

The Development of Digital Mova D203 Hyper

by Tetsuaki Oga and Shin'ichi Fukui*

Mitsubishi Electric's easy-to-use Model D203 digital cellular phone is an 800MHz PDC type that features a compact lightweight design, extended battery standby and operating time, and the ability to display text messages (using the Short Message Service) on a four line by ten character LCD panel with electroluminescent lighting for nighttime use.

In 1996, Japan had nearly 21 million digital cell phone users, and the market is continuing to grow. In June 1997, Mitsubishi Electric launched Model D203, developed under the guidance of NTT Mobile Communications Corporation for the company's 800MHz PDC digital phone service. The cell phone boasts several user-friendly features. Extensive measures to lower power dissipation have extended the battery operating time to 90 minutes of continuous speech and 200 hours on standby with a standard battery, or 190 minutes of speech and 420 hours on standby with an L-size battery. Incoming calls can be signaled by an audible ring tone or a silent vibrator, permitting discreet use, while the flip-open handset need not be open to answer calls, simplifying operation and enhancing reliability. Model D203 supports Japan's short mail service, available since June 1997, displaying messages on a four-line by ten-character screen. A bright electroluminescent backlight illuminates the screen for nighttime use. The product is available in cosmic blue and glossy gray finishes. Fig. 1 shows a photograph of the Model D203.

Specifications

Table 1 lists the specifications and Fig. 2 shows a circuit block diagram. The unit measures 123mm high, 40mm wide and 26mm thick and weighs 120g with a standard battery—lightweight and convenient for handheld operation. The L-size battery, which extends the operation and standby time, increases the width to 38mm and the weight to 155g. The flip-open case was designed to protect the keypad from impacts and accidental operation.

Transmitter Circuit

The I.Q. generator converts serial binary data



Fig. 1 Model D203 digital cellular telephone.

Table 1 Specifications

Battery type	S	L
Dimensions (LxWxD)	123 x 40 x 26mm	123 x 40 x 38mm
Weight	120g	155g
Battery type	Lithium ion	
Nominal operating voltage	3.6V	
Nominal capacity	600mAh	1,300mAh
Charging time	80min	190min
Transmit power	0.8W	
Frequency band	800MHz	
Talk time (max. power, full rate speech coding, "off" power saver mode)	90min	190min
Standby time	200h	420h

*Tetsuaki Oga and Shin'ichi Fukui are with the Mobile Communication Business Division.

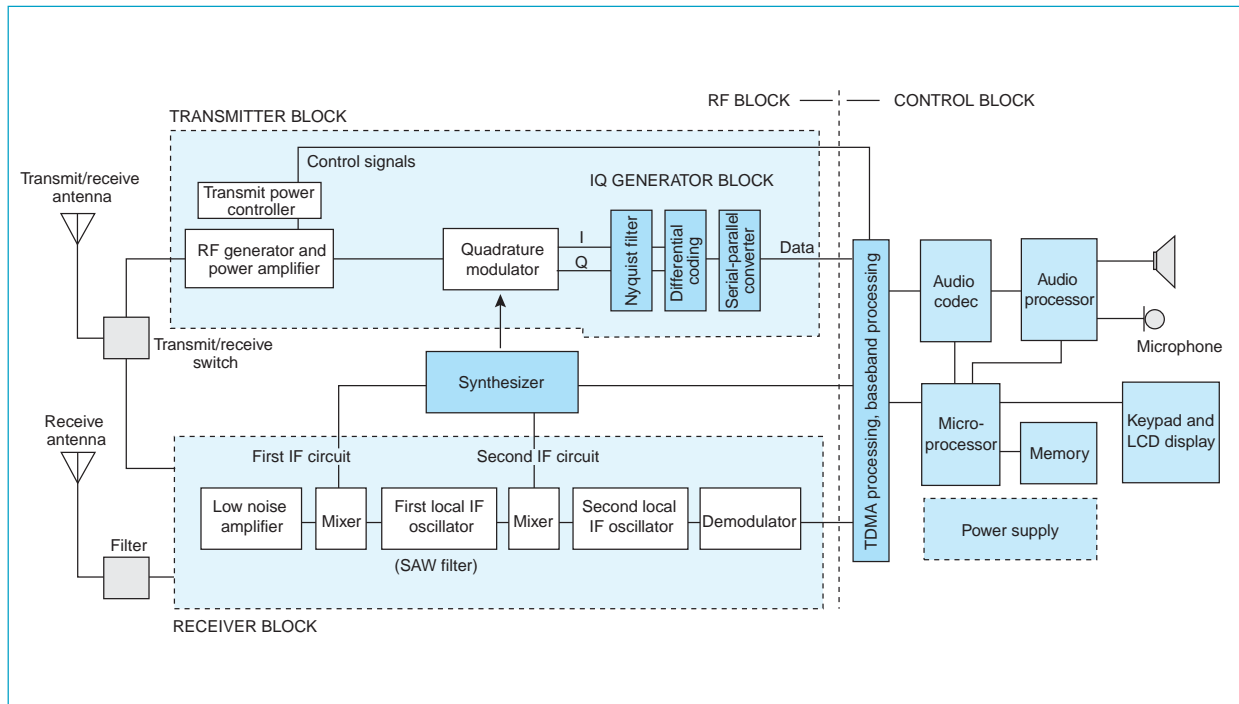


Fig. 2 Block diagram.

from a microprocessor in the logical control block to parallel data which is then differential coded and passed through a bandwidth-limiting Nyquist filter in preparation for $\pi/4$ quadrature phase shift keying (QPSK) modulation. The filter has a root Nyquist roll-off ratio of 0.5 that limits the width of the passband. The quadrature modulator performs direct quadrature modulation of the local transmission signal from the frequency synthesizer, which simplifies the circuitry and reduces the component count.

A compact two-stage GaAs amplifier has been used in the RF block, providing efficient, general-purpose amplification. Dual FETs are used to implement power control in six, 4dB steps.

Receiver Circuit

A diversity receiver coupled with a double superheterodyne amplifier is used to improve signal reception under conditions of poor wave propagation. A surface acoustic wave (SAW) resonator in the first IF filter saves space while a root Nyquist filter with a 0.5 roll-off in the second IF filter reduces distortion.

Frequency Synthesizer

A specially developed compact, power-saving ASIC, contains local oscillators for the transmitter and receiver circuits in both analog and digital bands. Produced using a BiCMOS process, the device includes mixers, amplifiers,

switches and phase-locked loops.

Logical Control Block

This section controls the RF block, processes signals to and from the base station, performs connection management, decodes keyboard inputs, manages the LCD panel, serves as a speech codec, performs audio passband filtering and volume control, and manages the connection with a fax-modem adapter. The M30600 series microprocessor, a monolithic device with a 16-bit data path, is used as the processor. Flash memory holds the firmware. SRAM and EEPROM are also used.

Display

The LCD panel features a space-saving integrated driver circuit that is fabricated directly on the LCD glass cover using Mitsubishi's chip-on-glass technology. The electroluminescent backlight is more than twice as bright as a point-source LED using the same power, and provides uniform illumination that makes the display easy to read in dark locations.

Careful engineering has resulted in a compact lightweight cell phone featuring extended battery operating time and support for text messages. The authors would like to express their thanks for the assistance of NTT Mobile Communications Corporation and the many individuals involved in the development project. □