OPERATIONAL DESCRIPTION OF CT9@9u

The equipment under test (EUT) is the transmitter of CT9@9u, a quad-band (850/900/1800/1900) GSM/GPRS mobile phone. The transmitter operates in a half-duplex system according to the GSM standards.

The majority of the phone circuitry consists of a four device chipset; the SKY74137 Transceiver IC, the sky77331 HBT IC Power Amplifier and the MT6229 Baseband Processor. The remainder of the major radio components is the SAW Frontend Module. There is also a combination Flash Memory/SRAM IC. The system is powered by a rechargeable lithium-ion battery with a nominal voltage of 3.8 volts.

The receiver consists of two distinct parts, the RF receiver front-end and the IF section. The RF receiver front-end amplifies the GSM850 (869-894 MHz), E-GSM900 (925-960 MHz), DCS1800 (1805-1880 MHz) or PCS1900 (1930-1990 MHz) aerial signal, converts the chosen channel down to a low IF of 100 kHz, and provides in addition more than 35 dB image suppression. Four LNAs are available on-chip and can be configured to allow 4-band functionality. The switched LNA will be used for roaming in different countries. Some selectivity is provided at this stage by an on-chip low-pass filter, and channel selectivity is provided by means of a high performance integrated band-pass filter. The IF section further amplifies the wanted channel performs gain control to tune the output level to the desired value and rejects DC. This DC rejection is realised with an active high pass circuit and operates either continuously or keeps the acquired offset correction during the burst depending on the programming.

The transmitter is fully differential using a direct up conversion architecture. It consists of a single side band power up mixer. Gain is controlled by 4 dB via 3-wire serial bus programming. The fully integrated VCO and the power mixer are designed to achieve LO suppression, quadrature phase error, quadrature amplitude balance and low noise floor specifications. Output balun components are integrated to drive a standard 50 ohms single ended load.

The local oscillator (LO) signals required are provided by an on chip VCO for operation of the receive and transmit sections. The VCO is fully integrated and self calibrating to reduce manufacturing tolerances. It consists of 64 differents frequency ranges that are selected internally depending on frequency programming. The frequencies of the RF VCO are set by an internal fractional N synthesiser PLL circuit,

which are programmable via a 3-wire serial bus. Comparison frequency is 26 MHz (24 Hz step programmability) derived from the 26 MHz reference signal which is generated from the semi integrated reference oscillator. The quadrature phase RF LO signals required for IQ mixers are generated internally.

An amplifier is integrated to build a crystal oscillator. Externally only a quartz and few passive components are needed. 26 MHz is the reference frequency. It is turned on when the supply voltage VCCSYN is applied. After buffering a reference clock of 26 MHz is supplied to the other parts of the system through the pin CLKOUT. Optionally an internal divider can be configured for an output of 13 MHz when setting the control pin PGMDIV to ground potential. An internal supply voltage regulator using VCCSYN as input supplies the reference oscillator and minimises parasitic couplings and pushing. AFC can be done by the FracN synthesiser programming or via an external varactor. Additionally a coarse AFC control with a resolution of 8 bit is integrated via switchable capacitors. The programming of the coarse AFC capacitors is maintained during sleep mode as the register memory is supplied via the continuous digital supply VDD. The reference signal (26 MHz) can alternatively be supplied from an external module (to pin REFIN). This module can be supplied through REFVCC pin.

The circuit can be powered-up into four different modes: RX, TX, SYN or REF mode, depending on supply voltages applied, the logical level at pin CTRL and the 3-wire bus serial programming. In RX (TX) mode, all sections required for receive (transmit) are turned on. The SYN mode is used to power-up the synthesiser and the RF-VCO prior to the RX or TX mode. In the SYN mode, some internal LO buffers are also powered-up such that VCO pulling is minimized when switching on the receiver or the transmitter. The reference oscillator (REF mode) is turned on by applying the supply voltage. Additionally band selection is done using the 3-wire bus serial programming allowing the proper enabling of the LNAs.

Four outputs are provided to drive RF switches of the phone, e.g. for switching between bands.

The baseband processor handles all physical layer radio control signals and network interfaces. The 32 KHz clock oscillator operates the baseband IC from a backup battery when the main battery is removed. The baseband processor is a dual-core device that splits the processing between a DSP core and an ARM-7EJ-S™ RISC processor. The DSP handles the physical and layer 1 processing, while the ARM7 executes the layer 2 and layer 3 protocol and the man-machine interface (MMI). The

dual cores communicate through a dedicated block of dual port memory. It also communicates with the Subscriber Identity Module (SIM) through an interface to the mixed signal device. The baseband processor also communicates to the calibration system or external devices through a digital serial link that is available on the system connector. The other main signals on the system connector include the digital audio interface (DAI) and allows for an external battery charging voltage.

The MMI completes the phone design and includes the displays, keypads, vibration motor, LEDs, speaker, microphone, and headset.