MN101E77 Series (Tentative)

8-bit Single-chip Microcontroller

■ Overview

The MN101E series of 8-bit single-chip microcomputers (the memory expansion version of MN101C series) incorporate multiple types of peripheral functions. This chip series is well suited for camera, VCR, MD, TV, CD, LD, printer, telephone, home automation, pager, air conditioner, PPC, remote controller, fax machine, music instrument and other applications.

This LSI brings to embedded microcomputer and applications flexible, optimized hardware configurations and a simple efficient instruction set. MN101EF77G has an internal 128 KB of ROM 2 KB of RAM. Peripheral functions include 6 external interrupts, 13 internal interrupts including NMI, 7 timer counters, 1 type of serial interfaces, A/D converter and 2 types of watchdog timer. The system configuration is suitable for system control microcontroller such as camera, timer selector for VCR, CD player, or MD.

With 4 oscillation systems (high-speed (internal frequency: 16 MHz), high-speed (crystal/ceramic frequency: max. 10 MHz) / low-speed (internal frequency: 5 kHz), low-speed (crystal frequency: 32.768 kHz) contained on the chip, the system clock can be switched to high-speed frequency input (NORMAL mode) or to low-speed frequency input (SLOW mode).

The system clock is generated by dividing the oscillation clock. The best operation clock for the system can be selected by switching its frequency ratio by programming. High speed mode has the standard mode which is based on the clock dividing fxtl/frc by 2 (fxtl/2 or frc/2), and the double speed mode which is based on the clock not dividing fxtl or frc.

A machine cycle (minimum instruction execution time) in the standard mode is 200 ns when the original oscillation fxtl is 10 MHz. A machine cycle in the double speed mode, in which the CPU operates on the same clock as the external clock, is 100 ns when fxtl is 10 MHz.

■ Product Summary

This datasheet describes the following model.

Model	ROM Size	RAM Size	Classification	Package
MN101EF77G	128 KB	2 KB	Flash EEPROM version	HQFP048-P-0707B

■ Features

- ROM Size:
  128 KB (131072 × 8-bit)

- RAM Size:
  2 KB (2048 × 8-bit)

- Package:
  48-HQFP (7 mm × 7 mm, 0.50 mm pitch) * *: halogen free package

- Machine Cycle:
  High speed mode 1 (External high speed oscillation) <fs = fxtl / 1>
  0.125 µs / 8 MHz (2.0 V to 3.6 V)
  0.250 µs / 4 MHz (V_{RSTL} to 3.6 V)
  High speed mode 2 (Internal high speed oscillation) <fs = frc / 2>
  0.125 µs / 8 MHz (V_{RSTL} to 3.6 V)
  * It is necessary to set Handshake mode
  Low speed mode 1 (External low speed oscillation) <fs = fxtls / 2>
  61.04 µs / 32.768 kHz (V_{RSTL} to 3.6 V)
  Low speed mode 2 (Internal low speed oscillation) <fs = frcs / 2>
  400 µs / 5 kHz (V_{RSTL} to 3.6 V)

- Clock Gear Circuit Embedded:
  The operation speed of system clock can be changed by switching the dividing ratio of the oscillation clock (fosc,fx)
  (1, 2, 4, 8, 16, 32, 64, 128 dividing)
  * fosc : High speed clock switched between Internal and External High speed oscillation
  fx : Low speed clock switched between Internal and External low speed oscillation

- Oscillation Circuit:
  External high speed oscillation (fxtl) : (crystal/ ceramic)
  Internal high speed oscillation (frc) : 16 MHz ± 2 %
  External low speed oscillation (fxtls) : (crystal)
  Internal low speed oscillation (frcs) : 5 kHz ± 10 %

- Operation Modes:
  NORMAL mode (High-speed mode)
  SLOW mode (Low-speed mode)
  HALT mode (High-speed / Low-speed mode)
  STOP mode
  The operation clock can be switched in each mode.

- ROM Correction:
  Maximum of 3 parts in a program

- Operation Voltage:
  V_{RSTL} to 3.6 V (V_{RSTL} : Auto Reset Voltage 1.95 V ± 0.15 V)

- Operating Temperature:
  –20°C to +60°C

■ Features (continued)

- Interrupt: 24 interrupts

<External Interrupt> Rising / falling edge can be specified.

IRQ0 – External Interrupt (Edge selectable, Noise filter connectable)
IRQ1 – External Interrupt (Edge selectable, Noise filter connectable)
IRQ2 – External Interrupt (Edge selectable, Both edges selectable)
IRQ3 – External Interrupt (Edge selectable, Both edges selectable)
IRQ4 – External Interrupt (Edge selectable, Both edges selectable)
IRQ6 – External Interrupt (Key scan interrupt)

<Timer Interrupt>

TM0IRQ – Timer 0 interrupt (8-bit timer)
TM1IRQ – Timer 1 interrupt (8-bit timer)
TM2IRQ – Timer 2 interrupt (8 bit timer)
TM3IRQ – Timer 3 interrupt (8-bi timer)
TM6IRQ – Timer 6 interrupt (8-bi timer)
TM7IRQ – Timer 7 interrupt (16-bit timer)
T7OC2IRQ – Timer 7 compare register 2 interrupt (16-bit timer)
TM8IRQ – Timer 8 interrupt (16-bit timer)
T8OC2IRQ – Timer 8 compare register 2 interrupt (16-bit timer)
TBIRQ — Time base timer interrupt

<Serial Interface Interrupt>

SC0RIRQ – Serial 0 UART reception interrupt (UART reception)
SC0TIRQ – Serial 0 UART transmission interrupt (UART transmission, synchronous)
SC1RIRQ – Serial 1 UART reception interrupt (UART reception)
SC1TIRQ – Serial 1 UART transmission interrupt (UART transmission, synchronous)
SC4IRQ – Serial 4 interrupt (Multi master IIC communication, synchronous)
SC4STPCIRQ – Serial 4 interrupt (Multi master IIC stop condition)

<Overrun Interrupt>

NMI – Non-maskable interrupt

<A/D Conversion Interrupt>

ADIRQ – A/D conversion end

- A/D Converter:

10-bit × 9 channels

- Gain-Amp:

2 channels

- Reference Power Supply:

1.7 V ± 0.1 V

- Voice-Amp:

ABclass Amp
Built in speaker disconnection detector circuit
Amplitude gain selectable

∗ Low pass filter for extracting voice signal from PWM output is not built in

■ Features (continued)

- Timer Counter: 10 Timers (All timer counters generate interrupts.)

Timer 0 – 8-bit timer

Square wave output, PWM output, Simple pulse width measurement
Added pulse (2-bit) system PWM
Clock source : fosc, fosc/4, fosc/16, fosc/32, fosc/64, fs/2, fs/4, fx, external clock
Square wave output and PWM output can be output to the large current pin P30(TM0O)

Timer 1 – 8-bit timer

Timer 0 and 1 can be connected in cascade
Clock source : fosc, fosc/4, fosc/16, fosc/64, fosc/128, fs/2, fs/8, fx
Usable as UART baud rate timer

Timer 2 – 8-bit timer

Square wave output, PWM output, Simple pulse width measurement,
Added pulse (2-bit) system PWM,
Clock source : fosc, fosc/4, fosc/16, fosc/32, fosc/64, fs/2, fs/4, fx , external clock
Square wave output and PWM output can be output to the large current pin P32(TM2O).
Usable as UART baud rate timer

Timer 3 – 8-bit timer

Timer 2 and Timer 3 can be connected in cascade
Clock source : fosc, fosc/4, fosc/16, fosc/64, fosc/128, fs/2, fs/8, fx

Timer 6 – 8-bit timer

Timer 6 can be combined to Time base timer
Clock source : fosc, fs, fx, time base output ($1/2^7$ or $1/2^{13}$)

Timer 7 – 16-bit timer (Double buffer composition)

Square wave output, PWM output (duty/cycle continuous changeable),Event count,
Pulse width measurement, Input capture
PWM output can be output to the large current pin P31 (TM7O).
Clock source : Dividing fosc, fs, external clock in 1, 2, 4 or 16

Timer 8 – 16-bit timer (Double buffer composition)

Square wave output, PWM output (duty/cycle continuous changeable),Event count,
Pulse width measurement, Input capture
PWM output can be output to the large current pin P33 (TM8O).
Clock source: Dividing fosc, fs, external clock in 1, 2, 4 or 16

Time base timer

Clock source : fosc, fx
Interrupt generation cycle : $fosc/2^7$, $fosc/2^8$, $fosc/2^9$, $fosc/2^{10}$, $fosc/2^{12}$, $fosc/2^{13}$, $fosc/2^{14}$, $fosc/2^{15}$, $fx/2^7$, $fx/2^8$, $fx/2^9$, $fx/2^{10}$, $fx/2^{12}$, $fx/2^{13}$, $fx/2^{14}$, $fx/2^{15}$

Watchdog timer

Error detection cycle: selectable from $fs/2^{16}$, $fs/2^{18}$, and $fs/2^{20}$.

Watchdog timer 2

Error detection cycle: selectable from $frcs/2^{11}$, $frcs/2^{12}$, $frcs/2^{14}$, and $frcs/2^{16}$.

- Clock output:

OSC source oscillation, system clock or internal low-speed clock can be output.

■ Features (continued)

- Serial Interface: 3 channel

<Serial interface 0>

CH0 – 3 channel type synchronous / UART (full duplex)

Transfer clock: 1/2 of fosc/2, fosc/4, fosc/16, fosc/64, fs/2, fs/4, timer1 or 2 output
At UART, timer1 or 2 are used as a baud rate timer
MSB/LSB can be selected as the first bit to be transferred.
Any transfer size from 1 to 8 bits can be selected.
Parity check, parity addition, overrun and framing error detection.
Usable as 2 channel type serial interface.

<Serial interface 1>

CH1 – 3 channel type synchronous / UART (full duplex)

Transfer clock: 1/2 of fosc/2, fosc/4, fosc/16, fosc/64, fs/2, fs/4, timer0 or 1 output
At UART, timer0 or 1 are used as a baud rate timer
MSB/LSB can be selected as the first bit to be transferred.
Any transfer size from 1 to 8 bits can be selected.
Parity check, parity addition, overrun and framing error detection.
Usable as 2 channel type serial interface.

<Serial interface 4>

CH4 – 3 channel type synchronous / Multi master IIC interface

Transfer clock: 1/2 of fosc/2, fosc/4, fosc/16, fosc/64, fs/2, fs/4, timer2 or 3 output
MSB/LSB can be selected as the first bit to be transferred.
Any transfer size from 1 to 8 bits can be selected.
Usable as 2 channel type serial interface.
7-bit or 10-bit slave address is available. (Multi master IIC)
Support general call communication mode. (Multi master IIC)

- Buzzer output:

Output frequency can be selected from
$fosc/2^{14}$, $fosc/2^{13}$, $fosc/2^{12}$, $fosc/2^{11}$, $fosc/2^{10}$, $fosc/2^{9}$, $fx/2^{4}$, $fx/2^{3}$

- LED driver:

7 pins (3 pins are used for Nch open-drain output)

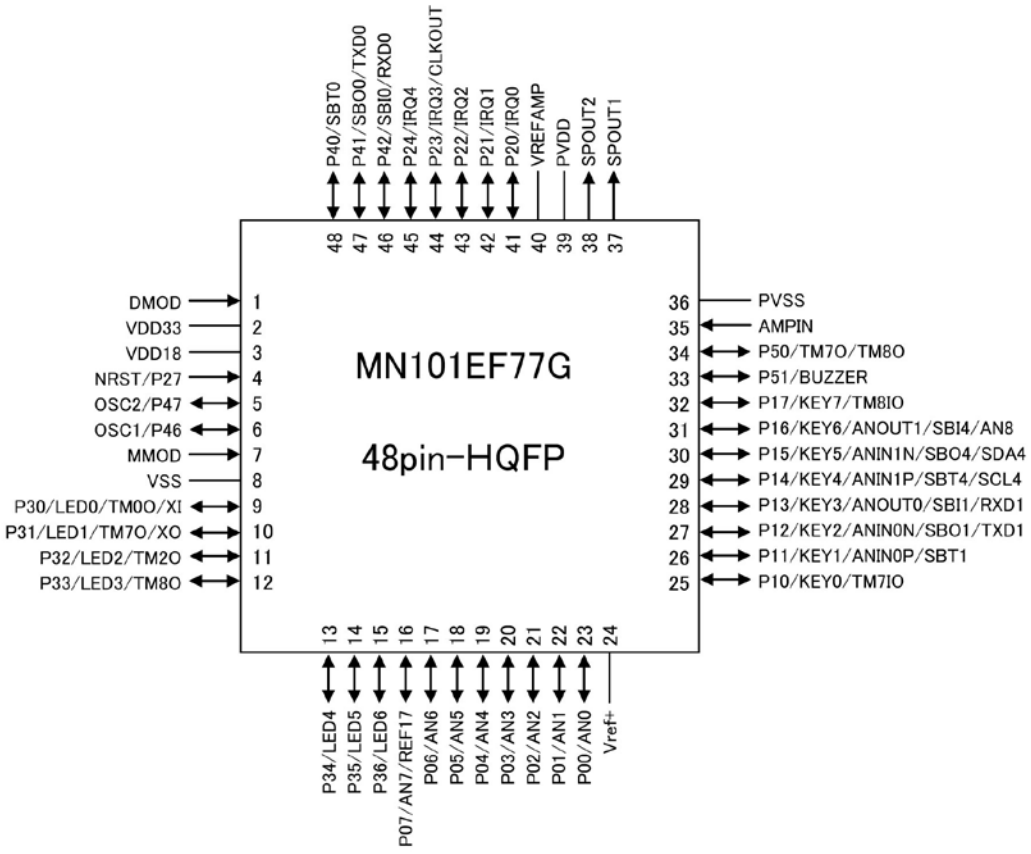
■ Features (continued)

- Port: I/O ports 35 ports (All ports are multi purpose)

LED (large current) driver ports	7 ports (switchable with timer output)
A/D input pins	9 pins
Timer output pin	5 pin
Timer I/O pins	2 pins
External interrupt pins	5 pins
Serial port pins	9 pins
Oscillator pins	4 pins
Gain-Amp pins	6 pins
Reference voltage output pin	1 pin
Key interrupt pins	8 pins
Buzzer output pin	1 pin
Clock output pin	1 pin
Special pin	
A/D Reference voltage input pin	1 pin
Power Supply pin	2 pins
Voice Amp power supply pin	2 pins
Voice Amp input pin	1 pin
Voice Amp Bias pin	1 pin (for connecting condenser)
Speaker Connection pin	2 pins
Operation mode setting pin	2 pins
Reset input pin	1 pin
Condenser connection pin	1 pin

■ Pin Description

- HQFP048-P-0707B



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