td>
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<tr>
<td>Palm™</td>
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<td>Development Platform</td>
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OMAP730 integrated communication and dedicated application processor

architecture to allow a single-set of RAM and flash devices to be shared by both the application processor and the baseband process. This allowed for significant PCB space, BOM cost, and power consumption savings. Second, the TCS2600 chipset offers an unparalleled integration level for this product segment. The new TCS2600 chipset integrates many additional functions into the chipset, such as high fidelity audio DAC, handsfree and headphone amplifiers, and reduces the required clock inputs from 4 to 2. This results in products that can be less than 2/3 the cost to build and in less than half the board space, all while adding functions like Bluetooth to the design.

The extremely low power consumption of the OMAP730 dramatically extends the battery life of a mobile device, by splitting the power supplies the application subsystem, the digital baseband subsystem, and the Real-time Clock (RTC). Using this split power feature, the OMAP730 can be placed in a standby mode where it consumes as little as 10 micro-Amperes (mA) of power while maintaining the state of the clock and its alarms. Other features such as a reduction of core voltage to 1.5V, reduction of I/O supply voltages to 2.75V and dual-voltage capable memory interfaces, allowing compatibility with older 3V memory devices and newer, low-power 1.8-V devices further reduce power consumption in the system. The OMAP730 also adds new modes of clocking for IDLE and STANDBY modes to further reduce current during these critical power modes.

The comprehensive set of peripheral interfaces on the OMAP730 processor will speed up product design and shorten time-to-market. The memory and traffic controller has been enhanced to support mobile SDRAM and low-cost, high-capacity NAND Flash, in addition to high-speed burst NOR Flash technology. Included are a low-power USB On-the-Go interface, a fully 4-bit compliant SD/MMC/SDIO controller for secure digital media storage, a dedicated 54-Mbps link for connectivity to 802.11a/b/g wireless LAN technology, the Enhanced Audio Controller interface, a digital camera interface, Smartcard interface, a high-speed Bluetooth voice/data interface, an infrared communications port (IrDA) capable of both Fast IR (FIR) and Slow IR (SIR) modes, I²C, uWire, and others.

The OMAP730 in the TCS2600 chipset provides the highest level of security available today in the wireless industry. And as more personal and financial information is stored on mobile devices and transmitted over the airwaves, strong security is rapidly becoming a differentiating factor in the marketplace.

The hardware-based security features of the TCS2600 chipset include a secure bootloader with 48 kB of secure ROM and 16 kB of secure RAM memory as well as dedicated NOR/NAND flash memory that is write protected against access. In addition, the OMAP730 offers hardware acceleration for a True Random Number Generator (TRNG), which is a critical requirement for high-speed encryption engines, as well as hardware acceleration of
TI’s reference design for a smartphone incorporating the TCS2600 chipset has set a new standard for low overall costs. Exclusive of the display screen, the estimated BOM of the TCS2600 smartphone reference design represents more than a $50 savings over comparable smartphones today with similar features and memory resources. In addition to estimated BOM cost savings, the TCS2600 reference design has reduced the overall form factor of the mobile device by half, saving considerably on printed circuit board costs and space.

In addition to optimized BOM and space, the TCS2600 reference design has extended the life of a battery power supply by cutting power consumption considerably. In fact, the new TCS2600 reference design has doubled the battery life of the previous generation to as much as 200 hours of standby power.

The TCS2600 smartphone reference design includes a range of development tools that will further streamline time-to-market. Besides the open, high-level OS tools that are accessible through the OMAP platform and OMAP Developer Network, the TCS2600 reference design comes with a comprehensive software development infrastructure, which includes a complete GPRS protocol stack, a trace multiplexer, USB tracer, bootloader, memory and cache diagnostics and other time-saving development tools.
The TCS2500 chipset is a highly integrated solution for 2.5G smartphones and PDAs. Because of its combination of application processing and low-power consumption, the TCS2500 has been widely adopted in a generation of feature-rich smartphones and multimedia handsets. At the heart of the chipset is the OMAP710 smartphone and PDA processor based on a TI-enhanced ARM925 general-purpose application processor and TI’s proven GSM/GPRS digital baseband, which includes a wide range of general-purpose peripherals as well as dedicated multimedia application peripherals.

With the software and hardware pin-compatibility among the OMAP processors, such as the OMAP710 processor of the TCS2500 chipset and OMAP730 processor of the TCS2600 chipset, mobile device manufacturers are able to reuse much of the software and engineering development efforts among different product lines targeted at the various market segments in the wireless industry. This not only speeds the manufacturer’s time-to-market, but it also accelerates the return-on-investment on development efforts.

With the OMAP710 device, TCS2500-based designs are able to take full advantage of all of the benefits of the OMAP family of wireless processors, such as the many leading third-party applications from the OMAP Developer Network as well as the worldwide support and wireless system expertise of the OTC.
The TCS2200 chipset and its handset reference design pack the processing performance and the low-power consumption needed for the GPRS Java and multimedia applications that will ensure a compelling 2.5G wireless experience. The TCS2200’s reference design includes TI’s acclaimed worldwide technical support streamline development so that a new mobile device can be in production inside of 6 months, shortening time-to-market and hastening a manufacturer’s return on investment.
The TCS2200 chipset consists of the dual-core TBB2200 digital baseband, the TWL3016 analog baseband with power management, and the highly integrated single-chip quad-band TRF6151 RF transceiver with direct conversion technology. The TBB2200 features TI's proven DBB architecture, including an industry-leading TMS320C54x™ digital signal processor (DSP) and an ARM 7TDMI GPP. The DSP core operates at 104 MHz and has all of the on-chip resources needed to run many next-generation multimedia applications, including 60 K words of program and data memory. In addition, the ARM processor features five megabits of on-chip SRAM with DMA and page-mode access for fast off-chip memory transfers. The resources of the DSP and GPP cores make it possible for the TBB2200 digital baseband to run a complete Class 12 modem and full suite of Java and embedded multimedia applications on the same device.

The TBB2200 includes a new level of connectivity that will facilitate the easy addition of the functions and capabilities needed for next-generation applications. For example, a USB client port is provided as well as a parallel port for color LCDs and an interface to a multimedia card/secure digital (MMC/SD). In addition, interfaces to Smart Card, Bluetooth, external NAND flash memory and an audio port are integrated on-chip.

Securing mobile devices

The history of computer and communications security has shown that software security measures cannot provide total security. The highest level of security is only possible when hardware and software work together to protect the system. With the hardware-based security features of the TCS2200 chipset and TI’s third-party security library, a mobile device manufacturer is able to make security a competitive advantage in the marketplace.

Many of the key hardware-based security features of the TCS2600 chipset apply to the TCS2200. These security features include a secure boot and flash loader to authenticate the integrity of boot code before it is loaded, secure services for read-only memory resources, and hardware-dedicated security features such as a True Random Number Generator (TRNG) for encryption engines, secure ROM and RAM, a hashing coprocessor for security standards like SHA-1 and MD5, and a symmetrical encryption processor for authentication standards like DES/3-DES.
The TCS2200 chipset is fully supported by a complete handset reference design and TI’s extensive worldwide technical support. The TCS2200 reference design is fully type-approved and includes a full BOM, detailed board design with schematics and layout. For mobile device manufacturers under market pressure to rapidly introduce new products, the TCS2200 reference design can reduce a product’s development time to 6 months or less. And for manufacturers new to the wireless industry, the TCS2200 reference design can provide a “jump start” to success.

The TCS development tools that accompany the TCS2200 chipset and reference design ensure that manufacturers will be able to easily and efficiently add differentiating capabilities, providing their products with a competitive advantage in the marketplace. The full complement of tools for the TCS2200 includes the Windows-based development environment, C compilers, assemblers, linkers, simulators, emulators and high-level language debuggers.
The TCS2100 chipset for GPRS handsets supports a full Class 12 GPRS implementation with processing headroom for additional value-added and differentiated functions and features.

In addition to its powerful TBB2100 dual-core digital baseband, the TCS2100 chipset includes the highly integrated TWL3014 analog baseband, which is capable of complete power management over the entire system. The TWL3014 features TI's innovative power-split technique for low power consumption. The TCS2100's RF subsystem consists of a single chip direct conversion (DC) RF transceiver, the TRF6150. Because of the high integration of DC technology, which combines several discrete filtering devices with the transceiver, the TRF6150 can reduce the chip count in an RF subsystem by some 30 percent over older architectures.

The TCS2100 is supported by complete communication software and the comprehensive TCS Wireless Application Suite. In addition, pairing the TCS2100 GPRS chipset with one of the OMAP family of wireless application processors, such as the OMAP1510 or OMAP1610 processors, provides manufacturers the high performance and power efficient technology to support multimedia-rich applications.
**TCS2010 chipset and reference design for voice-centric GSM/GPRS handsets**

**TCS2010 elements**
- TBB2010 GSM/GPRS digital baseband processor
- Full featured L1/L2/L3 GSM/GPRS protocol stack
- TWL3014 analog baseband integrated with power management
- TRF6151 direct conversion, quad-band RF transceiver
- Complete ready-to-manufacture GSM/GPRS handset reference design
- TCS Wireless Software Suite provides a range of embedded applications

**TCS2010 features**
- Dual-core digital baseband with TI's proven GSM/GPRS modem architecture
- Reduced BOM count for high-volume low-cost handsets
- Low power consumption with double the standby time of previous generation
- Pin-to-pin compatibility with TBB2100 GSM/GPRS modem
- Highly integrated quad-band, direct conversion, single-chip RF transceiver
- Software compatibility with TCS2200 and TCS2100 GSM/GPRS Chipsets
- Class 12 GPRS-ready
- Adaptive MultiRate Narrow Band (AMR-NB) vocoders
- Integrated EOTD location determination
- Optimized interface to OMAP application processors for multimedia-rich applications

The TCS2010 GSM/GPRS chipset for low-cost voice-centric handsets builds on the marketplace acceptance of TI's successful TCS2100 chipset. For the value-conscious segments of the wireless marketplace, the TCS2010 chipset offers a fully functional GSM/GPRS handset with application processing capabilities. Fully supported by a complete reference design, a wide variety of development tools and TI's worldwide network of wireless system design experts, the TCS2010 chipset can slash new product development to less than 6 months.

The TCS2010 chipset consists of three devices: the TBB2010 digital baseband processor, the TWL3014 analog baseband processor with integrated power management, and an advanced DC quad-band single-chip RF transceiver, the TRF6151.
The TBB2010 modem is based on the proven dual-core architecture used in TI's high-volume TCS2100 GSM/GPRS chipset. TBB2010 DBB features two processing cores, a DSP core based on TI's industry leading TMS320C54x DSP and an ARM7TDMI core. Each core is equipped with on-chip memory. A fast four-channel, two-port direct memory access (DMA) controller ensures efficient data movements into and out of on-chip memory. Page mode for external memory access further facilitates data transfers. The TBB2010 is a GSM ultra-low power device (ULPD).

Because the TBB2010 is pin-for-pin and software compatible with TI's industry-leading and market-proven TBB2100 GSM/GPRS modem, handset manufacturers can maximize system and application software development reuse by spreading development costs over multiple product platforms.

For those platforms where extra application processing is needed, the TCS2010 is optimized to interface to one of TI's OMAP wireless processors, such as the OMAP1510 or new OMAP1610 application processors. Combining the capabilities of the TCS2010 chipset with the processing power of an OMAP application processor gives a mobile device platform the kind of processing headroom needed for the most advanced next-generation applications, such as video conferencing, speech processing including voice-to-text and text-to-speech, high-end graphics for interactive 3D gaming, streaming video and many more processing-intensive applications. By including an OMAP processor, the mobile device manufacturer also has available the many resources of the OMAP Developer Network, such as many of the wireless industry's leading software applications and core technologies.
The TWL3014 ABB is a proven performer in the GSM/GPRS market. As an integral part of TI’s proven high-volume TCS2010 chipset, the highly integrated TWL3014 cuts system cost factors by lowering board space requirements, reducing chip count and minimizing development time. The device includes both voiceband and baseband coders/decoders (codecs), and it features programmable low-dropout voltage regulators on-chip. Complete with interfaces to a battery charger, 3.3 V or 1.8 V external memory, an audio headset and LEDs, the TWL3014 comes in a space-saving 10 mm x 10 mm, 100-pin MicroStar BGA™ package.

The single-chip DC TRF6151 RF transceiver is one of the most advanced RF transceivers in the industry. It provides the same RF performance, lower BOM cost and reduced handset size featured in the TCS2600 and TCS2200 chipsets targeted for the high-performance handset and smartphone segments.

The TCS2010 wireless handset reference design can dramatically reduce a manufacturer’s time-to-market yet enable the rapid addition of differentiating features and capabilities. The reference design includes everything needed by the manufacturer, including a complete board layout and schematics as well as a BOM.

The TCS2010 reference design is fully tested and type approved. It includes a number of TI innovations, including TI’s unique power split technique, which partitions the system’s architecture so that sections of the device can be placed in low-power sleep modes, reducing power consumption to a bare minimum. Based on tests of the TCS2010 reference design, a handset based on the TCS2010 chipset will have double the standby time over the previous generation GSM chipset.
**TCS1110 chipset solution for GSM handset**

**TCS1110 elements**
- TBB1100 dual-core, high-performance digital baseband processor
- Full featured L1/L2/L3 GSM protocol stack
- TWL3012 analog baseband with power management
- TRF6150 tri-band direct conversion RF transceiver
- Complete ready-to-manufacture GSM handset reference design

**TCS1110 features**
- Complete solution and reference design reduces time-to-market
- Full GSM implementation
- Dual-core digital baseband with TI’s proven GSM modem architecture
- Reduced BOM count and cost via highly integrated single-chip tri-band RF transceiver
- Audio software modules
- Bluetooth connectivity

**TCS1110 chipset solution**
TI’s GSM chipset, the TCS1110, has a proven track record of success in the marketplace, having gone through four generations of increasing capabilities and performance. This three-chip solution provides multi-band DC RF operation and features a proven dual-core digital baseband.

The versatility, scalability and adaptability of the TCS1110 handset reference design is borne out by the fact that it has been implemented in a vast array of mobile devices serving diverse segments of the wireless marketplace.

**TI’s roadmap for complete TCS chipset solutions**
The TCS Wireless Software Suite includes a complete Class 12 GSM/GPRS protocol stack as well as TI’s comprehensive set of embedded wireless services, applications and tools. The TCS Wireless Software Suite ensures a high degree of cross-platform software re-use and portability, thereby reducing significantly a mobile handset manufacturer’s investment in system and application software. The TCS application suite includes a bundled set of pre-integrated multimedia applications, including Java virtual machine, WAP browser, MP3/Advanced Audio Coding (AAC), Musical Instrument Digital Interface (MIDI) and polyphonic ringtones, Enhanced Messaging Service (EMS), Multimedia Messaging Service (MMS), m-commerce, voice recognition, Bluetooth connectivity and others. In addition, the TCS Wireless Software Suite includes a customizable handset MMI as well as a full-featured MMI toolkit for rapid user interface development and differentiation.

TI’s TCS Wireless Software Suite features a Windows-based development environment and development tools so designers can rapidly integrate applications now, and in the future, quickly port new applications as they are developed. In fact, the TCS chipset embedded software environment includes all the software resources and tools needed to quickly bring a new handset to market, including a real-time operating system, development tools like compilers, debuggers, linkers, simulators and emulators.

While the GSM/GPRS market has emerged and grown into the largest wireless segment in the world, some 20 handset manufacturers have chosen one of TI’s TCS chipsets, making the company the leading supplier of GSM/GPRS chipsets. Some of the reasons manufacturers cite are TI’s complete system-level expertise, low BOM costs, high-performance digital basebands, highly integrated analog basebands, leading RF technology, low power consumption, comprehensive reference designs, an extensive software suite including full protocol stacks, OS support, application development tools, worldwide technical support, a selection of ready-to-deploy applications and much more.

TI’s latest GSM/GPRS additions to its TCS family of chipsets—the TCS2600, TCS2200, TCS2010—again have established a new set of features and segment-targeted capabilities that will ensure the success of wireless mobile handsets when they reach the marketplace.

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