NT68P81

USB Keyboard Micro-Controller

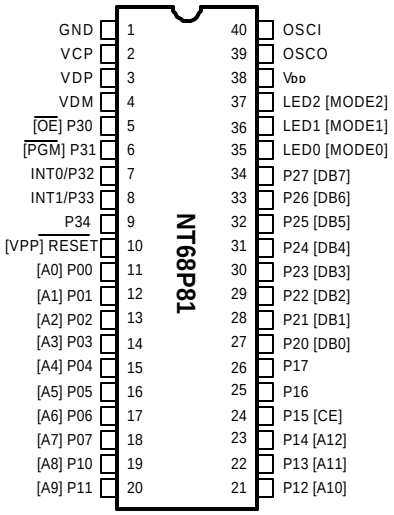
Features

- Built-in 6502C 8-bit CPU
- 3 MHz CPU operation frequency when oscillator is running at 6 MHz
- 6K bytes of OTP (one time programming) ROM
- 256 bytes of SRAM
- One 8-bit programmable base timer with pre-divider circuit
- 29 programmable bi-directional I/O pins including two external interrupts
- 3 LED direct sink pins with internal serial resistors
- On-chip oscillator (Crystal or Ceramic Resonator)
- Watch-dog timer reset
- Built-in power-on reset
- USB interface
- 3 supported endpoints
- Remote wakeup provided
- CMOS technology for low power consumption
- 40-pin DIP package, 42-pad Dice form and COB

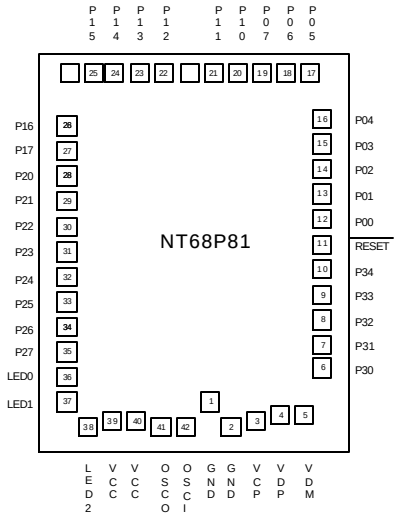
General Description

The NT68P81 is a single chip micro-controller for USB keyboard applications. It incorporates a 6502C 8-bit CPU core, 6K bytes of OTP ROM, and 256 bytes of RAM used as working RAM and stack area. It also includes 29 programmable bi-directional I/O pins with built-in resistors, and one 8-bit pre-loadable base timer. Additionally, it includes a built-in power-on reset, a built-in low voltage reset, an oscillator that requires crystal or ceramic resonator applied, and a watch-dog timer that prevents system standstill.

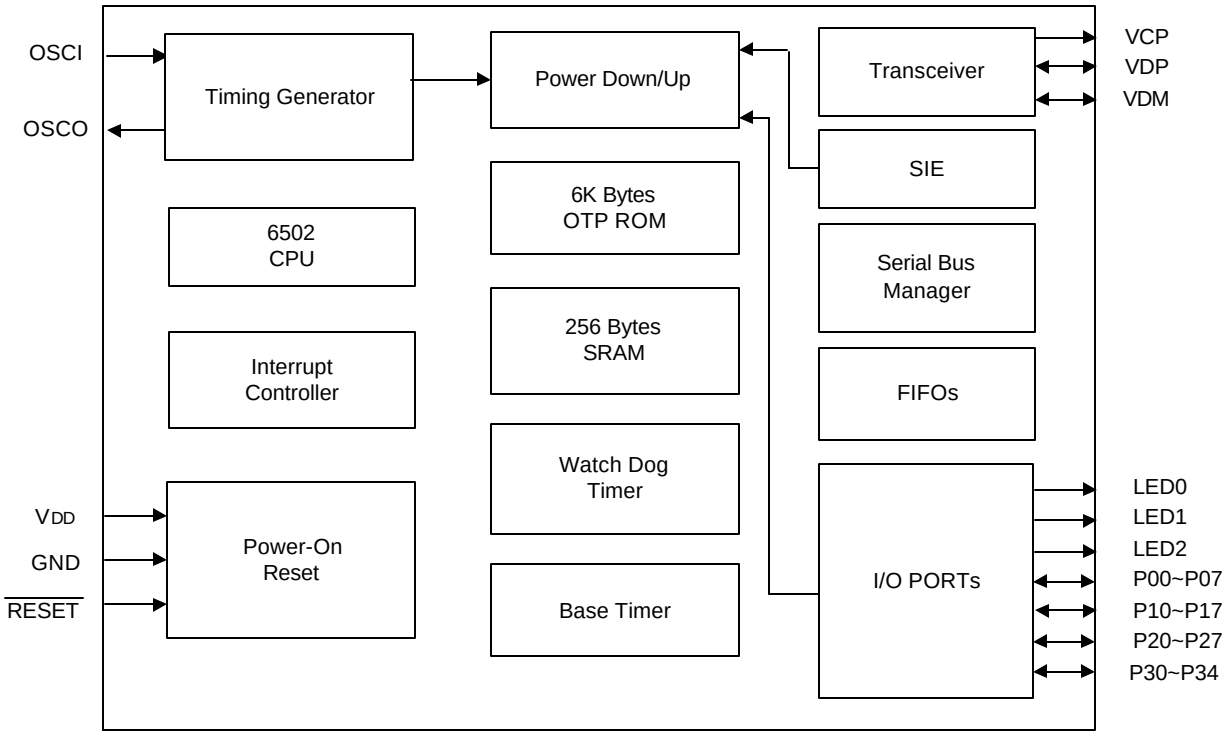
Pin Configuration



Pad Configuration



Block Diagram



Pin and Pad Descriptions

Pin No.	Pad No.	Designation	I/O	Shared with OTP[I/O]	Description
1	1,2	GND	P		Ground
2	3	VCP	O		USB 3.3V driver
3	4	VDP	I/O		USB data plus
4	5	VDM	I/O		USB data minus
5	6	P30	I/O		Bi-directional I/O pin
				$\overline{OE}$ [I]	Program output enable
6	7	P31	I/O		Bi-directional I/O pin
				$\overline{PGM}$ [I]	Program control
7	8	P32/INT0	I/O		Bi-directional I/O shared with INT0
8	9	P33/INT1	I/O		Bi-directional I/O shared with INT1
9	10	P34	I/O		Bi-directional I/O pin
10	11	$\overline{RESET}$	I		Internally pulled down resistor
				VPP [P]	Program supply voltage
11 ~ 18	12 ~ 19	P00 ~ P07	I/O		Bi-directional I/O pin
				A0 ~ A7 [I]	Program address buffer
19 ~ 23	20 ~ 24	P10 ~ P14	I/O		Bi-directional I/O pin
				A8 ~ A12	Program address buffer
24	25	P15	I/O		Bi-directional I/O pin
				CE [I]	Program chip enable
25	26	P16	I/O		Bi-directional I/O pin
				VPIH[I]	OTP Program Input Voltage High
26	27	P17	I/O		Bi-directional I/O pin
27 ~ 34	28 ~ 35	P20 ~ P27	I/O		Bi-directional I/O pin
				DB0 ~ DB7 [I/O]	Program data buffer
35	36	LED0	O		LED direct sink
				MODE0 [I]	Mode selection
36	37	LED1	O		LED direct sink
				MODE1 [I]	Mode selection
37	38	LED2	O		LED direct sink
				MODE2 [I]	Mode selection
38	39,40	V_{DD}	P		Power supply (+5V)
39	41	OSCO	O		Crystal oscillator output
				CLK[I]	Program Clock

40	42	OSCI	I		Crystal oscillator input
				VPIL[I]	OTP Program Input Voltage Low

* [ ]: OTP Mode

Functional Description

1. 6502C CPU

The 6502C is an 8-bit CPU that provides 56 instructions, decimal and binary arithmetic, thirteen addressing modes, true indexing capability, programmable stack pointer and variable length stack, a wide selection of addressable memory range, and an interrupt input. Other features are also included.
The CPU clock cycle is 3MHz (6MHz system clock divided by 2). Please refer to 6502 data sheet for more detailed information.

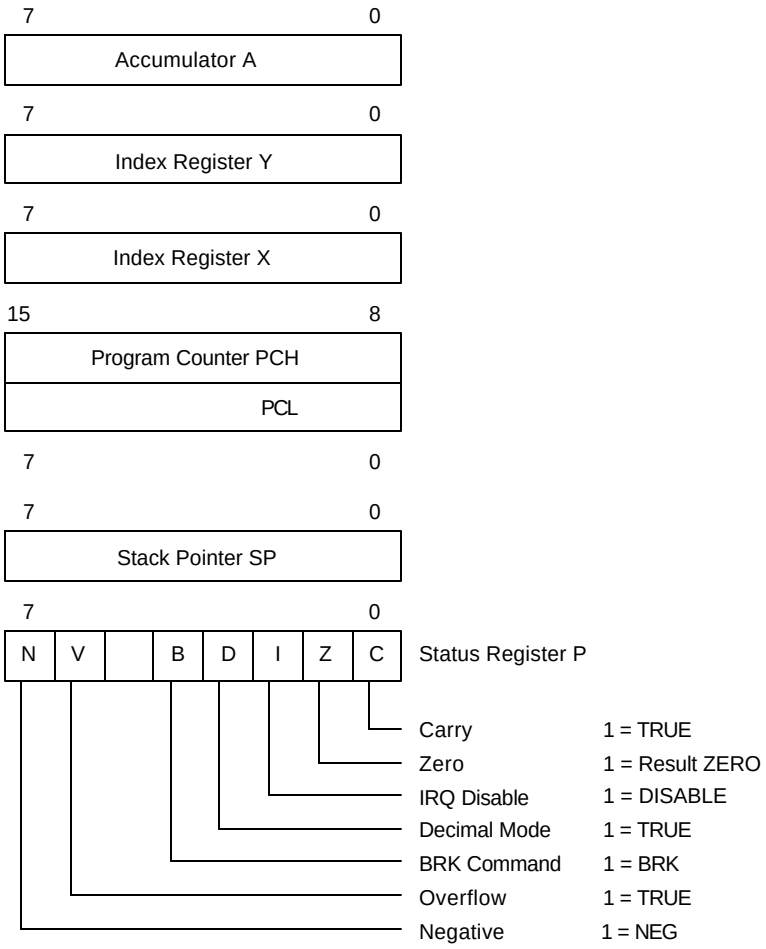


Figure 1. 6502 CPU Registers and Status Flags

2.Instruction Set List

Instruction Code	Meaning	Operation
ADC	Add with carry	A + M + C → A, C
AND	Logical AND	A · M → A
ASL	Shift left one bit	C ← M7 · · · M0 ← 0
BCC	Branch if carry clear	Branch on C=0
BCS	Branch if carry set	Branch on C=1
BEQ	Branch if equal to zero	Branch on Z=1
BIT	Bit test	A · M, M7 → N, M6 → V
BMI	Branch if minus	Branch on N=1
BNE	Branch if not equal to zero	Branch on Z=0
BPL	Branch if plus	Branch on N=0
BRK	Break	Forced interrupt PC + 2↓ PC↓
BVC	Branch if overflow clear	Branch on V=0
BVS	Branch if overflow set	Branch on V=1
CLC	Clear carry	0 → C
CLD	Clear decimal mode	0 → D
CLI	Clear interrupt disable bit	0 → I
CLV	Clear overflow	0 → V
CMP	Compare accumulator to memory	A − M
CPX	Compare with index register X	X − M
CPY	Compare with index register Y	Y − M
DEC	Decrement memory by one	M − 1 → M
DEX	Decrement index X by one	X − 1 → X
DEY	Decrement index Y by one	Y − 1 → Y
EOR	Logical exclusive-OR	A ⊕ M→A
INC	Increment memory by one	M + 1 → M
INX	Increment index X by one	X + 1 → X
INY	Increment index Y by one	Y + 1 → Y
JMP	Jump to new location	(PC + 1) → PCL, (PC + 2) → PCH
JSR	Jump to subroutine	PC + 2↓, (PC + 1) → PCL, (PC + 2) → PCH

Instruction Set List (contiuned)

Instruction Code	Meaning	Operation
LDA	Load accumulator with memory	M → A
LDX	Load index register X with memory	M → X
LDY	Load index register Y with memory	M → Y
LSR	Shift right one bit	0 → M7・・・M0 → C
NOP	No operation	No operation (2 cycles)
ORA	Logical OR	A + M → A
PHA	Push accumulator on stack	A ↓
PHP	Push status register on stack	P ↓
PLA	Pull accumulator from stack	A ↑
PLP	Pull status register from stack	P ↑
ROL	Rotate left through carry	C ← M7・・・M0 ← C
ROR	Rotate right through carry	C → M7・・・M0 → C
RTI	Return from interrupt	P ↑, PC ↑
RTS	Return from subroutine	PC ↑, PC+1 → PC
SBC	Subtract with borrow	A − M − C → A, C
SEC	Set carry	1 → C
SED	Set decimal mode	1 → D
SEI	Set interrupt disable status	1 → I
STA	Store accumulator in memory	A → M
STX	Store index register X in memory	X → M
STY	Store index register Y in memory	Y → M
TAX	Transfer accumulator to index X	A → X
TAY	Transfer accumulator to index Y	A → Y
TSX	Transfer stack pointer to index X	S → X
TXA	Transfer index X to accumulator	X → A
TXS	Transfer index X to stack pointer	X → S
TYA	Transfer index Y to accumulator	Y → A

*For more detailed specifications, please refer to 6502 programming data book.

3. OTP ROM: 6K X 8 bits

The built-in OTP ROM program code, executed by the 6502 CPU, has a capacity of 6K x 8-bit and is addressed from E800H to FFFFH. It can be programmed by the universal EPROM writer through a conversion adapter and programming configuration such as INTEL - 27C64. In the OPERATING mode, the OTP ROM is integrated with the system and it cannot be directly accessed. When the user wants to work with the OTP ROM alone, the user must first enter the PROGRAMMING mode by setting: PIN < $\overline{\text{RESET}}$ = VPP>. At this time, through multiplex pins, we can use familiar procedures to program and verify the OTP ROM block with the universal programmer.

OTP ROM Mega Cell D.C. Electrical Characteristics (READ Mode)

(V_{DD} = 5V, T_A = 25℃, unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
V_{IH}	Input Voltage	V_{DD} - 0.3		V_{DD} + 0.3	V		1
V_{IL}		-0.3		0.3	V		1
I_{IL}	Input Current			+/-10	µA		
I_{OH}	Output Voltage	-400			µA	V_{DD} = 5V, V_{OH} = 4.5V	
I_{OL}		1			mA	V_{DD} = 5V, V_{OL} = 0.5V	
I_{DD}	Operating Current			1	mA	F = 3MHz	2
I_{STB1}	Standby Current			100	µA		3

Note: 1. All inputs and outputs are CMOS compatible
2. F = 3MHz, I_{out} = 0mA, CE = V_{IH}. V_{DD} = 5V
3. CE = V_{IH}, $\overline{\text{OE}}$ = V_{IL}, V_{DD} = 5V

OTP ROM Mega Cell A.C. Electrical Characteristics (READ Mode)

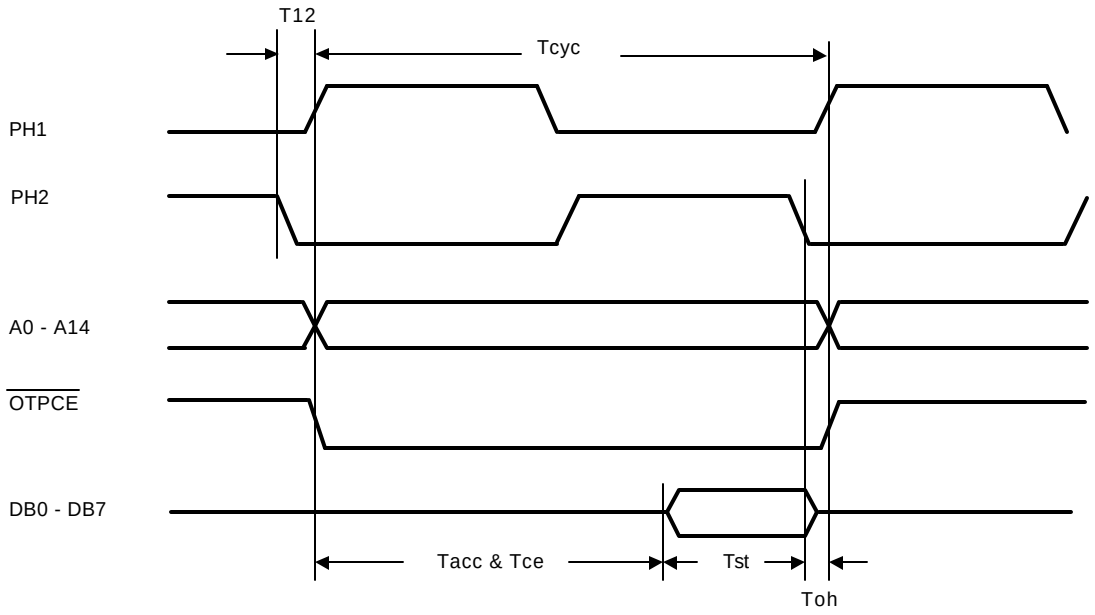
(V_{DD} = 5V, T_A = 25℃, unless otherwise specified)

Symbol	Parameter	Min.	Max.	Unit	Conditions
T_{cyc}	Cycle Time	250		ns	4.5V < V_{DD} < 5.5V
T_{12}	Non-overlap Time to PH1 & PH2	5	65	ns	
T_{acc}	Address Access Time		145	ns	
T_{ce}	OTPCE to Output Valid		145	ns	
T_{st}	Output Data Setup Time	20		ns	
T_{oh}	Output Data Hold Time	0		ns	

OTP ROM Mega Cell A.C. Test Conditions

Output Load	1 CMOS Gate and CL = 10pF
Input Pulse Rise and Fall Times	10ns Max.
Input Pulse Levels	0V to 5V
Timing Measurement Reference Level	Inputs 0V and 5V Outputs 0.3V and 4.7V

OTP ROM Mega Cell Timing Waveforms (READ mode)



OTP ROM Mega Cell D.C. Electrical Characteristics (PROGRAMMING Mode)

(V_{DD} = 5V, T_A = 25℃, unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
V_{DD}	Supply Voltage		6	6.5	V		4
VPP		10.5		12.75	V		
V_{IH}	Input Voltage	2		V_{DD} + 0.3	V		
V_{IL}		-0.3		0.6	V		
I_{IL}	Output Current			+/-10	μA		
I_{OH}	Output Current	-400			μA	V_{DD} = 5V, V_{OH} = 4.5V	
I_{OL}		1			mA	V_{DD} = 5V, V_{OL} = 0.5V	
I_{DD}	Operating Current			30	mA		
I_{PP}				20	mA	VPP = 12.75V	
CLK	Input Clock		53.203424		MHz		
VPIH	Input Voltage	2		V_{DD} + 0.3	V		
VPIL		-0.3		0.6	V		

Note: 4. For reliability concerns, we suggest V_{DD} = 6V & VPP = 12.75V for testing OTP ROM AC characteristics in PROGRAMMING mode, and the same condition is suggested for universal programmer supply voltage.

OTP ROM Mega Cell A.C. Electrical Characteristics (PROGRAMMING Mode)

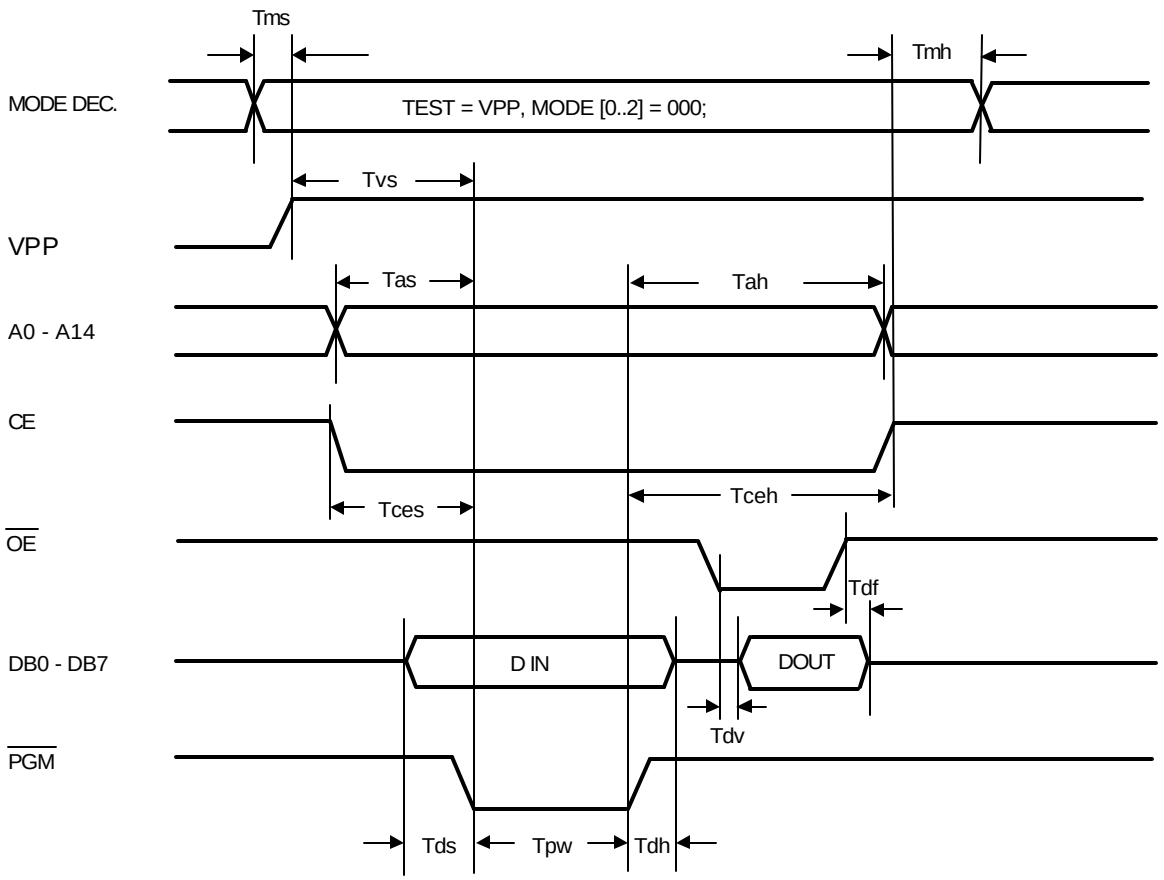
(T_A = 25°C, unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
T_{ms}	Mode Decode Setup Time	2			µs		
T_{mh}	Mode Decode Hold Time	2			µs		
T_{as}	Address Setup Time	2			µs		
T_{ah}	Address Hold Time	2			µs		
T_{ces}	CE Setup Time	2			µs		
T_{ceh}	CE Hold Time	2			µs		
T_{ds}	Date Setup Time	2			µs		
T_{dh}	Data Hold Time	2			µs		
T_{vs}	VPP Setup Time	2			µs		
T_{pw}	Program Pulse Width			100	µs		
T_{dv}	$\overline{OE}$ to Output Valid			150	ns		
T_{df}	$\overline{OE}$ to Output High-Z			90	ns	CE = V_{IL}	

OTP ROM Mega Cell A.C. Test Conditions

Output Load	1 TTL Gate and C L = 100pF
Input Pulse Rise and Fall Times	10ns max.
Input Pulse Levels	0.45V to 2.4V
Timing Measurement Reference Level	Inputs 0.8V and 2.2V Outputs 0.8V and 2.4V

OTP ROM Mega Cell Timing Waveform (Program)



Note: 5. V_{DD} must be applied simultaneously or before VPP and cut off simultaneously or after VPP.

6. Removing the device from the socket or setting the device in socket with VPP = 12.75V may cause permanent damage.

OTP ROM Mega Cell Mode Selection

$\overline{RESET}$ = 12.75V, VPIL = V_{IL}, VPIH = V_{IH}	Mode [0..2]	Mode	CE	$\overline{OE}$	VPP	DB0-DB7
not VPP	—	Normal Operating	—	—	—	—
VPP	000	Output Disable	—	V_{IH}	—	high-Z
VPP	000	Program	V_{IH}	V_{IH}	VPP	data in
VPP	000	Program Verify	V_{IH}	V_{IL}	—	data out
VPP	000	Program Inhibit (Standby)	V_{IL}	—	VPP	high-Z
VPP	001	Security (Program)	V_{IH}	—	VPP	data in
VPP	010	Word-line Stress	—	—	VPP	—
VPP	011	Bit-line Stress	—	—	VPP	"0"
VPP	100	OTP Row (after pkg)	V_{IH}	V_{IH}	VPP	data in
VPP	101	OTP Column (after pkg)	V_{IH}	V_{IH}	VPP	data in

*The security byte is at $0000 address.

READ MODE

The NT68P81's OTP ROM mega cell has 2 control pins. The CE (chip enable) controls the operation power and is used for device selection. The $\overline{OE}$ (output enable) controls the output buffers.

OUTPUT DISABLE MODE

If $\overline{OE}$ = V_{IH}, the outputs will be in a high impedance state. So two or more ROMs can be connected together on a common bus.

STANDBY MODE

By applying a low level to the chip is in standby mode, it will reduce the operating current to 100μA.

PROGRAM MODE

Initially, all bits are in "1" state which is an erased state. Thus the program operation is to introduce "0" data into the desired bit locations by electronic programming. When the VPP input is at 12.75V and CE is at V_{IH}, the chip is in the PROGRAMMING mode.

PROGRAM VERLFY MODE

The VERIFY mode will check to see that the desired data is correctly programmed on the programmed bit. The VERIFY is accomplished with CE at V_{IH}, VPP input is at 12.75V, and $\overline{OE}$ = V_{IL}.

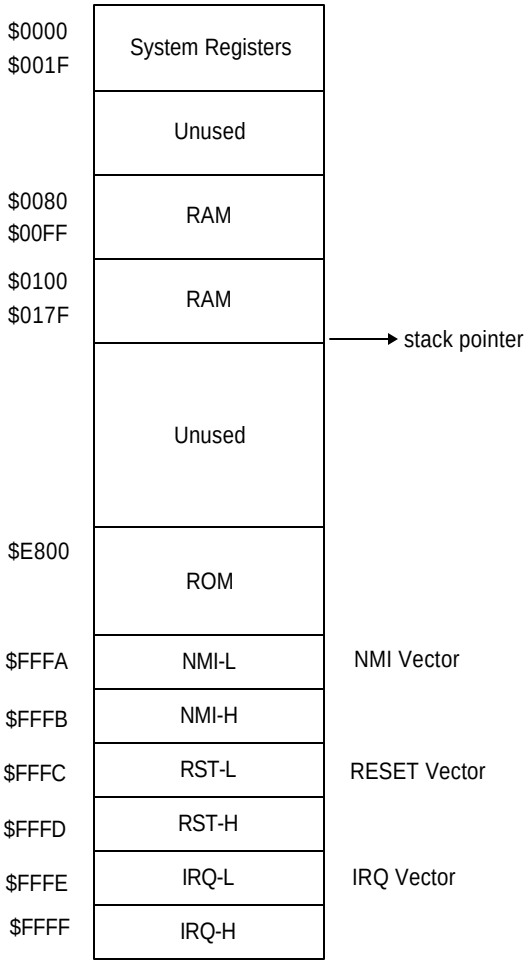
PROGRAM INHIBIT

Using this mode, programming of two or more OTP ROMs in parallel with different data is accomplished. All inputs except for CE and $\overline{OE}$ may be commonly connected. The TTL high level program pulse is only applied to the CE of the desired device and TTL high level signal is applied to the other devices.

4. SRAM: 256 X 8 bits

The built-in SRAM is used for general purpose data memory and for stack area. SRAM is addressed from 0080H to 017FH. Because the 6502C default stack pointer is 01FFH, the stack area will map $01FF-$0180 to $00FF-$0080, thus the programmer can set the "S" register to 7FH when starting program, allowing stack point to be 017FH.

```
as;   LDX    #$7F
      TXS
```



5. System Reserved Registers

Address	Register	Reset	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	R/W
$0000	IRQFUNC	00H	—	—	—	—	KBD	INT1	INT0	TMR	R
$0001	IRQCLRF	00H	—	—	—	—	CKBD	CINT1	CINT0	CTMR	W
$0002	IE_FUNC	00H	—	—	—	—	EKBD	EINT1	EINT0	ETMR	R/W
$0003	IRQUSB	00H	SUSP	STUP	—	—	IN2	IN1	OT0	IN0	R
$0004	IRQCLRU	00H	CSUSP	CSTUP	—	—	CIN2	CIN1	COT0	CIN0	W
$0005	IE_USB	00H	ESUSP	ESTUP	—	—	EIN2	EIN1	EOT0	EIN0	R/W
$0006	BT	00H	BT7	BT6	BT5	BT4	BT3	BT2	BT1	BT0	W
$0007	TCON	01H	—	—	—	—	—	—	—	$\overline{\text{ENBT}}$	W
$0008	TMOD	00H	—	—	—	—	—	TM2	TM1	TM0	R/W
$0009	PORT0	FFH	P07	P06	P05	P04	P03	P02	P01	P00	R/W
$000A	PORT1	FFH	P17	P16	P15	P14	P13	P12	P11	P10	R/W
$000B	PORT2	FFH	P27	P26	P25	P24	P23	P22	P21	P20	R/W
$000C	PORT3	1FH	—	—	—	P34	P33	P32	P31	P30	R/W
$000D	LED	07H	—	—	—	—	—	LED2	LED1	LED0	W
$000E	CLRWDT	00H	0	1	0	1	0	1	0	1	W
$000F	MODE_FG	02H	—	—	—	—	—	—	POF	SUSF	R/W

— : no effect

6. Power-on Reset

Built-in power-on reset circuit can generate a minimum of 5ms pulse to reset the entire chip. The user also can use an external $\overline{\text{RESET}}$ pin to reset the entire chip.

7. Timing Generator

This block generates the system timing and control signals supplied to the CPU and on-chip peripherals. The crystal oscillator generates a 6MHz system clock. It only generates 3MHz clock for CPU.

8. Base Timer (BT)

The Base Timer is an 8-bit counter with a programmable clock source selection. The BT can be enabled/disabled by the CPU. After reset, the BT is disabled and cleared. The BT can be preset by writing a preset value to BT7 ~ BT0 of the BT register at any time. When the BT is enabled, the BT starts counting from the preset value. When the value reaches FFH, it generates a timer interrupt if the timer interrupt is enabled. When it reaches the maximum value of FFH, the BT will wrap around and begin counting at 00H. The BT can be enabled by writing a "0" to "$\overline{\text{ENBT}}$" bit in the TCON (Timer Control) register. The $\overline{\text{ENBT}}$ signal is level trigger.

The input clock source of BT is controlled by the TMOD register. The following table shows 8 ranges of the BT.

TM2	TM1	TM0	Pre-scalar Ratio	Min. Count	Max. Count
0	0	0	System Clock/2^3	1.33 µs	341.33 µs
0	0	1	System Clock/2^4	2.66 µs	682.66 µs
0	1	0	System Clock/2^5	5.32 µs	1.36 ms
0	1	1	System Clock/2^6	10.64 µs	2.72 ms
1	0	0	System Clock/2^7	21.28 µs	5.44 ms
1	0	1	System Clock/2^8	42.56 µs	10.89 ms
1	1	0	System Clock/2^9	85.12 µs	21.79 ms
1	1	1	System Clock/2^{10}	170.24 µs	43.58 ms

For counting accuracy, please set the TMOD register first, then preset the BT register, and enable the base timer finally.
(TM2, TM1, TM0) = (1, 1, 1) is reserved for USB driver use.

9. Interrupt Controller

There are 10 interrupt sources: Timer, INT0, INT1, KBD, SUSP, IN0, IN1, IN2, OT0 and STUP.

9.1. Timer Interrupt

When the BASE TIMER overflows, it will set the TMR flag, If the interrupt is enabled by writing "1" to the bit 0 in IE_FUNC ($0002H), then it will interrupt 6502 CPU. The TMR flag can be read by the software. Once set by an interrupt source, it can read from bit0 in IRQFUNC ($0000H) and remains high unless cleared by writing "1" to the bit 0 in IRQCLRF ($0001H). All of register's data is cleared to "0" at initialization by the system reset. When an interrupt occurs, the CPU jumps to $FFFEH & $FFFFH to execute the interrupt service routine, thus the TMR flag must be cleared by the software.

9.2. INT0 Interrupt

As soon as INT0 pin detects a falling edge trigger, NT68P81 sets the INT0 flag ($0000H, bit1). After that, the 6502 CPU is interrupted if this interrupt has been already been enabled by writing "1" to EINT0 ($0002H, bit1). If the EINT0 flag is cleared, the 6502 CPU can' t be INT0 interrupted even if the INT0 flag is set. INT0 flag can be only be set by hardware and cannot be set or cleared directly by the software except for writing "1" to CINT0 ($0001H, bit1) flag to clear INT0 flag. When an interrupt occurs, the CPU will jump to $FFFEH & $FFFFH to execute the interrupt service routine so the INT0 flag must be cleared by software.

9.3. INT1 Interrupt

As soon as the INT1 pin detects a falling edge trigger, NT68P81 sets the INT1 flag ($0000H, bit2). Then the 6502 CPU is interrupted if the interrupt has already been enabled by writing "1" to EINT1 ($0002H, bit2). If EINT0 flag is cleared, the 6502 CPU can' t be INT1 interrupted even if INT1 flag is set. INT1 flag can only be set by the hardware and can not be set or cleared directly by the software except for writing "1" to CINT1 ($0001H, bit2) flag to clear INT1 flag.

When an interrupt occurs, CPU jumps to $FFFEH & $FFFFH to execute the interrupt service routine, the INT1 flag must be cleared by the software.

9.4. KBD Interrupt

This interrupt will set the KBD flag ($0000H, bit3) every 4ms(HID 1.00 version) to indicate that keyboard scan data is ready to send for endpoint1. Then the 6502 CPU is interrupted if this interrupt has been enabled already by writing "1" to EKBD ($0002H, bit3). If the EKBD flag is cleared, the 6502 CPU can' t be KBD interrupted even if the KBD flag is set. The KBD flag can only be set by the hardware and can not be set or cleared directly by the software except for writing "1" to CKBD ($0001H, bit 3) flag to clear KBD flag.

When an interrupt occurs, the CPU jumps to $FFFEH & $FFFFH to execute the interrupt service routine, the KBD flag must be cleared by the software.

9.5. IN0 Token Interrupt

When an IN TOKEN for endpoint 0 is done, it will set the IN0 flag. If this interrupt is enabled by writing "1" to EIN0 ($0005H, bit0), it will interrupt 6502 CPU.

When an interrupt occurs, the CPU jumps to $FFFEH & $FFFFH to execute the interrupt service routine, the IN0 flag must be cleared by the software.

9.6. OT0 (OUT 0) Token Interrupt

When an OUT TOKEN for endpoint 0 is done, it will set the OT0 flag. If this interrupt is enabled by writing "1" to EOT0 ($0005H, bit1), it will interrupt 6502 CPU.

When an interrupt occurs, the CPU jumps to $FFFEH & $FFFFH to execute the interrupt service routine, the OT0 flag must be cleared by the software.

9.7. IN1 Token Interrupt

When an IN TOKEN for endpoint 1 is done, it will set the IN1 flag. If this interrupt is enabled by writing "1" to EIN1 ($0005H, bit2), it will interrupt the 6502 CPU.

When an interrupt occurs, the CPU jumps to $FFFEH & $FFFFH to execute the interrupt service routine, the IN1 flag must be cleared by the software.

9.8. IN2 Token Interrupt

When an IN TOKEN for endpoint 2 is done, it will set the IN2 flag. If this interrupt is enabled by writing "1" to EIN2 ($0005H, bit3), it will interrupt 6502 CPU.

When an interrupt occurs, the CPU jumps to $FFFEH & $FFFFH to execute the interrupt service routine, the IN2 flag must be cleared by the software.

9.9. STUP (SETUP) Token Interrupt

When a SETUP TOKEN for endpoint 0 is done, it will set the STUP flag. If this interrupt is enabled by writing "1" to ESTUP ($0005H, bit6), it will interrupt 6502 CPU.

When an interrupt occurs, the CPU jumps to $FFFEH & $FFFFH to execute the interrupt service routine, the STUP flag must be cleared by the software.

9.10. SUSP Interrupt

When USB SIE detects a suspend signal, it sets the SUSP flag. Then the 6502 CPU is interrupted if the interrupt has already been enabled by writing "1" to ESUSP ($0005H, bit7). If ESUSP flag is cleared, 6502 CPU can't be SUSP interrupted even if SUSP flag is set. SUSP flag can be set by H/W only and can't be set/cleared directly by the software except for writing "1" to CSUSP ($0004H, bit 7) flag to clear SUSP flag.

When an interrupt occurs, the CPU jumps to $FFFEH & $FFFFH to execute the interrupt service routine, the SUSP flag must be cleared by the software.

10. I/O PORTs

The NT68P81 has 32 pins dedicated to input and output. These pins are grouped into 5 ports, as follows:

PORT0 (P00~P07)

PORT0 is an 8-bit bi-directional CMOS I/O port that is internally pulled high by PMOS. Each pin of PORT0 can be bit programmed as an input or output port under software control. When programmed as output, data is latched to the port data register and output to the pin. PORT0 pins with "1" written to them are pulled high by the internal PMOS pull-ups, and can be used as inputs in that state, then these input signals can be read. The port will output high after the reset.

PORT1 (P10~P17): Functions the same as PORT0.
PORT2 (P20~P27): Functions the same as PORT0.
PORT3 (P30~P34): Functions the same as PORT0. Except for P33/P32 is shared with INT1/INT0 pin. It is also a Schmitt Trigger input with an interrupt source of falling edge sensitive.

LED: There are three LED direct sink pins which require no external serial resistors.
The address is mapped to $000DH.

11. Watch-Dog Timer (WDT)

The NT68P81 has a watch-dog timer reset function that protects programs against system standstill. The clock of the WDT is derived from the crystal oscillator. The WDT interval is about 0.15 seconds when the operation frequency is 6MHz. The timer must be cleared every 0.15 second during normal operation; otherwise, it will overflow and cause a system reset (This cannot be disabled by the software). Before watch-dog reset occurs, the software will clear the watch-dog register by writing #55H to CLRWDT ($000EH) register.

For example:

```
LDA    #$55H
STA    $000E
```

12. Power Control

The power-off flag (POF) in the MODE_FG register indicates whether a reset is a warm start or a cold start reset. POF is set by hardware when an external power V_{cc} arises to its normal operating level, and must be cleared by the software in the cold reset initialization procedure. A warm start reset (POF = 0) occurs at a watch-dog reset or resume reset.

Address	Register	Reset	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	R/W
$000FH	MODE_FG	02H	-	-	-	-	-	-	POF	SUSF	R/W

13. Universal Serial Bus Interface

Please refer to the UNIVERSAL SERIAL BUS specification Version 1.0 Chapter 7, 8, and 9.

14. Suspend and Resume

Suspend:

When SIE receives the suspend signal, NT68P81 generates a SUSP interrupt request. In the SUSP interrupt service routine, the software will carry out the following steps:

1) Clear SUSP IRQ flag,
2) Store all the port status,
3) Force return lines (PORT2) pull-high,
4) Force scan lines (PORT0, PORT1 and P30, P31 or P32) pull-low,
5) Turn off LED output,
6) Clear watch-dog register

After the above action has been completed, the software will then set SUSLO ($1EH) to #55H and SUSHI ($1FH) to #AAH in order to enter the SUSPEND mode. The oscillator will stop for in order to save power.

Resume:

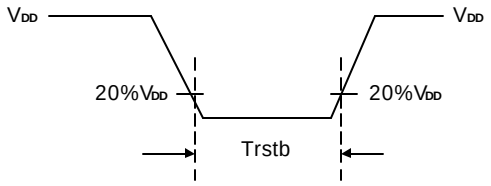
When the SIE detects a resume signal, the NT68P81 trigger oscillator to oscillate and resets whole chip. After a reset, software checks the status of POF bit in MODE_FG register to see whether a cold start reset or a warm start reset occurred. If cold reset, it executes all initial procedure. If warm reset, software checks the status of SUSF bit in MODE_FG register to see whether a watch-dog reset or resume reset. Under resume reset condition, programmer should restores all port status. After a warm start, user software should clear the SUSF bit. When any key stroked in suspend mode, it remotely resume NT68P81 functions. The action is same as host resume.

15. Reset Source Summary

These are 5 reset sources in NT68P81 as shown below.

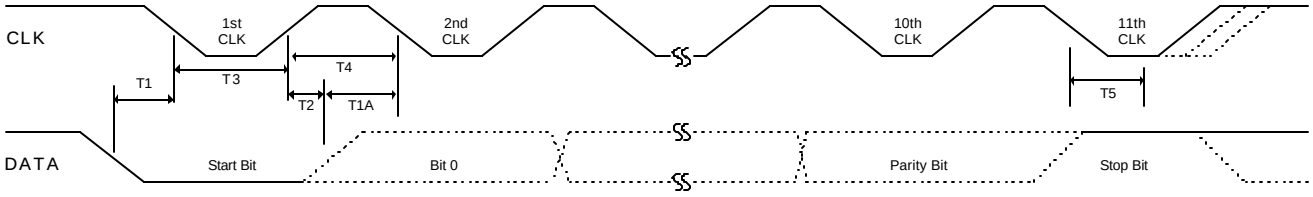
No.	Type	Function	Description
1	Cold	External Pin ($\overline{\text{RESET}}$)	Applied Externally
2	Cold	Power-on Reset	Reset after Power-on
3	Cold	USB Reset Signaling	10 ms Reset Period
4	Warm-1	Resume Reset	USB Reset Period
5	Warm-2	Watch-dog Reset	Reset every 0.15S (OSC = 6MHz)

NT68P81 can also be reset externally through the $\overline{\text{RESET}}$ pin. A reset is initialed when the signal at the $\overline{\text{RESET}}$ pin is held Low for at least 10 system clocks. When $\overline{\text{RESET}}$ signal goes high, the NT68P81 begins to work. The following shows the definition of $\overline{\text{RESET}}$ input low pulse width.



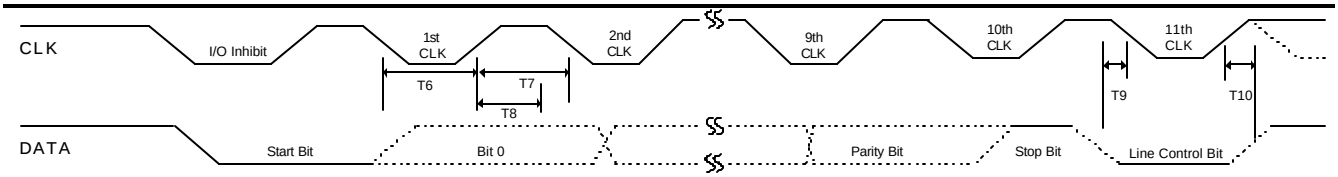
16. PS/2 Mouse Application

A PS/2 mouse interface is implemented in P32 (CLK), P33 (DATA) and P34 (Power Control). The timing diagrams are described as follows.



Auxiliary Device Sending Data Timings

Timing	Description	MIN/MAX
T1	Time from DATA transaction to falling edge of CLK 1	5/25*u* s
T1A	Time from DATA transaction to falling edge of CLK 2-11	5/25*u* s
T2	Time from rising edge of CLK to DATA transaction	5/T4-5*u* s
T3	Duration of CLK inactive (LOW)	30/50*u* s
T4	Duration of CLK active (HIGH)	30-50*u* s
T5	Time to Auxiliary Device inhibit after clock 11 to ensure the Auxiliary Device does not start another transmission	>0/50*u* s



Auxiliary Device Receiving Data Timings

Timing	Description	MIN/MAX
T6	Duration of CLK interface (LOW)	30/50*u* s
T7	Duration of CLK active (HIGH)	30/50*u* s
T8	Time from inactive to active CLK transition, used to time when the Auxiliary Device samples DATA	5/25*u* s
T9	Time from falling edge of line control bit to falling edge of clock 11 CLK	5*u* s/
T10	Time from rising edge of clock 11 to rising edge of line control bit	5/25*u* s

Absolute Maximum Rating*

DC Supply Voltage . . . . . -0.3V to +7.0V

Input/Output Voltage . . . . . .GND - 0.2V to V_{DD} + 0.2V

Operating Ambient Temperature . . . . . .0 °C to 70 °C

Storage Temperature . . . . . .-55 °C to +125 °C

Operating Voltage (V_{DD}) . . . . . .+4.4V to +5.25V

*Comments

Stresses above those listed under "Absolute Maximum Rating" may cause permanent damage to the device. These are stress ratings only. Functional operation of this device at these or any other conditions above those indicated in the operational sections of this specification is not implied and exposure to absolute maximum rating conditions for extended periods may affect device reliability.

DC Electrical characteristics (V_{DD} = 5V, GND = 0V, T_A = 25°C, F_{OSC} = 6MHz, unless otherwise noted)

Symbol	Parameters	Min.	Typ.	Max.	Unit	Conditions
V_{DD}	Operating Voltage	4.4	5	5.25	V	
I_{OP}	Operating Current			20	mA	No load
I_{SP}	Suspend Current			500	µA	
V_{IH}	Input High Voltage	2			V	
V_{IL}	Input Low Voltage			0.8	V	
V_{OH}	Output High Voltage	2.4			V	I_{OH} = -100µA
V_{OL1}	Output Low Voltage (P0/P1/P2)			0.4	V	I_{OL1} = 4mA
V_{OL2}	Output Low Voltage (P3)			0.4	V	I_{OL2} = 5mA
I_{LED}	LED Sink Current	6	10	14	mA	V_{OL} = 3.2V
V_{STIH}	Schmitt Trigger Input High Voltage		1.7	2	V	
V_{STIH}	Schmitt Trigger Input Low Voltage	0.8	1.1		V	

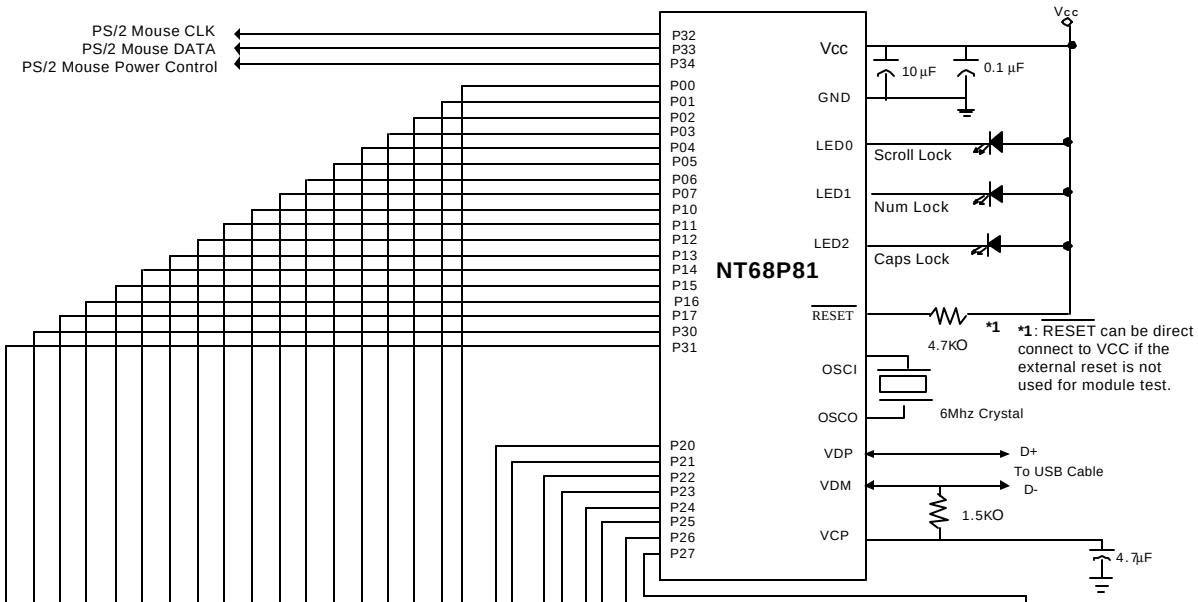
AC Electrical characteristics (V_{DD} = 5V, GND = 0V, T_A = 25°C, F_{OSC} = 6MHz, unless otherwise noted)

Symbol	Parameters	Min.	Typ.	Max.	Unit	Conditions
F_{OSC}	Oscillator Frequency	5.97	6	6.03	MHz	OSC within +/- 0.5%
T_{RSTB}	$\overline{\text{RESET}}$ Input Low Pulse Width	1.67			µs	10 system clocks
T_{POR}	Power-on Reset Time	5		30	ms	

USB DC/AC SPECIFICATIONS

Please refer to the UNIVERSAL SERIAL BUS specification Version 1.0 Chapter 7.

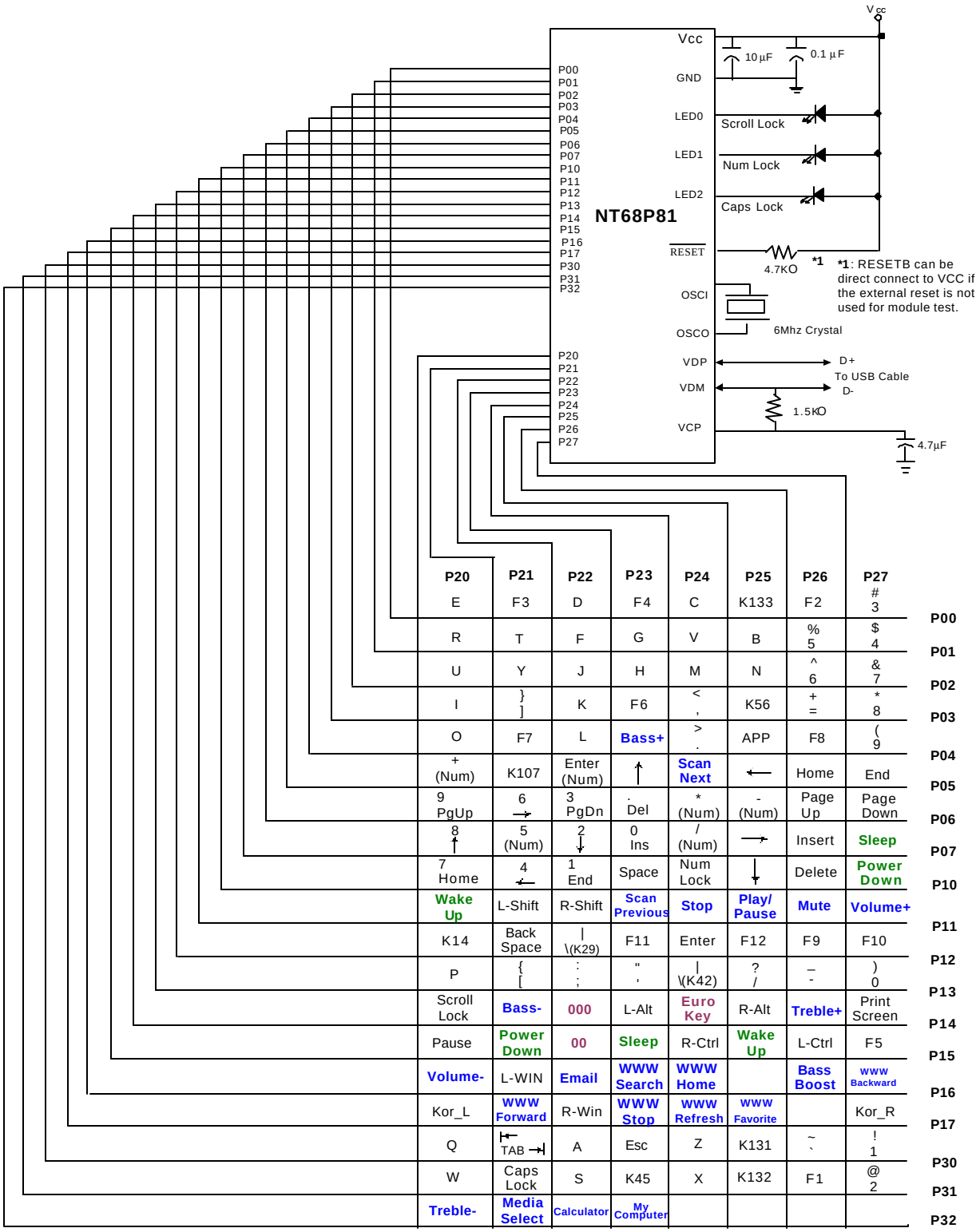
Application Circuit 1 (Simple Keyboard with PS/2 Mouse)



P20	P21	P22	P23	P24	P25	P26	P27	
E	F3	D	F4	C	K133	F2	# 3	
R	T	F	G	V	B	% 5	$ 4	P00
U	Y	J	H	M	N	^ 6	& 7	P01
I	}]	K	F6	< ,	K56	+ =	* 8	P02
O	F7	L		> .	APP	F8	(9	P03
+ (Num)	K107	Enter (Num)	↑		←	Home	End	P04
9 PgUp	6 →	3 PgDn	. Del	* (Num)	- (Num)	Page Up	Page Down	P05
8 ↑	5 (Num)	2 ↓	0 Ins	/ (Num)	→	Insert	Kor_R	P06
7 Home	4 ←	1 End	Space	Num Lock	↓	Delete	Kor_L	P07
	L-Shift	R-Shift						P10
K14	Back Space	| \(K29)	F11	Enter	F12	F9	F10	P11
P	{ [	: ;	" '	| \(K42)	? /	_ -	) 0	P12
Scroll Lock		000	L-Alt		R-Alt		Print Screen	P13
Pause		00		R-Ctrl		L-Ctrl	F5	P14
	L-WIN							P15
Kor_L		R-Win					Kor_R	P16
Q	TAB → |	A	Esc	Z	K131	~ `	! 1	P17
W	Caps Lock	S	K45	X	K132	F1	@ 2	P30
								P31

Notice: "Return Key" must be forced to PORT2 for remote wake up function. If not, remote wake up function will not work.

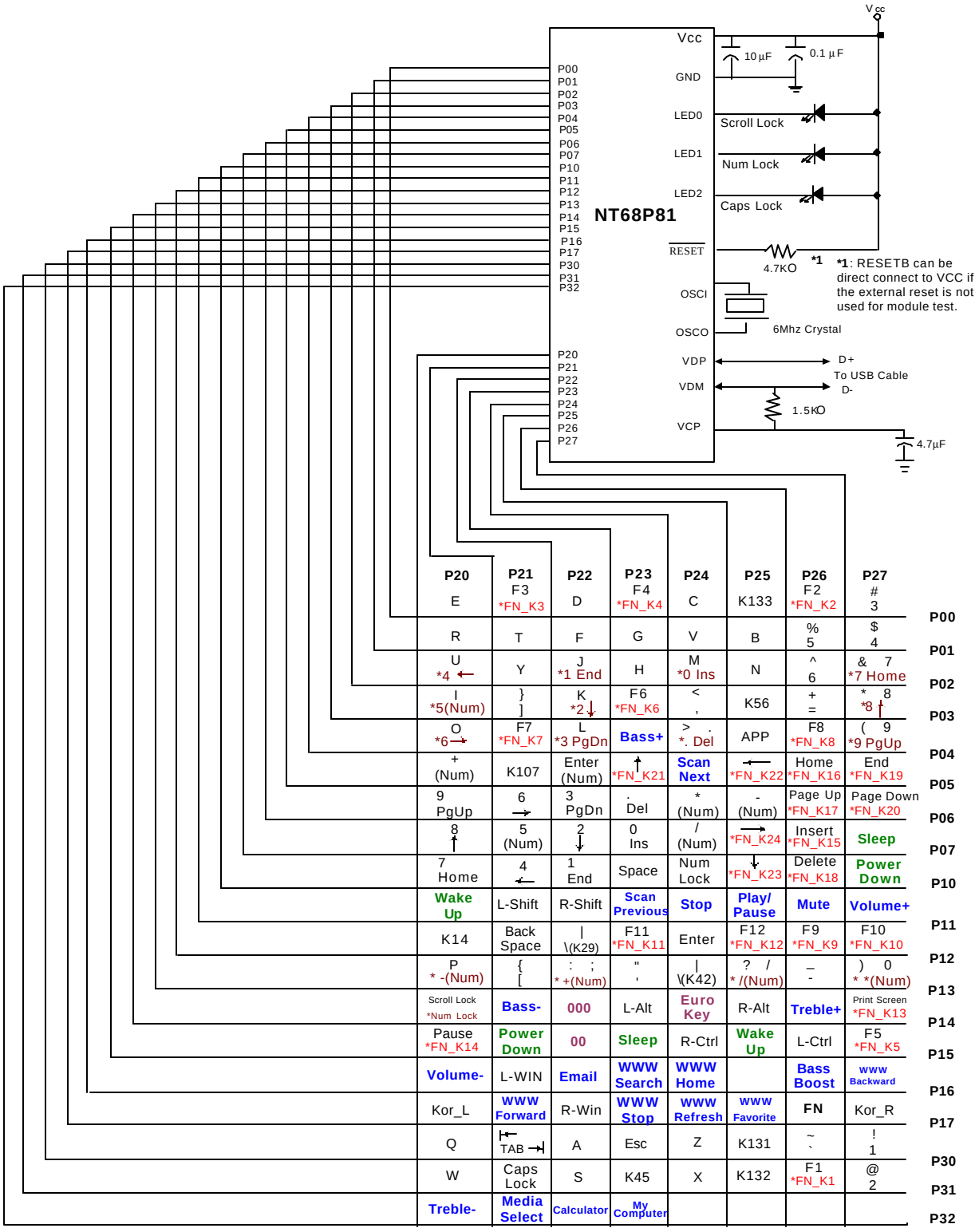
Application Circuit 2 (Windows 2000 Compatible Keyboard)



	P20	P21	P22	P23	P24	P25	P26	P27	
	E	F3	D	F4	C	K133	F2	# 3	
P00	R	T	F	G	V	B	% 5	$ 4	P00
P01	U	Y	J	H	M	N	^ 6	& 7	P01
P02	I	}]	K	F6	< ,	K56	+ =	* 8	P02
P03	O	F7	L	Bass+	> .	APP	F8	(9	P03
P04	+ (Num)	K107	Enter (Num)	↑	Scan Next	←	Home	End	P04
P05	9 PgUp	6 →	3 PgDn	. Del	* (Num)	- (Num)	Page Up	Page Down	P05
P06	8 ↑	5 (Num)	2 ↓	0 Ins	/ (Num)	→	Insert	Sleep	P06
P07	7 Home	4 ←	1 End	Space	Num Lock	↓	Delete	Power Down	P07
P10	Wake Up	L-Shift	R-Shift	Scan Previous	Stop	Play/ Pause	Mute	Volume+	P10
P11	K14	Back Space	| \(K29)	F11	Enter	F12	F9	F10	P11
P12	P	{ [	: ;	" '	| \(K42)	? /	_ -	) 0	P12
P13	Scroll Lock	Bass-	000	L-Alt	Euro Key	R-Alt	Treble+	Print Screen	P13
P14	Pause	Power Down	00	Sleep	R-Ctrl	Wake Up	L-Ctrl	F5	P14
P15	Volume-	L-WIN	Email	WWW Search	WWW Home		Bass Boost	WWW Backward	P15
P16	Kor_L	WWW Forward	R-Win	WWW Stop	WWW Refresh	WWW Favorite		Kor_R	P16
P17	Q	↹ TAB	A	Esc	Z	K131	~ `	! 1	P17
P30	W	Caps Lock	S	K45	X	K132	F1	@ 2	P30
P31	Treble-	Media Select	Calculator	My Computer					P31
P32									P32

Notice: “Return Key” must be forced to PORT2 for remote wake up function. If not, remote wake up function will not work.

Application Circuit 3 (Mini Keyboard)



P20	P21	P22	P23	P24	P25	P26	P27	
E	F3 *FN_K3	D	F4 *FN_K4	C	K133	F2 *FN_K2	# 3	P00
R	T	F	G	V	B	% 5	$ 4	P01
U *4 ←	Y	J *1 End	H	M *0 Ins	N	^ 6	& 7 *7 Home	P02
I *5(Num)	}]	K *2 ↓	F6 *FN_K6	< ,	K56	+ =	* 8 *8 ↑	P03
O *6 →	F7 *FN_K7	L *3 PgDn	Bass+	> . *. Del	APP	F8 *FN_K8	(9 *9 PgUp	P04
+ (Num)	K107	Enter (Num)	↑ *FN_K21	Scan Next	← *FN_K22	Home *FN_K16	End *FN_K19	P05
9 PgUp	6 →	3 PgDn	. Del	* (Num)	- (Num)	Page Up *FN_K17	Page Down *FN_K20	P06
8 ↑	5 (Num)	2 ↓	0 Ins	/ (Num)	→ *FN_K24	Insert *FN_K15	Sleep	P07
7 Home	4 ←	1 End	Space	Num Lock	↓ *FN_K23	Delete *FN_K18	Power Down	P10
Wake Up	L-Shift	R-Shift	Scan Previous	Stop	Play/ Pause	Mute	Volume+	P11
K14	Back Space	| \(K29)	F11 *FN_K11	Enter	F12 *FN_K12	F9 *FN_K9	F10 *FN_K10	P12
P * -(Num)	{ [	: ; * +(Num)	" '	| \(K42)	? / * /(Num)	_ -	) 0 * *(Num)	P13
Scroll Lock *Num Lock	Bass-	000	L-Alt	Euro Key	R-Alt	Treble+	Print Screen *FN_K13	P14
Pause *FN_K14	Power Down	00	Sleep	R-Ctrl	Wake Up	L-Ctrl	F5 *FN_K5	P15
Volume-	L-WIN	Email	WWW Search	WWW Home		Bass Boost	www Backward	P16
Kor_L	WWW Forward	R-Win	WWW Stop	WWW Refresh	www Favorite	FN	Kor_R	P17
Q	TAB →	A	Esc	Z	K131	~ `	! 1	P30
W	Caps Lock	S	K45	X	K132	F1 *FN_K1	@ 2	P31
Treble-	Media Select	Calculator	My Computer					P32

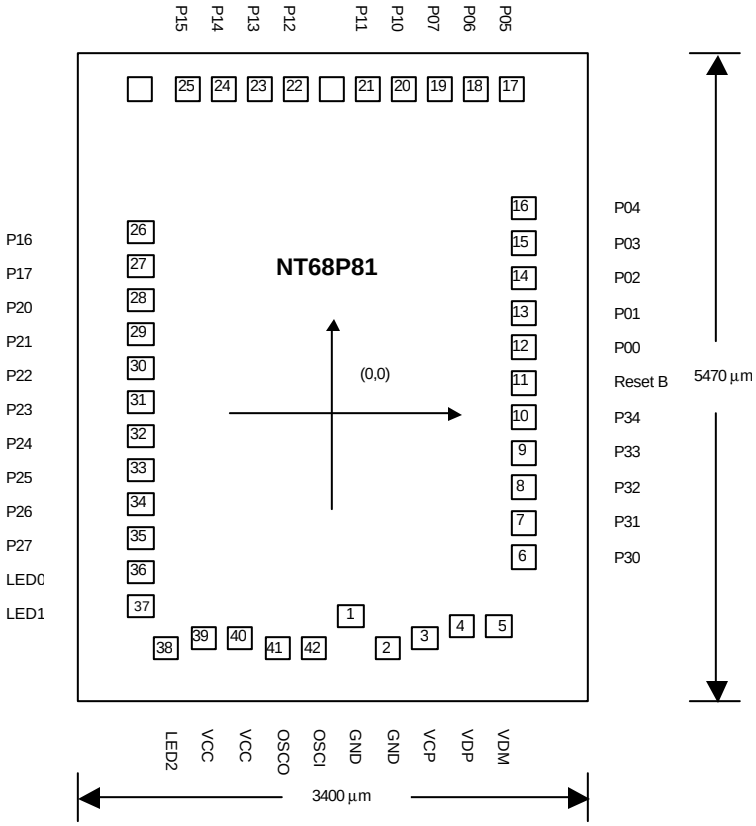
Notice: “Return Key” must be forced to PORT2 for remote wake up function. If not, remote wake up function will not work.

*: For FN key model usage

FN Key Model Usage for Keypad											
FN+Scroll Lock	Num Lock										
FN+&	7	7 Home	FN+*	8	8 ↑	FN + (	9	9 PgUp	FN+)	0	*(Num)
FN+U		4 ←	FN+I		5(Num)	FN+O		6 →	FN+P		-(Num)
FN+J		1 End	FN+K		2 ↓	FN+L		3 PgDn	FN+:	;	+(Num)
FN+M		0 Ins				FN+>	.	. Del	FN+?	/	/(Num)

FN Key Model Usage for Consumer Keys					
FN_K1	FN+F1	WWW Backward	FN_K2	FN+F2	WWW Forward
FN_K3	FN+F3	WWW Stop	FN_K4	FN+F4	WWW Refresh
FN_K5	FN+F5	WWW Search	FN_K6	FN+F6	WWW Favorite
FN_K7	FN+F7	WWW Home	FN_K8	FN+F8	Email
FN_K9	FN+F9	My Computer	FN_K10	FN+F10	Calculator
FN_K11	FN+F11	Media Select	FN_K12	FN+F12	Mute
FN_K13	FN+Print Screen	Bass Boost	FN_K14	FN+Pause	Sleep
FN_K15	FN+Insert	Volume+	FN_K16	FN+Home	Bass+
FN_K17	FN+Page Up	Treble+	FN_K18	FN+Delete	Volume-
FN_K19	FN+End	Bass-	FN_K20	FN+Page Down	Treble-
FN_K21	FN+ ↑	Stop	FN_K22	FN+ ←	Scan Previous Track
FN_K23	FN+ ↓	Play/Pause	FN_K24	FN+ →	Scan Next Track

Bonding Diagram



Substrate connect to VCC

Unit: µm

Pad No.	Designation	X	Y
1	GND	264.50	-2460.05
2	GND	424.50	-2481.00
3	VCP	734.95	-2470.00
4	VDP	1069.35	-2466.00
5	VDM	1368.85	-2466.00
6	P30	1443.05	-2069.05
7	P31	1443.05	-1768.65
8	P32	1443.05	-1468.25
9	P33	1443.05	-1167.85
10	P34	1443.05	-867.45
11	$\overline{\text{RESET}}$	1443.05	-560.45
12	P00	1443.05	-235.35
13	P01	1443.05	65.05
14	P02	1443.05	365.45
15	P03	1443.05	659.85
16	P04	1443.05	1007.20
17	P05	1463.90	2545.00
18	P06	1173.90	2545.00
19	P07	883.90	2545.00
20	P10	593.90	2545.00
21	P11	303.90	2545.00
Pad No.	**Designation**	**X**	**Y**
22	P12	-308.10	2545.00
23	P13	-598.10	2545.00
24	P14	-888.10	2545.00
25	P15	-1178.10	2545.00
26	P16	-1478.00	1012.50
27	P17	-1478.00	670.80
28	P20	-1478.00	370.40
29	P21	-1478.00	70.00
30	P22	-1478.00	-230.40
31	P23	-1478.00	-530.80
32	P24	-1478.00	-831.20
33	P25	-1478.00	-1131.60
34	P26	-1478.00	-1432.00
35	P27	-1478.00	-1732.40
36	LED0	-1478.00	-2037.15
37	LED1	-1478.00	-2337.55
38	LED2	-1112.85	-2481.00
39	VCC	-812.45	-2470.55
40	VCC	-626.85	-2470.55

41	OSCO	-326.45	-2481.00	42	OSCI	-7.75	-2481.00

Ordering Information

Part No.	Packages
NT68P81H	CHIP FORM
NT68P81	40L DIP

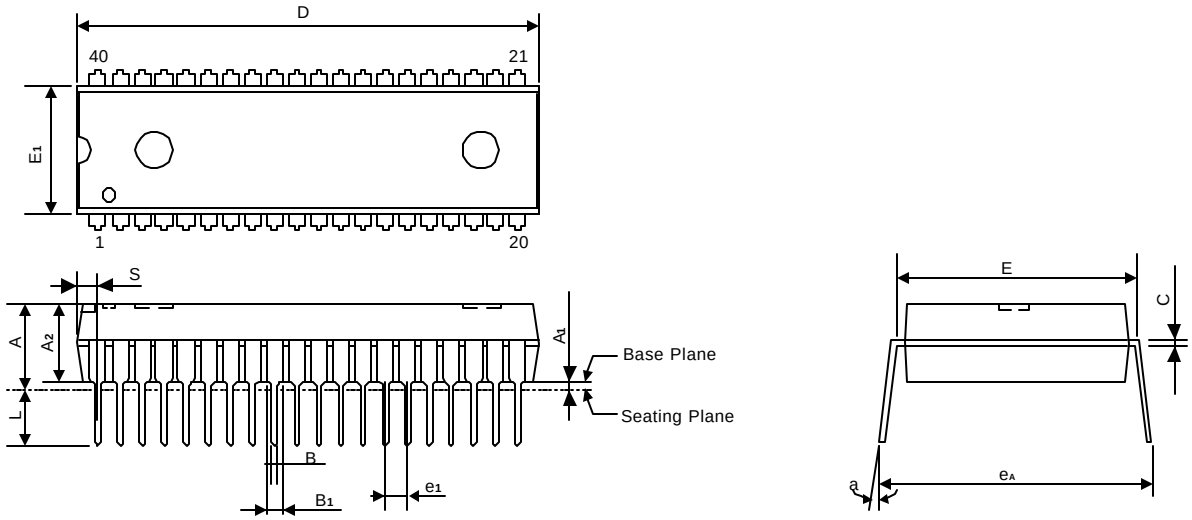
Standard code functional descriptions

Code Number	Name	Reference application circuit	Functional Description
NT68P81-D01012	Simple Keyboard with PS/2 Mouse	Application circuit 1	1. PS/2 mouse port 2. '000' and '00' keys
NT68P81-D01013	Windows 2000 Compatible Keyboard	Application circuit 2	1. ACPI keys 2. '000', '00' and Euro keys 3. Consumer keys (Windows 2000)
NT68P81-D01014	Mini Keyboard	Application circuit 3	1. ACPI keys 2. ‘000’, ‘00’ and Euro keys 3. Consumer keys (Windows 2000) 4. FN key and 40 Translated keys

Package Information

P-DIP 40L Outline Dimensions

unit: inches/mm



Symbol	Dimensions in inches	Dimensions in mm
A	0.210 Max.	5.33 Max.
A_1	0.010 Min.	0.25 Min.
A_2	0.155±0.010	3.94±0.25
B	0.018 +0.004 -0.002	0.46 +0.10 -0.05
B_1	0.050 +0.004 -0.002	1.27 +0.10 -0.05
C	0.010 +0.004 -0.002	0.25 +0.10 -0.05
D	2.055 Typ. (2.075 Max.)	52.20 Typ. (52.71 Max.)
E	0.600±0.010	15.24±0.25
E_1	0.550 Typ. (0.562 Max.)	13.97 Typ. (14.27 Max.)
e_1	0.100±0.010	2.54±0.25
L	0.130±0.010	3.30±0.25
α	0°~ 15°	0°~ 15°
e_A	0.655±0.035	16.64±0.89
S	0.093 Max.	2.36 Max.

Note:

1. The maximum value of dimension D includes end flash.
2. Dimension E_1 does not include resin fins.
3. Dimension S includes end flash.

Product Spec. Change Notice

NT68P81 Specification Revision History		
Version	**Content**	**Data**
2.1	FN Key Model Usage for Consumer Keys modified - FN_K22 and FN_K24 (Page 24)	Oct. 2002
2.0	Volume Knob Application deleted (Page 18) PS/2 Mouse Application added (Page 18 and 19) Application circuit 2 and 3 modified (Page 22 and 23) FN key usage added (Page 24) Standard code functional descriptions modified (Page 26)	Sep. 2002
1.3	Application circuits modified (Page 20, 21 and 22) Standard code functional description added (Page 24)	July 2002
1.0	Original	Nov. 1998