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The semiconductor business of Panasonic Corporation was transferred on September 1, 2020 to Nuvoton Technology Corporation (hereinafter referred to as "Nuvoton"). Accordingly, Panasonic Semiconductor Solutions Co., Ltd. became under the umbrella of the Nuvoton Group, with the new name of Nuvoton Technology Corporation Japan (hereinafter referred to as "NTCJ").

In accordance with this transfer, semiconductor products will be handled as NTCJ-made products after September 1, 2020. However, such products will be continuously sold through Panasonic Corporation.

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**Nuvoton Technology Corporation Japan**

# 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  $f_{xtl}/f_{rc}$  by 2 ( $f_{xtl}/2$  or  $f_{rc}/2$ ), and the double speed mode which is based on the clock not dividing  $f_{xtl}$  or  $f_{rc}$ .

A machine cycle (minimum instruction execution time) in the standard mode is 200 ns when the original oscillation  $f_{xtl}$  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  $f_{xtl}$  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<sub>RSTL</sub> to 3.6 V)
  - High speed mode 2 (Internal high speed oscillation) <fs = frc / 2>
    - 0.125 μs / 8 MHz (V<sub>RSTL</sub> 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<sub>RSTL</sub> to 3.6 V)
  - Low speed mode 2 (Internal low speed oscillation) <fs = frcs / 2>
    - 400 μs / 5 kHz (V<sub>RSTL</sub> 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<sub>RSTL</sub> to 3.6 V (V<sub>RSTL</sub> : 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-bit timer)

TM6IRQ – Timer 6 interrupt (8-bit 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 :  $f_{osc}$ ,  $f_{osc}/4$ ,  $f_{osc}/16$ ,  $f_{osc}/32$ ,  $f_{osc}/64$ ,  $f_s/2$ ,  $f_s/4$ ,  $f_x$ , external clock  
 Square wave output and PWM output can be output to the large current pin P30(TM00)

### Timer 1 – 8-bit timer

Timer 0 and 1 can be connected in cascade  
 Clock source :  $f_{osc}$ ,  $f_{osc}/4$ ,  $f_{osc}/16$ ,  $f_{osc}/64$ ,  $f_{osc}/128$ ,  $f_s/2$ ,  $f_s/8$ ,  $f_x$   
 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 :  $f_{osc}$ ,  $f_{osc}/4$ ,  $f_{osc}/16$ ,  $f_{osc}/32$ ,  $f_{osc}/64$ ,  $f_s/2$ ,  $f_s/4$ ,  $f_x$ , external clock  
 Square wave output and PWM output can be output to the large current pin P32(TM20).  
 Usable as UART baud rate timer

### Timer 3 – 8-bit timer

Timer 2 and Timer 3 can be connected in cascade  
 Clock source :  $f_{osc}$ ,  $f_{osc}/4$ ,  $f_{osc}/16$ ,  $f_{osc}/64$ ,  $f_{osc}/128$ ,  $f_s/2$ ,  $f_s/8$ ,  $f_x$

### Timer 6 – 8-bit timer

Timer 6 can be combined to Time base timer  
 Clock source :  $f_{osc}$ ,  $f_s$ ,  $f_x$ , 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 (TM70).  
 Clock source : Dividing  $f_{osc}$ ,  $f_s$ , 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 (TM80).  
 Clock source: Dividing  $f_{osc}$ ,  $f_s$ , external clock in 1, 2, 4 or 16

### Time base timer

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

### Watchdog timer

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

### Watchdog timer 2

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

- **Clock output:**

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

**■ Features (continued)**

## • Serial Interface: 3 channel

&lt;Serial interface 0&gt;

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

Transfer clock:  $1/2$  of  $f_{osc}/2$ ,  $f_{osc}/4$ ,  $f_{osc}/16$ ,  $f_{osc}/64$ ,  $f_s/2$ ,  $f_s/4$ , 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.

&lt;Serial interface 1&gt;

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

Transfer clock:  $1/2$  of  $f_{osc}/2$ ,  $f_{osc}/4$ ,  $f_{osc}/16$ ,  $f_{osc}/64$ ,  $f_s/2$ ,  $f_s/4$ , 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.

&lt;Serial interface 4&gt;

CH4 – 3 channel type synchronous / Multi master IIC interface

Transfer clock:  $1/2$  of  $f_{osc}/2$ ,  $f_{osc}/4$ ,  $f_{osc}/16$ ,  $f_{osc}/64$ ,  $f_s/2$ ,  $f_s/4$ , 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

 $f_{osc}/2^{14}$ ,  $f_{osc}/2^{13}$ ,  $f_{osc}/2^{12}$ ,  $f_{osc}/2^{11}$ ,  $f_{osc}/2^{10}$ ,  $f_{osc}/2^9$ ,  $f_x/2^4$ ,  $f_x/2^3$ 

## • LED driver:

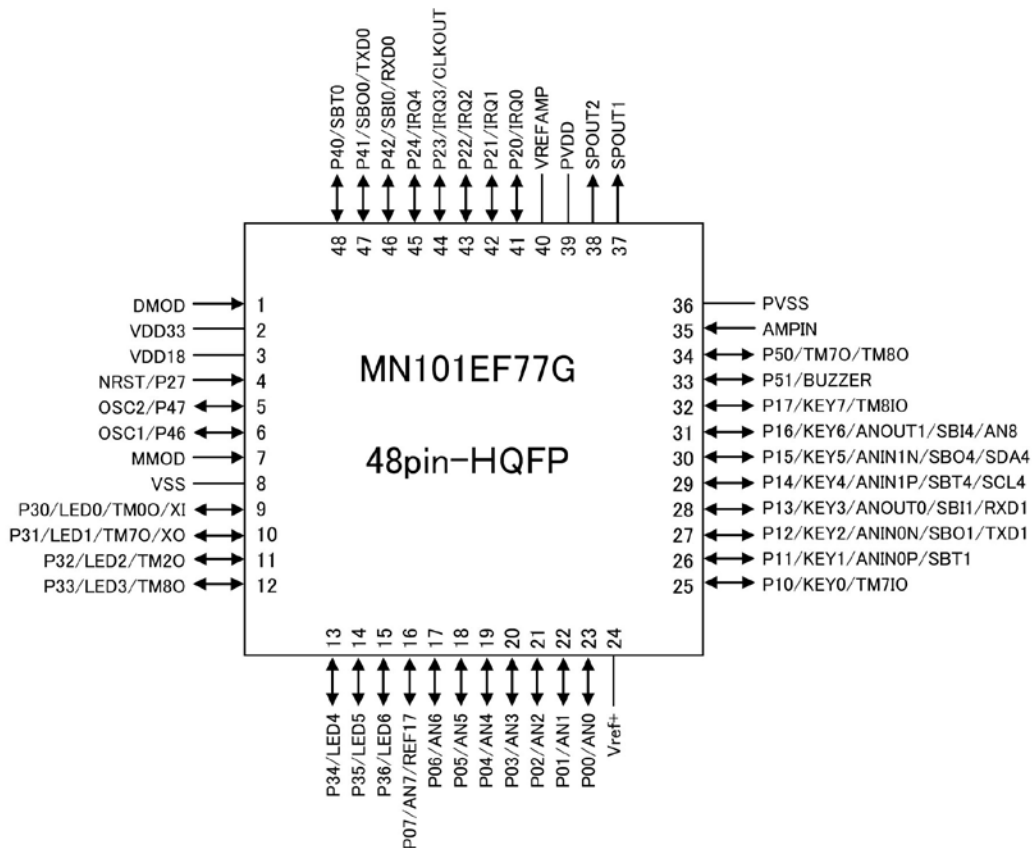
7 pins (3 pins are used for Nch open-drain output)

■ 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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