MC60 GSM/GPRS+GNSS Combo Module Presentation

July, 2016
Build a Smarter World

Internet of Things
**MC60** is a GSM/GPRS+GNSS combo module based on **MT2503D** platform which is the combination of GNSS platform MT3333 and GSM/GPRS platform MT6261. While offering the same performance as MT6261 and MT3333, **MT2503D** features greatly reduced size, and also offers more advanced features in GNSS part.

### Old solution

- **MT6261**: 8.1x7.6 mm
- **MT3333**: 6x6 mm

Total Size: **148 mm²**

### MT2503 single chip

- **MT2503**: 8.4x6.2 mm

Total Size: **89.8 mm²**

Save size up to 40%
Block Diagram

RF Part

VDD_EXT
RTC
SIM1 Interface
SIM2 Interface
PWM
GPIO
LNA
Filter
Crystal 2
TCXO

PMU
MEMORY
RF Transceiver

Crystal 1

BT
Serial Interface
SD Interface
AUDIO
PCM
ADC

BB&RF

BT_ANT
UART
SD Interface
AUDIO
PCM
ADC

GPS_VCC_EN
NETLIGHT
GPS_ANT

GPS_UART
GPS_VCC

RF_ANT
VBAT
PWRKEY
VDD_EXT
VRTC
SIM1 Interface
SIM2 Interface

GPS_VCC

LNA
Filter
Crystal 2
TCXO
**Advanced Features**

**GNSS Features**
- GPS + GLONASS
- EASY™
- LOCUS™
- GLP
- DGPS
- AlwaysLocate™
- Build-in LNA
- EPO™*
- SUPL* 

**GSM/GPRS Features**
- Quad-band: 850/900/1800/1900MHz
- GPRS Multi-slot Class: Class 12
- AT Commands: GSM 07.07, 07.05 and enhanced AT commands
- TCP/UDP/HTTP/FTP/PPP*
- Jamming Detection
- Audio
- QuecFOTA™
- Dual SIM Single Standby
- OpenCPU

**Bluetooth**
- BT3.0
- Profiles: SPP, HFP-AG

**Others**
- Extended temperature range: -40 °C~ +85 °C
- Support 3V/1.8V SIM/USIM cards
- Highly compact size

* Under Development
# Specifications

<table>
<thead>
<tr>
<th></th>
<th>GPS L1 Band Receiver (1575.42MHz)</th>
<th>GLONASS L1 Band Receiver (1601.71MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Channel</strong></td>
<td>33 tracking channels</td>
<td>99 acquisition channels</td>
</tr>
<tr>
<td></td>
<td>210 PRN channels</td>
<td></td>
</tr>
<tr>
<td><strong>C/A code</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SBAS</strong></td>
<td>WAAS, EGNOS MSAS, GAGAN</td>
<td></td>
</tr>
<tr>
<td><strong>Horizontal Position Accuracy</strong></td>
<td>Autonomous</td>
<td>&lt;2.5m CEP</td>
</tr>
<tr>
<td><strong>Velocity Accuracy</strong></td>
<td>Without Aid</td>
<td>&lt;0.1m/s</td>
</tr>
<tr>
<td><strong>Acceleration Accuracy</strong></td>
<td>Without Aid</td>
<td>0.1m/s²</td>
</tr>
<tr>
<td><strong>Timing Accuracy</strong></td>
<td>1PPS</td>
<td>10ns</td>
</tr>
<tr>
<td><strong>TTF@-130dBm with EASY™</strong></td>
<td>Cold Start</td>
<td>&lt;15s</td>
</tr>
<tr>
<td></td>
<td>Warm Start</td>
<td>&lt;5s</td>
</tr>
<tr>
<td></td>
<td>Hot Start</td>
<td>&lt;1s</td>
</tr>
<tr>
<td><strong>TTF@-130dBm without EASY™</strong></td>
<td>Cold Start</td>
<td>&lt;35s</td>
</tr>
<tr>
<td></td>
<td>Warm Start</td>
<td>&lt;30s</td>
</tr>
<tr>
<td></td>
<td>Hot Start</td>
<td>&lt;1s</td>
</tr>
<tr>
<td><strong>Sensitivity</strong></td>
<td>Acquisition</td>
<td>-149dBm</td>
</tr>
<tr>
<td></td>
<td>Tracking</td>
<td>-167dBm</td>
</tr>
<tr>
<td></td>
<td>Re-acquisition</td>
<td>-161dBm</td>
</tr>
<tr>
<td><strong>Quad-band</strong></td>
<td>850/900/1800/1900MHz</td>
<td></td>
</tr>
<tr>
<td><strong>GPRS Multi-slot Class</strong></td>
<td>Class 12</td>
<td></td>
</tr>
<tr>
<td><strong>GPRS Mobile Station</strong></td>
<td>Class B</td>
<td></td>
</tr>
<tr>
<td><strong>Compliant to GSM Phase 2/2+</strong></td>
<td>(2W @850/900MHz)</td>
<td>Class 4</td>
</tr>
<tr>
<td></td>
<td>(1W @1800/1900MHz)</td>
<td>Class 1</td>
</tr>
<tr>
<td><strong>Supply Voltage Range</strong></td>
<td>3.3~4.6V</td>
<td>4.0V Typ.</td>
</tr>
<tr>
<td><strong>Low Power Consumption</strong></td>
<td>1.2mA @DRX=5</td>
<td></td>
</tr>
<tr>
<td><strong>Operation Temperature</strong></td>
<td>-40°C ~ +85°C</td>
<td></td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td>18.7 × 15.8 × 2.1mm</td>
<td></td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>Approx. 1.3g</td>
<td></td>
</tr>
<tr>
<td><strong>Control via AT Commands</strong></td>
<td>GSM 07.07, 07.05 and other enhanced AT commands</td>
<td></td>
</tr>
<tr>
<td><strong>Speech Codec Modes</strong></td>
<td>Half Rate (HR)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Full Rate (FR)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Enhanced Full Rate (EFR)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adaptive Multi-Rate (AMR)</td>
<td></td>
</tr>
<tr>
<td><strong>Echo Arithmetic</strong></td>
<td>Echo Cancellation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Echo Suppression</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Noise Reduction</td>
<td></td>
</tr>
<tr>
<td><strong>Bluetooth</strong></td>
<td>BT 3.0 Profile: SPP, HFP</td>
<td></td>
</tr>
<tr>
<td><strong>SIM/USIM</strong></td>
<td>3V/1.8V</td>
<td></td>
</tr>
<tr>
<td><strong>UART</strong></td>
<td>×3</td>
<td></td>
</tr>
</tbody>
</table>
Enhanced AT Commands

- Standard V.25ter AT commands
- GSM 07.07
- GSM 07.05 (SMS)
- GPRS AT commands in accordance with GSM 07.07
- TCP/IP stack AT commands
- STK (SIM Application Toolkit)
- Quectel defined AT commands (Enhanced Functions)
MC60’s GNSS part supports PQ commands which are developed based on SDK. The commands and corresponding functions are:

<table>
<thead>
<tr>
<th>PQ Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PQBUAD</td>
<td>Set NMEA Port Default Baudrate</td>
</tr>
<tr>
<td>PQEPE</td>
<td>Enable/Disable PQEPE Sentence Output</td>
</tr>
<tr>
<td>PQECEF*</td>
<td>Enable/Disable ECEFPOSVEL Sentence Output</td>
</tr>
<tr>
<td>PQODO*</td>
<td>Start/Stop Odometer Reading</td>
</tr>
<tr>
<td>PQPZ90*</td>
<td>Enable/Disable Switching from WGS84 to PZ-90.11</td>
</tr>
<tr>
<td>PQVEL*</td>
<td>Enable/Disable 3 Ways Velocity Sentence Output</td>
</tr>
</tbody>
</table>

* Under Development
MC60 supports GPS+GLONASS

- GPS: max acquisition 10 SV
- GPS+GLONASS: max acquisition 22 SV

More satellites are available for position calculation, which greatly improves accuracy.

The two-constellation system is especially suitable for urban areas with high-rise buildings and complex environments.
Positioning - Build-in LNA

- Expensive active antenna
- Increased external circuits

- Low-cost ceramic/chip antenna
- No need of external circuits
EPO Function
It is a kind of offline AGPS technology which provides predicted Extended Prediction Orbit to speed up TTFF.

Key Benefits:
• No need of extra server.
• EPO data downloading through GPRS network and upload to GNSS engine automatically.
• Small data size ensures short download time.

MTK EPO Server
Positioning - EPO (2)

TTFF Comparison

<table>
<thead>
<tr>
<th>Test Condition</th>
<th>TTFF without EPO™</th>
<th>TTFF with EPO™</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under real network conditions and conductive power level of -130dBm</td>
<td>Cold Start</td>
<td>&lt;35s</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;15s</td>
</tr>
<tr>
<td></td>
<td>Warm Start</td>
<td>&lt;30s</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;5 s</td>
</tr>
</tbody>
</table>
MC60 supports SUPL, an online AGPS technology which integrates EPO data, NITZ/NTP time sync, and QuecLocator to achieve 5 seconds TTFF for Cold Start in Open Sky.
Positioning - GLP (1)

- In acquisition or tracking condition, GLP (GNSS Low Power) is the best power-saving mode.
- In GLP mode, MC60 module still outputs NMEA data at 1Hz data update rate.
- The module will automatically exit from GLP mode when positioning conditions are not satisfied.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>In GLP Mode (mA)</th>
<th>In Normal Mode (mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static</td>
<td>8.9</td>
<td>22</td>
</tr>
<tr>
<td>Walking</td>
<td>11.2</td>
<td>22</td>
</tr>
<tr>
<td>Running</td>
<td>11.5</td>
<td>22</td>
</tr>
<tr>
<td>Driving</td>
<td>21.5</td>
<td>22</td>
</tr>
</tbody>
</table>

Average Current Consumption in GLP and Normal Modes

100% Power consumption

Only 40% Power consumption

Maximum accuracy

Tiny Accuracy Trade-off
(No Effect on Wearable Devices)
Positioning - Periodic Mode

• Periodic standby mode can control the power on/off time of MC60’s GNSS part periodically to reduce average power consumption.

• The on/off time can be configured by using PMTK command. For details, please see the figure on the right.
EASY™ is the abbreviation of Embedded Assist System for quick positioning. With EASY™ technology, MC60’s GNSS engine can automatically calculate and predict orbits automatically using the ephemeris data (up to 3 days) when the power is on, and then save the predict information into the memory. So the GNSS engine can use the information for positioning later if there is not enough information received from the satellites.

This function is helpful for positioning and TTFF improvement under indoor or urban conditions.

![Diagram showing EASY™ Technology](image-url)
### TTFF Comparison

<table>
<thead>
<tr>
<th>Test Condition</th>
<th>TTFF without EASY™</th>
<th>TTFF with EASY™</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under GNSS signal generator, and conductive power level of -130dBm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cold Start</td>
<td>&lt;35s</td>
<td>&lt;15s</td>
</tr>
<tr>
<td>Warm Start</td>
<td>&lt;30s</td>
<td>&lt;5 s</td>
</tr>
</tbody>
</table>
AlwaysLocate™ is an intelligent controller of periodic mode.

MC60’s GNSS part can adaptively adjust the on/off time to achieve balance between positioning accuracy and power consumption according to the environmental and motion conditions. So the average power consumption is lower in AlwaysLocate™ power saving mode than that in periodic power saving mode. The typical average power consumption is 2.8mA.
Positioning - LOCUS™ Technology

LOCUS is an embedded logger function of MC60’s GNSS part. When enabled by PMTK command, it allows the module to log GNSS data (data format: UTC, Latitude, Longitude, Height) to internal flash memory automatically without the need of host CPU (MCU) or external flash.

Benefits:
- Automatically log data to chipset internal flash, with no need to wake up HOST
- Smart overlapping mechanism to keep the latest logger data (4KB base)
- **Logger capability in chipset internal flash:**
  - With 1 sector flash (64KB), user can log >16 hours
  - With AlwaysLocate™, user can log up to 48hrs (2 days) under standard scenario.
Positioning – Static Filed Test

The following is a 12-hour testing result in static field.

GPS+GLONASS

Only GPS
Positioning - Estimated Position Error

• **Estimated Position Error**
  Large error values can be filtered via PQEPE command.

• **Static Speed Threshold**
  Threshold setting can effectively suppress static drift.
Positioning - Dynamic Field Testing

U turning

Under Viaduct

Turning

_uCompany M8

MC60
Bluetooth Function – Bluetooth Profiles

- Profile: SPP

BT3.0

- Profile: HFP+AG

Series Data

M2M Devices
Bluetooth Application

GSM/GPRS

DVR

OBD

TPM

Application on vehicles
Mechanical Dimensions

Length: 18.7mm (±0.15mm)
Width: 16.0mm (±0.15mm)
Height: 2.1mm (±0.2mm)
Weight: Approx. 1.3g

- Highly compact size
- Easier soldering process with LCC package
Target Applications

Vehicle Tracker

Wearable Devices (e.g. watch)

Personal Tracker (e.g. shoe tracker)

Pet Tracker
Support Package (1)

Evaluation Board

GSM-EVB Kit
- GSM EVB Board
- GSM Antenna
- Serial port cable
- RF cable for GSM Antenna connection

MC60-TE-A Kit
- MC60-TE-A
- GNSS Antenna
- RF cable for GNSS Antenna connection
Documents

- Specification
- Hardware Design
- MC60 AT Commands
- MC60 GNSS AT Commands
- Footprint & Parts in PADS and Protel Formats
- Evaluation Board User Guide
- Reference Design

PC tool

- PowerGPS - GPS/GLONASS testing tool
Support Package (3)

PC tool: QCOM/Qnavigator/USSDTool - GSM Test Tool

QCOM

Qnavigator

USSDTool