



ARM Cortex™ -M0
32-BIT MICROCONTROLLER

NuMicro Mini51™ DE Series
Product Brief

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1 GENERAL DESCRIPTION

The NuMicro Mini51™ series 32-bit microcontroller is embedded with ARM® Cortex™-M0 core for industrial control and applications which require high performance, high integration, and low cost. The Cortex™-M0 is the newest ARM® embedded processor with 32-bit performance at a cost equivalent to the traditional 8-bit microcontroller.

The NuMicro Mini51™ series can run up to 24 MHz and operate at 2.5V ~ 5.5V, -40°C ~ 105°C, and thus can afford to support a variety of industrial control and applications which need high CPU performance. The NuMicro Mini51™ series offers 4K/8K/16K-bytes embedded program flash, size configurable data flash (shared with program flash), 2K-byte flash for the ISP, and 2K-byte SRAM.

Many system level peripheral functions, such as I/O Port, Timer, UART, SPI, I²C, PWM, ADC, Watchdog Timer, Analog Comparator and Brown-out Detector, have been incorporated into the NuMicro Mini51™ series in order to reduce component count, board space and system cost. These useful functions make the NuMicro Mini51™ series powerful for a wide range of applications.

Additionally, the NuMicro Mini51™ series is equipped with ISP (In-System Programming) and ICP (In-Circuit Programming) functions, which allow the user to update the program memory without removing the chip from the actual end product.



2 FEATURES

- Core
 - ARM® Cortex™-M0 core running up to 24 MHz
 - One 24-bit system timer
 - Supports Low Power Sleep mode
 - A single-cycle 32-bit hardware multiplier
 - NVIC for the 32 interrupt inputs, each with 4-level of priority
 - Supports Serial Wire Debug (SWD) interface and two watch points/four breakpoints
- Built-in LDO for wide operating voltage ranged: 2.5 V to 5.5 V
- Memory
 - 4 KB/ 8 KB/ 16 KB Flash memory for program memory (APROM)
 - Configurable Flash memory for data memory (Data Flash)
 - 2 KB Flash for loader (LDROM)
 - 2 KB SRAM for internal scratch-pad RAM (SRAM)
- Clock Control
 - Programmable system clock source
 - ◆ Switch clock sources on-the-fly
 - 4 ~ 24 MHz external crystal input (HXT)
 - 32.768 kHz external crystal input (LXT) for Power-down wake-up and system operation clock
 - 22.1184 MHz internal oscillator (HIRC) (1% accuracy at 25°C, 5V)
 - ◆ Dynamically calibrating the HIRC OSC to 22.1184 MHz $\pm 1\%$ from -40°C to 105°C by external 32.768K crystal oscillator (LXT)
 - 10 kHz internal low-power oscillator (LIRC) for Watchdog Timer and Power-down wake-up
- I/O Port
 - Up to 30 general-purpose I/O (GPIO) pins for LQFP-48 package
 - Four I/O modes:
 - ◆ Input-only with high impedance
 - ◆ Push-pull output
 - ◆ Open-drain output
 - ◆ Quasi-bidirectional
 - TTL/Schmitt trigger input selectable
 - I/O pin can be configured as interrupt source with edge/level setting
 - Supports high driver and high sink I/O mode
 - Configurable default I/O mode of all pins after POR
- Timer



- Provides two channel 32-bit timers. One 8-bit pre-scale counter with 24-bit up counter for each timer
- Independent clock source for each timer
- Provides One-shot, Periodic, Toggle and Continuous operation modes
- 24-bit up counter value is readable through TDR (Timer Data Register)
- Provides trigger counting/free counting/counter reset function triggered by external capture pin or internal comparator signal
- Provides event counter function
- Supports wake-up from Idle or Power-down mode
- WDT (Watchdog Timer)
 - Multiple clock sources
 - Supports wake-up from Idle or Power-down mode
 - Interrupt or reset selectable on watchdog time-out
- PWM
 - Independent 16-bit PWM duty control units with maximum six outputs
 - Supports group/synchronous/independent/ complementary modes
 - Supports One-shot or Auto-reload mode
 - Supports Edge-aligned and Center-aligned type
 - Programmable dead-zone insertion between complementary channels
 - Each output has independent polarity setting control
 - Hardware fault brake protections
 - Supports duty, period, and fault break interrupts
 - Supports duty/period trigger ADC conversion
 - Timer comparing matching event trigger PWM to do phase change
 - Supports comparator event trigger PWM to force PWM output low for current period
 - Provides interrupt accumulation function
- UART (Universal Asynchronous Receiver/Transmitters)
 - One UART device
 - Buffered receiver and transmitter, each with 16-byte FIFO
 - Optional flow control function (CTS_n and RTS_n)
 - Supports IrDA (SIR) function
 - Programmable baud-rate generator up to 1/16 system clock
 - Supports RS-485 function
- SPI (Serial Peripheral Interface)
 - One SPI devices
 - Supports Master/Slave mode



- Full-duplex synchronous serial data transfer
- Provides 3-wire function
- Variable length of transfer data from 8 to 32 bits
- MSB or LSB first data transfer
- Rx latching data can be either at rising edge or at falling edge of serial clock
- Tx sending data can be either at rising edge or at falling edge of serial clock
- Supports Byte Suspend mode in 32-bit transmission
- 4-level depth FIFO buffer
- I²C
 - Supports Master/Slave mode
 - Bidirectional data transfer between masters and slaves
 - Multi-master bus (no central master)
 - Arbitration between simultaneously transmitting masters without corruption of serial data on the bus
 - Serial clock synchronization allows devices with different bit rates to communicate via one serial bus
 - Serial clock synchronization can be used as a handshake mechanism to suspend and resume serial transfer
 - Programmable clocks allow for versatile rate control
 - Supports 7-bit addressing mode
 - Supports multiple address recognition (four slave addresses with mask option)
 - Supports Power-down wake-up function
 - Support FIFO function
- ADC (Analog-to-Digital Converter)
 - 10-bit SAR ADC with 300K SPS
 - Up to 8-ch single-end input and one internal input from band-gap
 - Conversion started either by software trigger, PWM trigger, or external pin trigger
 - Supports conversion value monitoring (or comparison) for threshold voltage detection
- Analog Comparator
 - Two analog comparators with programmable 16-level internal voltage reference
 - Build-in CRV (comparator reference voltage)
 - Supports Hysteresis function
 - Interrupt when compared results changed
- ISP (In-System Programming) and ICP (In-Circuit Programming)
- BOD (Brown-out Detector)
 - With 4 programmable threshold levels: 4.4V/3.7V/2.7V/2.2V



- Supports Brown-out interrupt and reset option
- 96-bit unique ID
- LVR (Low Voltage Reset)
 - Threshold voltage level: 2.0V
- Operating Temperature: -40°C~105°C
- Reliability: EFT > ± 4KV, ESD HBM pass 4KV
- Packages:
 - Green package (RoHS)
 - 48-pin LQFP (7x7), 33-pin QFN (5x5) , 33-pin QFN (4x4), 20-pin TSSOP



3 PARTS INFORMATION LIST AND PIN CONFIGURATION

3.1 NuMicro Mini51™ Series Selection Code

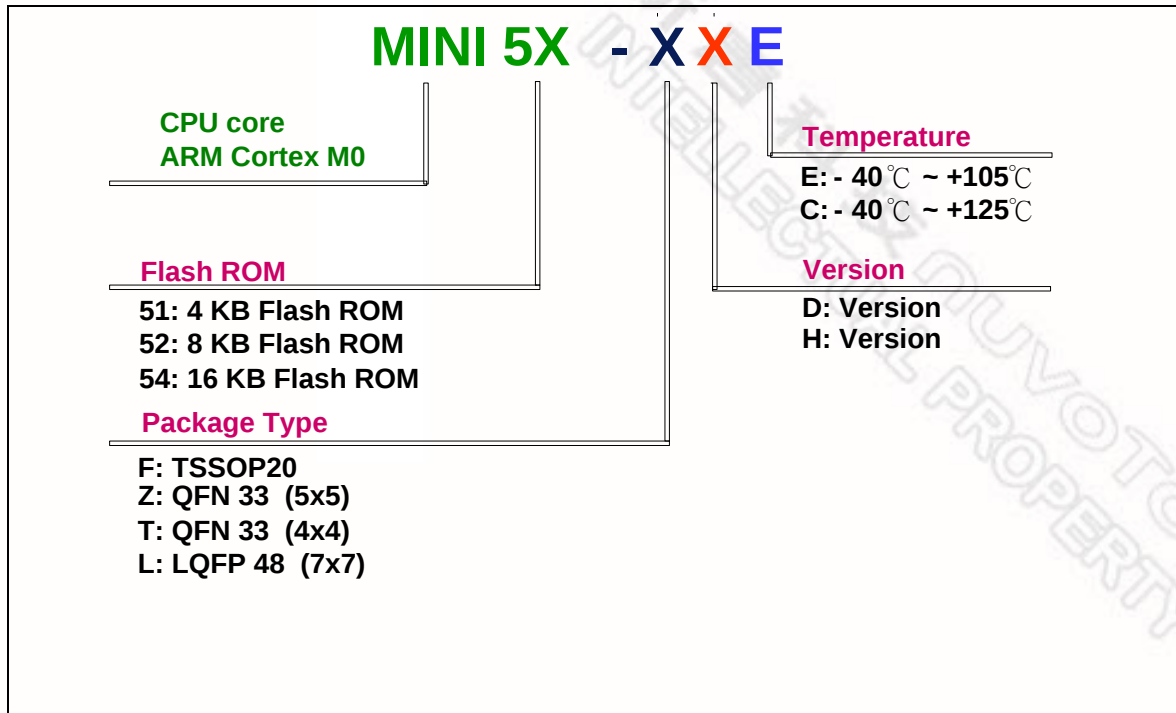


Figure 3.1-1 NuMicro Mini51™ Series Selection Code



3.2 NuMicro Mini51™ Series Product Selection Guide

Part No.	APROM	RAM	Data Flash	ISP Loader ROM	I/O	Timer	Connectivity			Comp.	PWM	ADC	ISP ICP IAP	IRC 22.1184 MHz	Package
							UART	SPI	I ² C						
MINI51FDE	4 KB	2 KB	Configurable	2 KB	up to 17	2x 32-bit	1	1	1	-	3	4x10-bit	v	v	TSSOP20
MINI51LDE	4 KB	2 KB	Configurable	2 KB	up to 30	2x 32-bit	1	1	1	2	6	8x10-bit	v	v	LQFP48
MINI51ZDE	4 KB	2 KB	Configurable	2 KB	up to 29	2x 32-bit	1	1	1	2	6	8x10-bit	v	v	QFN33 (5x5)
MINI51TDE	4 KB	2 KB	Configurable	2 KB	up to 29	2x 32-bit	1	1	1	2	6	8x10-bit	v	v	QFN33 (4x4)
MINI52FDE	8 KB	2 KB	Configurable	2 KB	up to 17	2x 32-bit	1	1	1	-	3	4x10-bit	v	v	TSSOP20
MINI52LDE	8 KB	2 KB	Configurable	2 KB	up to 30	2x 32-bit	1	1	1	2	6	8x10-bit	v	v	LQFP48
MINI52ZDE	8 KB	2 KB	Configurable	2 KB	up to 29	2x 32-bit	1	1	1	2	6	8x10-bit	v	v	QFN33 (5x5)
MINI52TDE	8 KB	2 KB	Configurable	2 KB	up to 29	2x 32-bit	1	1	1	2	6	8x10-bit	v	v	QFN33 (4x4)
MINI54FDE	16 KB	2 KB	Configurable	2 KB	up to 17	2x 32-bit	1	1	1	-	3	4x10-bit	v	v	TSSOP20
MINI54LDE	16 KB	2 KB	Configurable	2 KB	up to 30	2x 32-bit	1	1	1	2	6	8x10-bit	v	v	LQFP48
MINI54ZDE	16 KB	2 KB	Configurable	2 KB	up to 29	2x 32-bit	1	1	1	2	6	8x10-bit	v	v	QFN33 (5x5)
MINI54TDE	16 KB	2 KB	Configurable	2 KB	up to 29	2x 32-bit	1	1	1	2	6	8x10-bit	v	v	QFN33 (4x4)
*MINI54FHC	16 KB	2 KB	Configurable	2 KB	up to 17	2x 32-bit	1	1	1	-	6	3x10-bit	v	v	TSSOP20

Table 3.2-1NuMicro Mini51™ Series Product Selection Guide

* Mini54FHC is a special part number, not pin to pin compatible to others Mini51series part number.



3.3 PIN CONFIGURATION

3.3.1 LQFP 48-pin

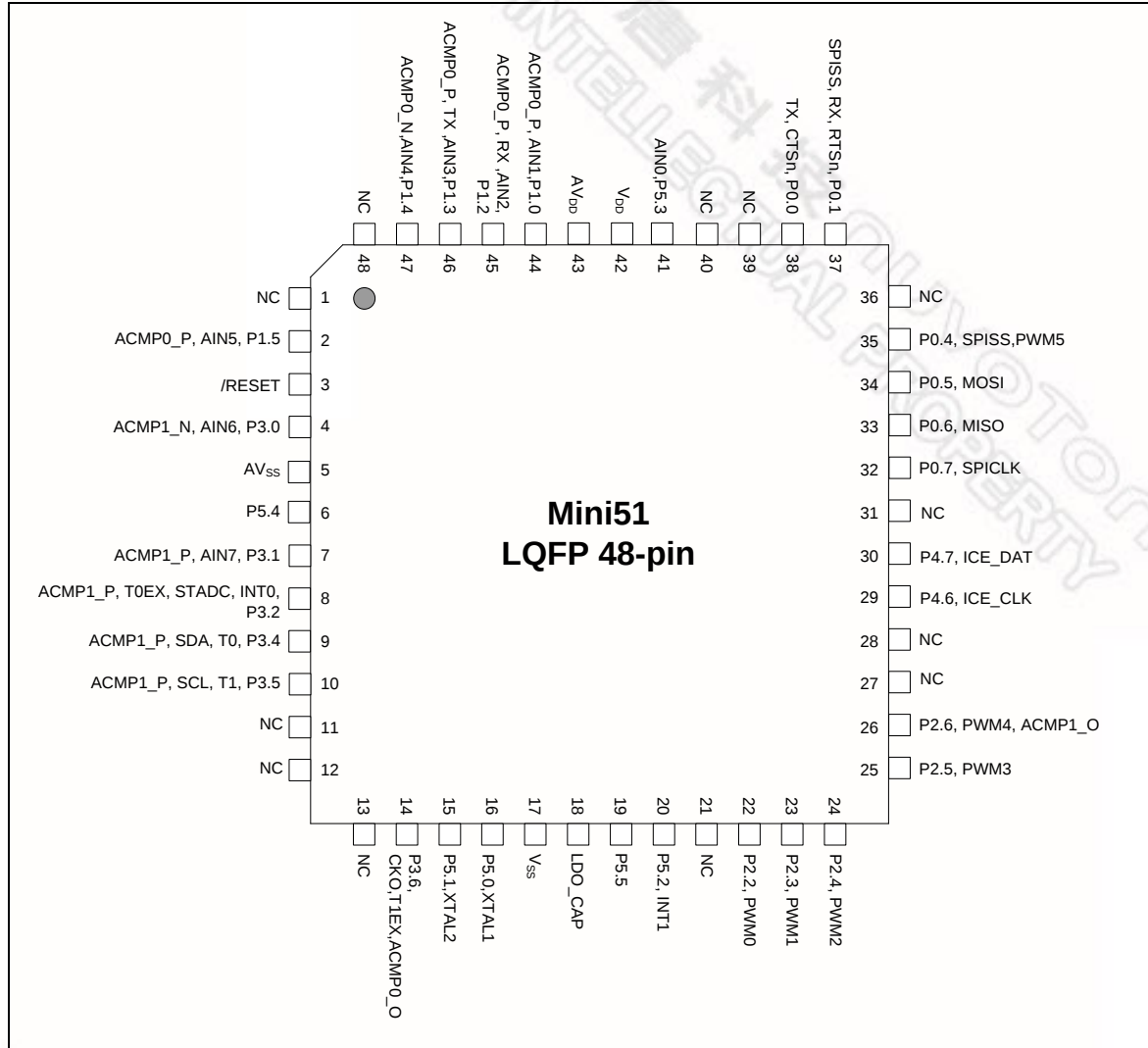


Figure 3.3-1 NuMicro Mini51™ Series LQFP 48-pin Diagram

3.3.2 QFN 33-pin

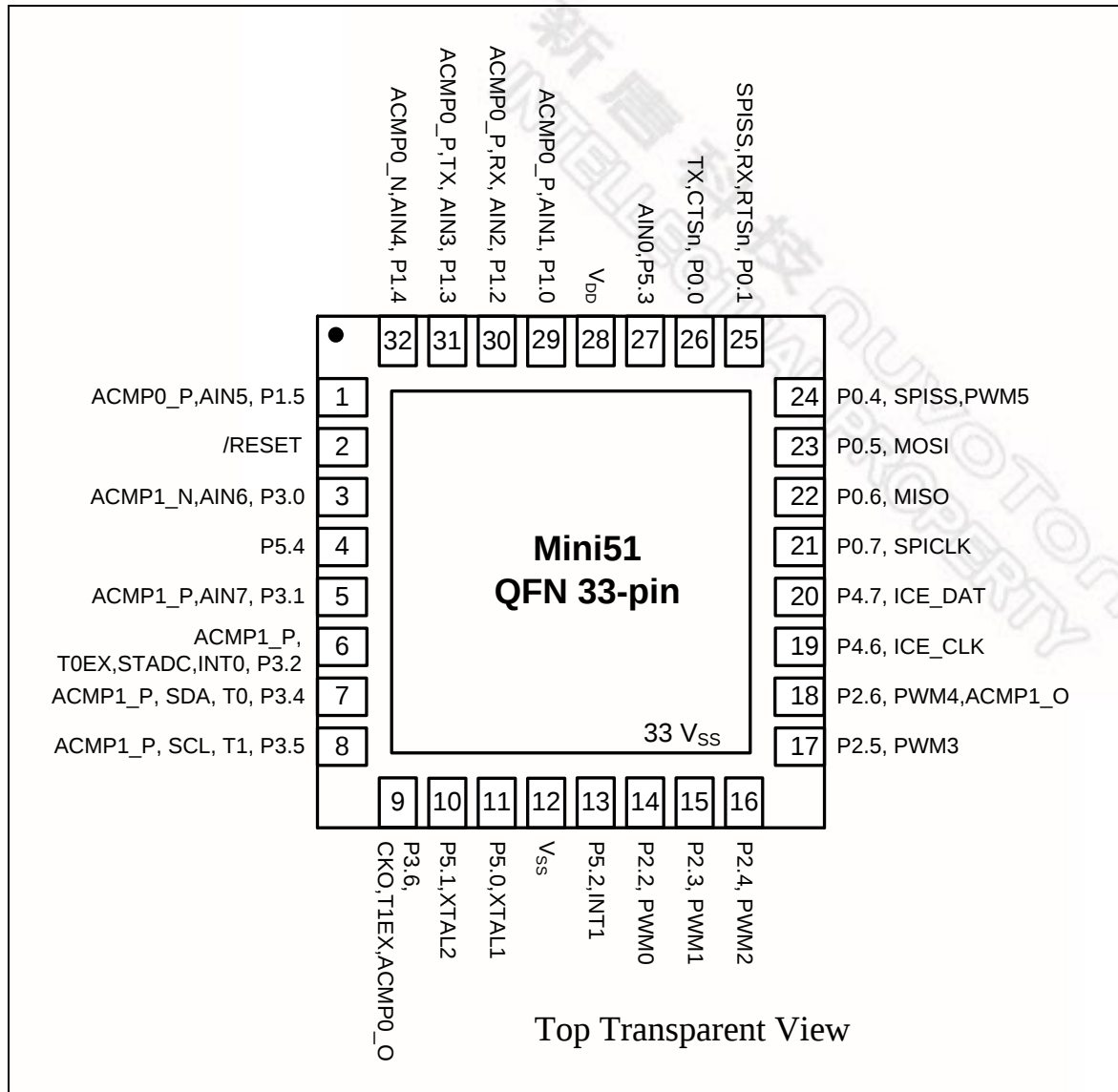


Figure 3.3-2 NuMicro Mini51™ Series QFN 33-pin Diagram

3.3.3 TSSOP 20-pin

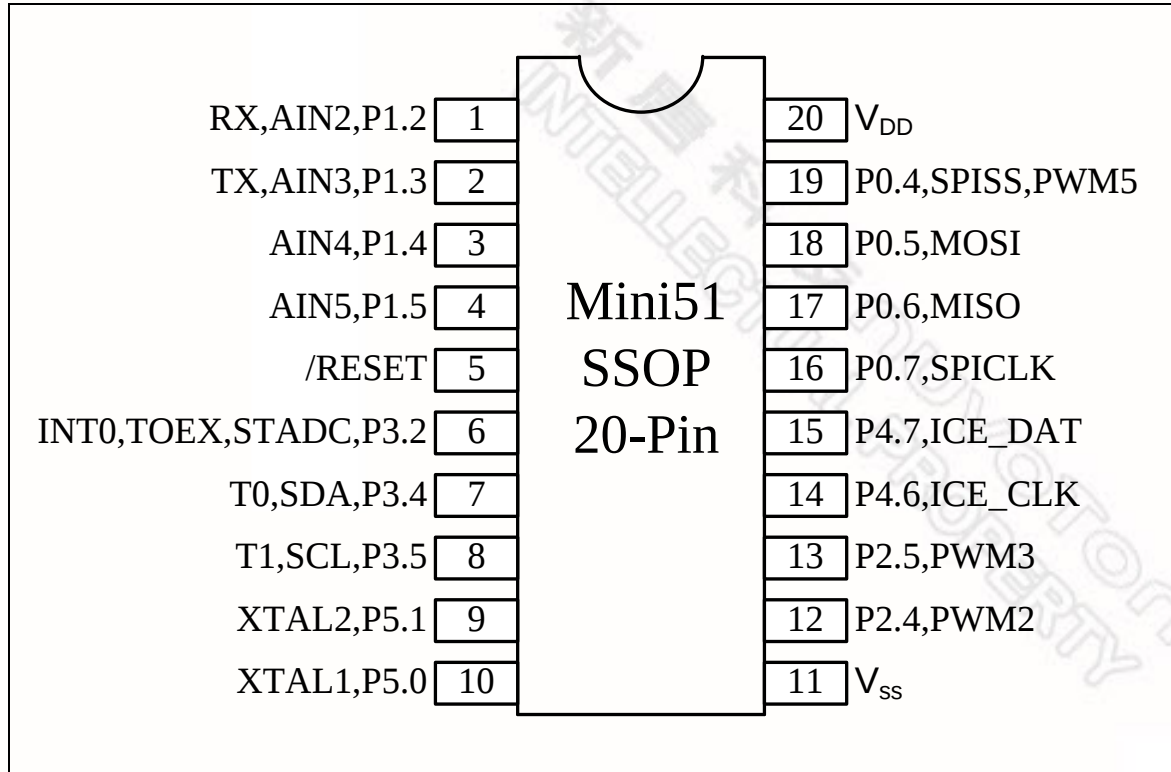


Figure 3.3-3 NuMicro Mini51™ Series TSSOP 20-pin Diagram

3.3.4 Mini54FHC (TSSOP20-pin)

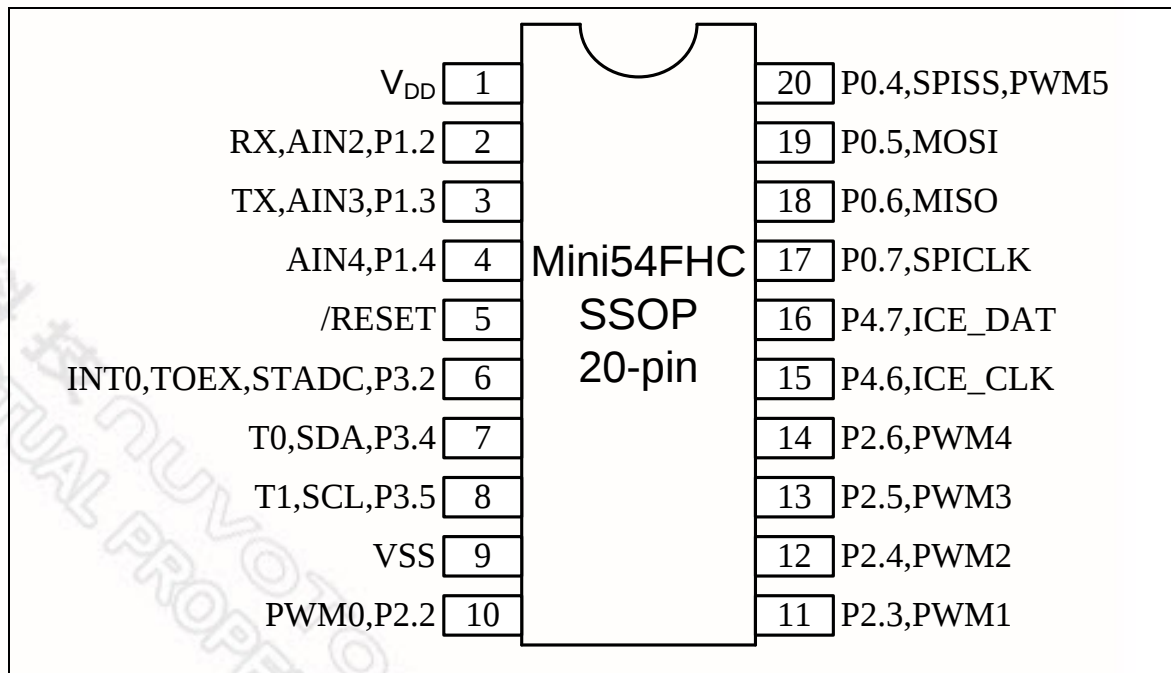


Figure 3.3-4 NuMicro Mini51™ Series TSSOP 20-pin Diagram

4 BLOCK DIAGRAM

4.1 NuMicro Mini51™ Block Diagram

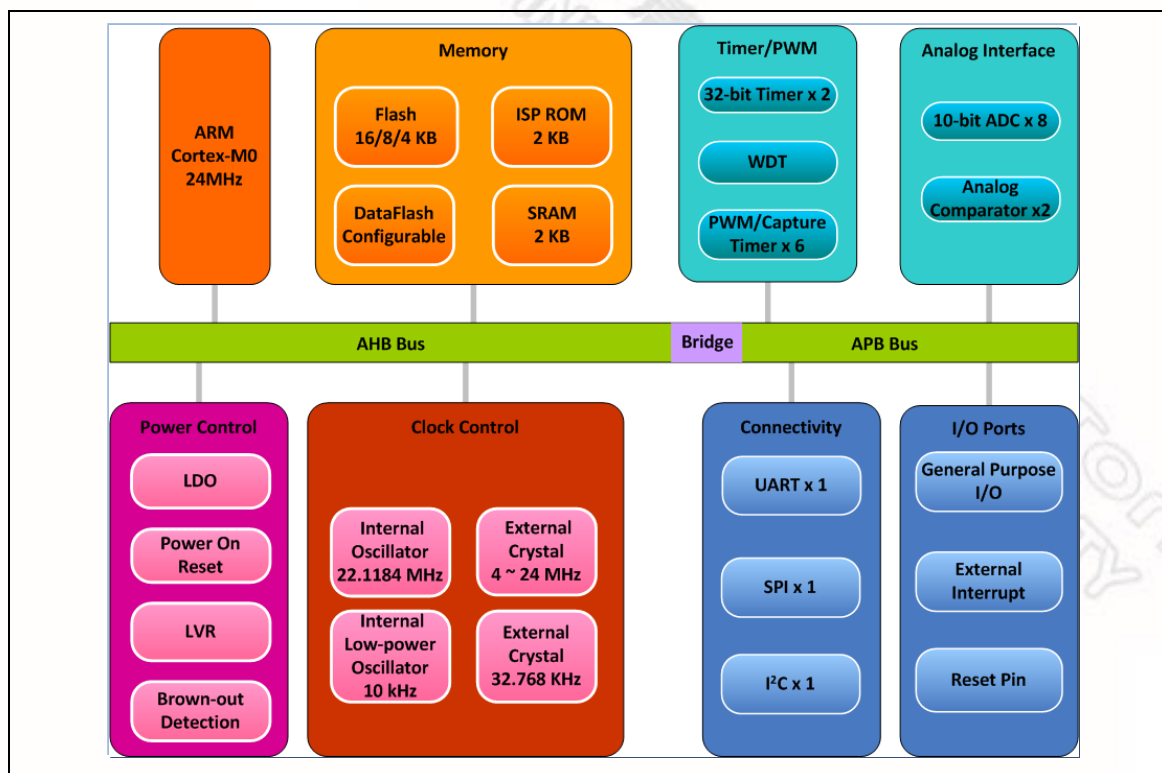
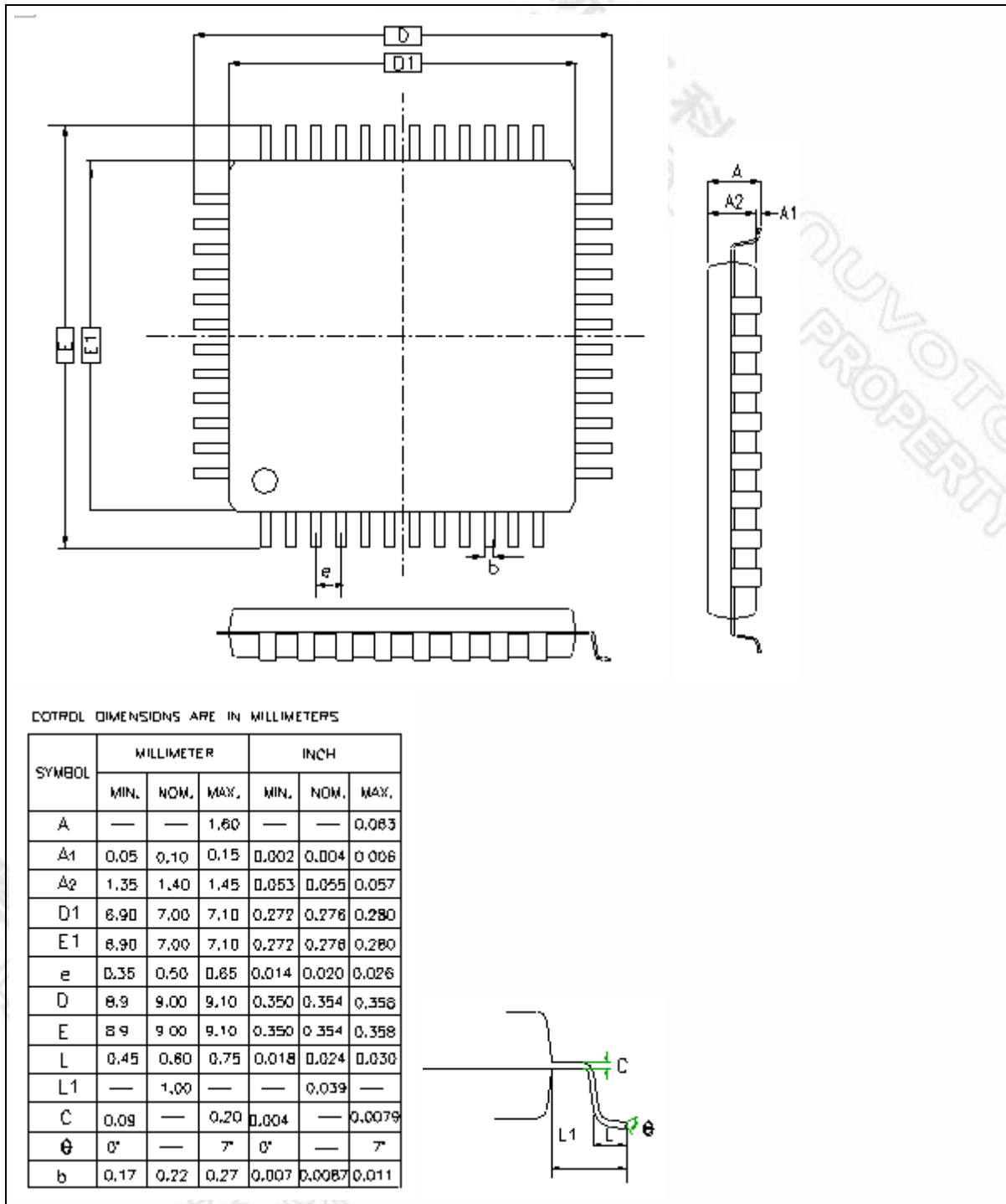


Figure 4.1-1 NuMicro Mini51™ Series Block Diagram



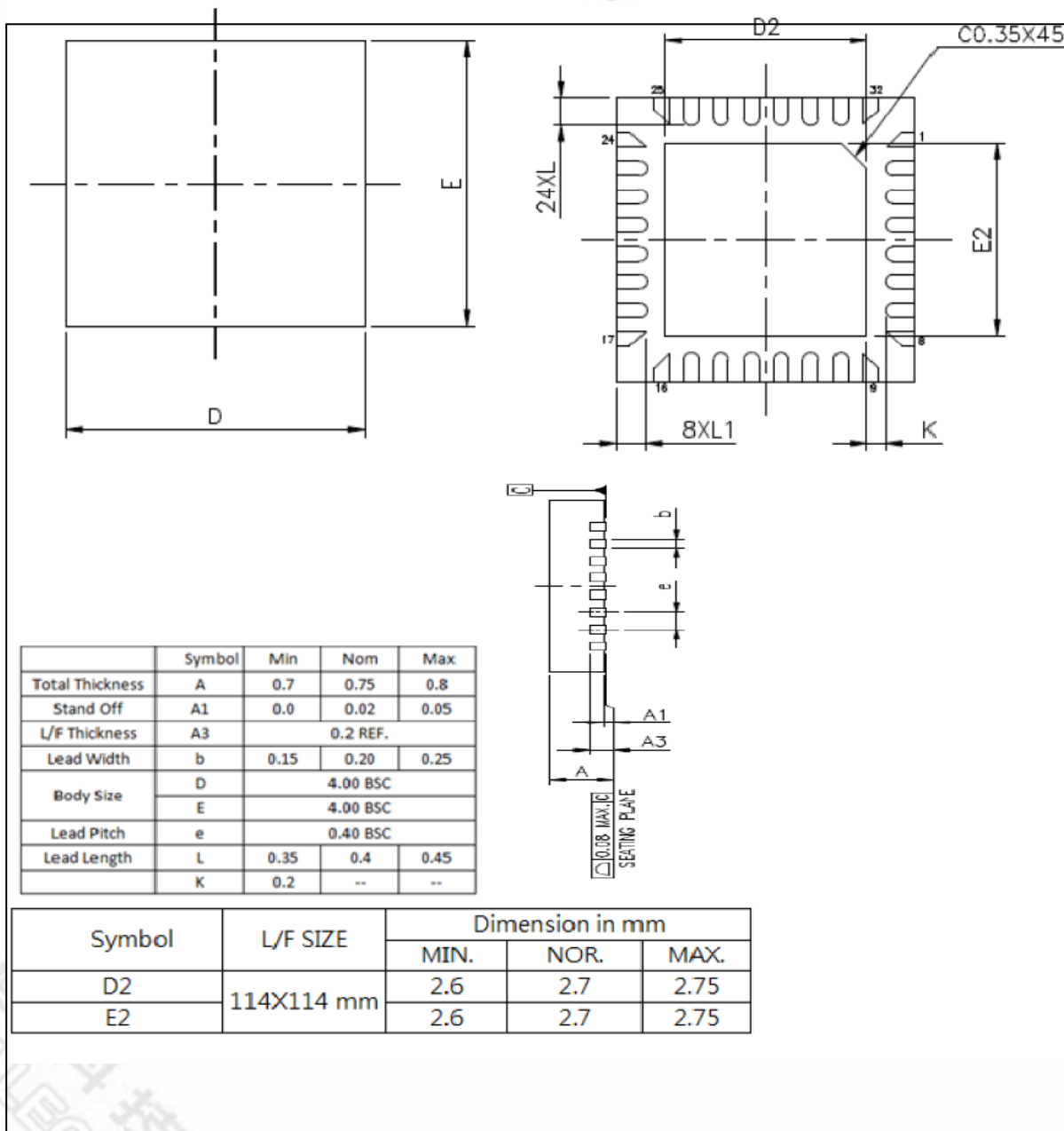
5 PACKAGE DIMENSIONS

5.1 48-pin LQFP



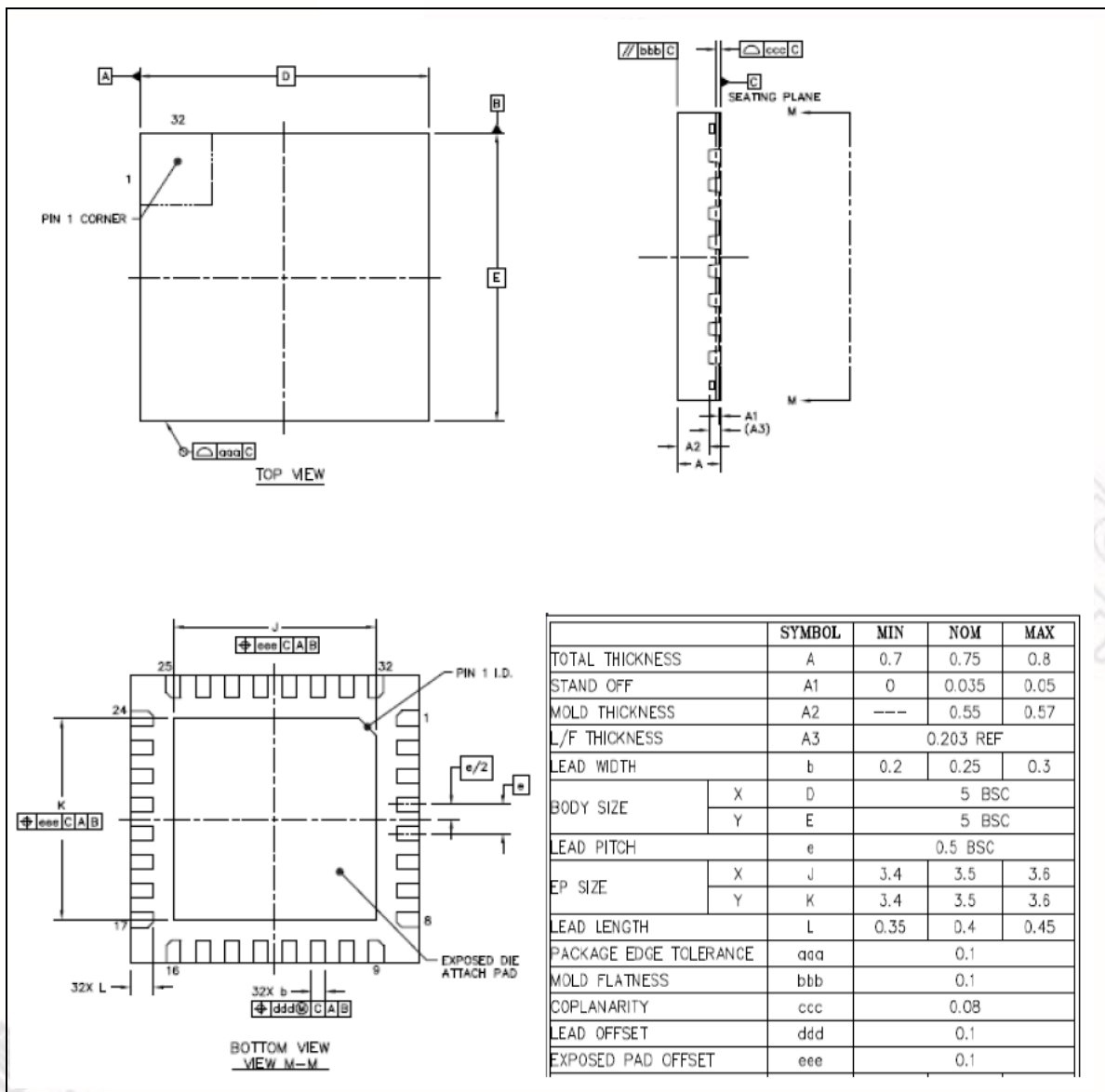


5.2 33-pin QFN (4 mm x 4 mm)



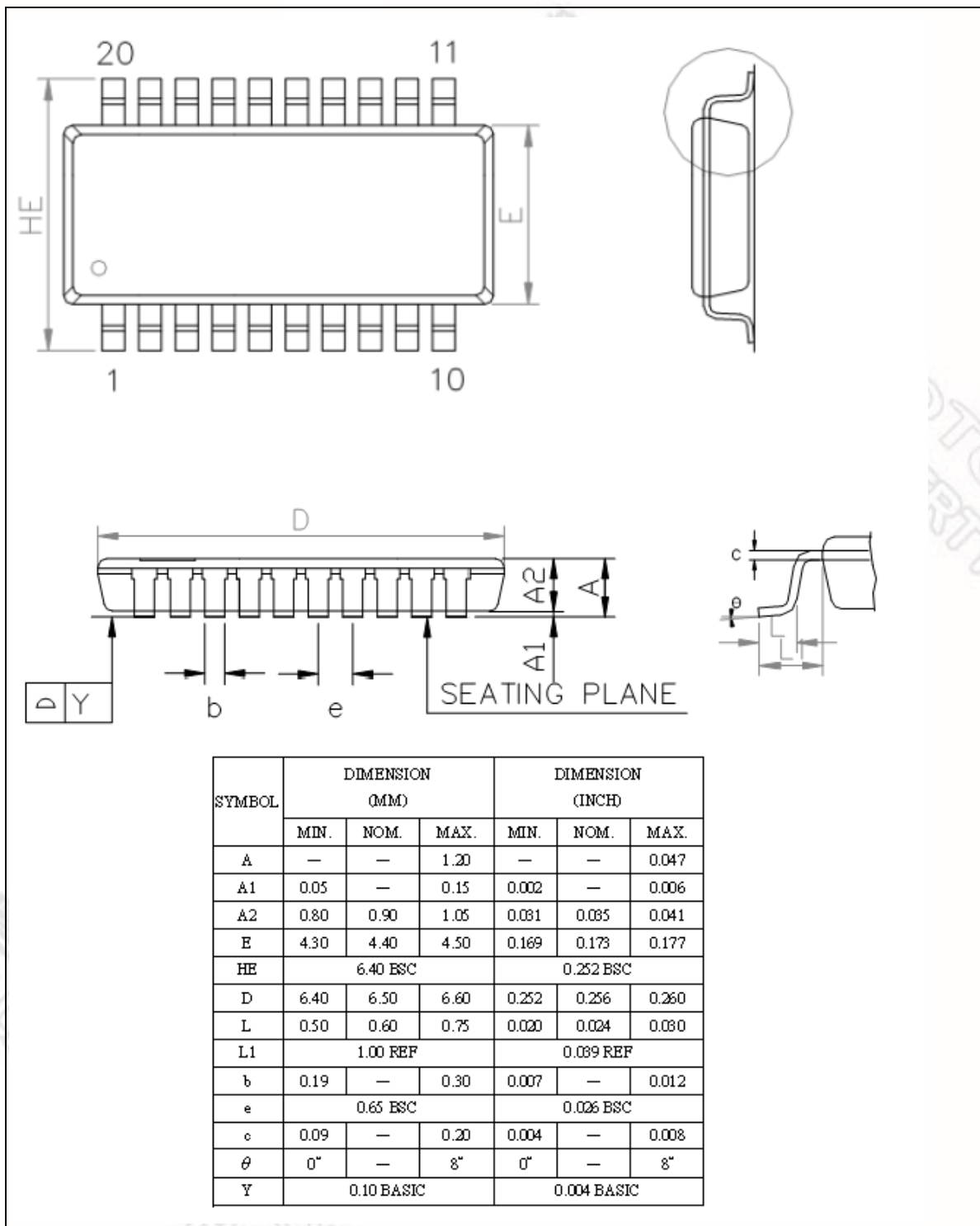


5.3 33-pin QFN (5 mm x 5 mm)





5.4 20-pin TSSOP





6 REVISION HISTORY

Revision	Date	Description
1.00	Oct. 18, 2013	Preliminary version
1.01	May 20, 2014	Supported the Mini54FHC for NuMicro Mini51 series.

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