PRELIMINARY

4-BIT SINGLE CHIP OTP TINY CONTROLLER

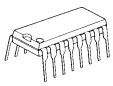
■ GENERAL DESCRIPTION

The **NJU3151** is the C-MOS 4-bit Single Chip OTP type Micro Controller with programmable Flash Memory.

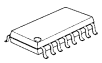
It is completely compatible with the **NJU3101** in function and the pin configuration. Therefore, the **NJU3151** is suitable for the final evaluation before **NJU3101** mask generation, the small quantity production and short lead-time.

* *In this data sheet, only OTP programming and the difference between **NJU3151** and **NJU3101** are mentioned mainly.*
*Therefore the detail function and specification should be referred on the **NJU3101** data sheet.*

■ PACKAGE OUTLINE



NJU3151D

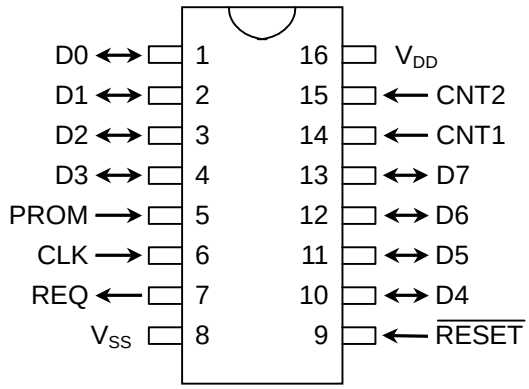


NJU3151M

■ FEATURES

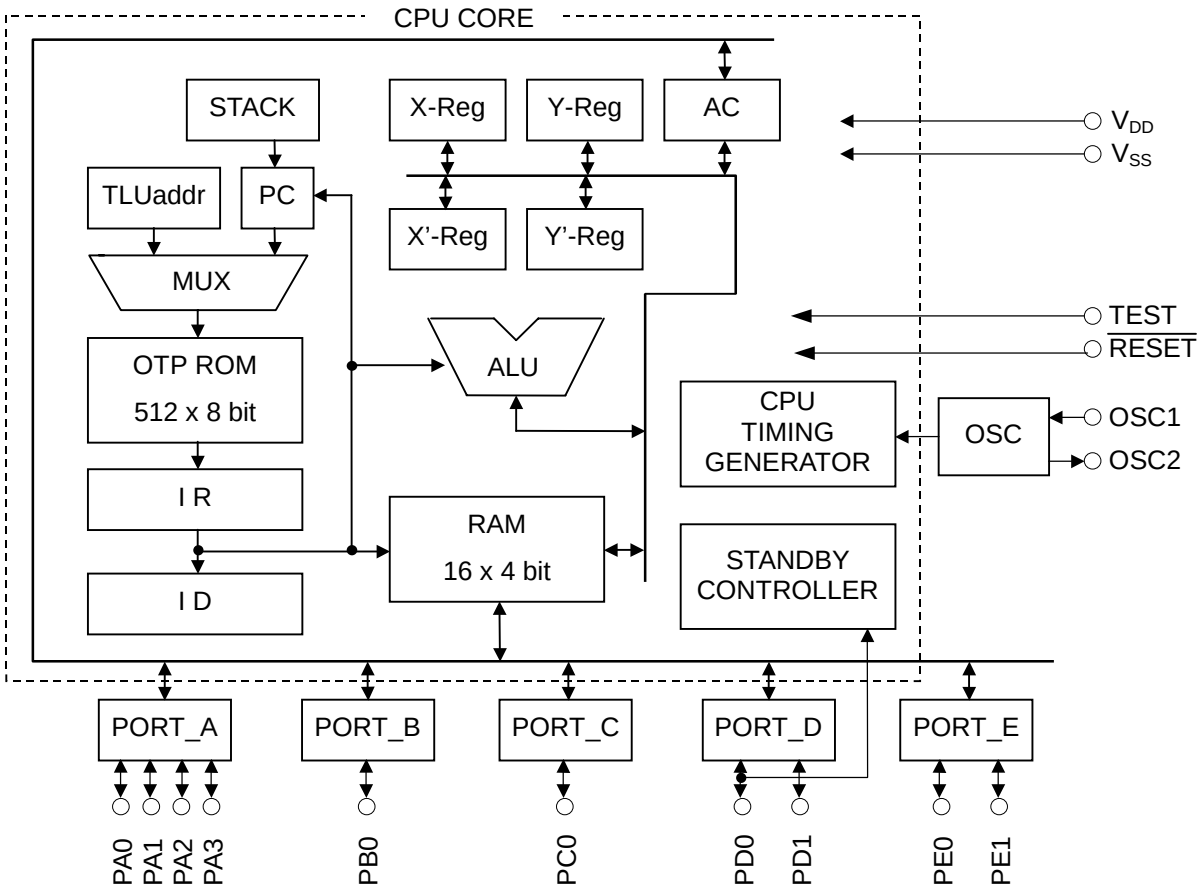
- Internal One Time Programmable ROM 512 X 8bits
- Internal Data RAM 16 X 4bits
- Wide operating voltage range 2.7V ~ 5.5V
- Package outline DIP16 / DMP16
- ROM programmer “SUPERPRO/L” by XELTEK co,.

■ PIN CONFIGURATION IN OTP PROGRAMMING MODE



Note) The pin configuration in Normal operating mode is the same as **NJU3101**.

■ BLOCK DIAGRAM



■ TERMINAL DESCRIPTION IN OTP PROGRAMMING MODE

No.	SYMBOL	INPUT/OUTPUT	F U N C T I O N
9	$\overline{\text{RESET}}$	INPUT	RESET terminal. When the low-level input-signal, the system is initialized.
1 - 4, 10 - 13,	D0 - D7	INPUT/OUTPUT	Data bus
14, 15	CNT1 CNT2	INPUT INPUT	OTP control input terminal
7	REQ	OUTPUT	Request output terminal
6	CLK	INPUT	Clock input terminal
5	PROM	INPUT	OTP programming enable terminal
16	V_{DD}	-	Power Source (5V)
8	V_{SS}	-	Power Source (0V)

Note 1) Use at V_{DD}=5V in OTP programming mode.
2) Non connect anything to the other terminals.

■ Difference between NJU3151 (OTP version) and NJU3101 (MASK version)

● Operating mode

NJU3151 has two operating modes. One is "Normal operating mode" and the other is "OTP programming mode".

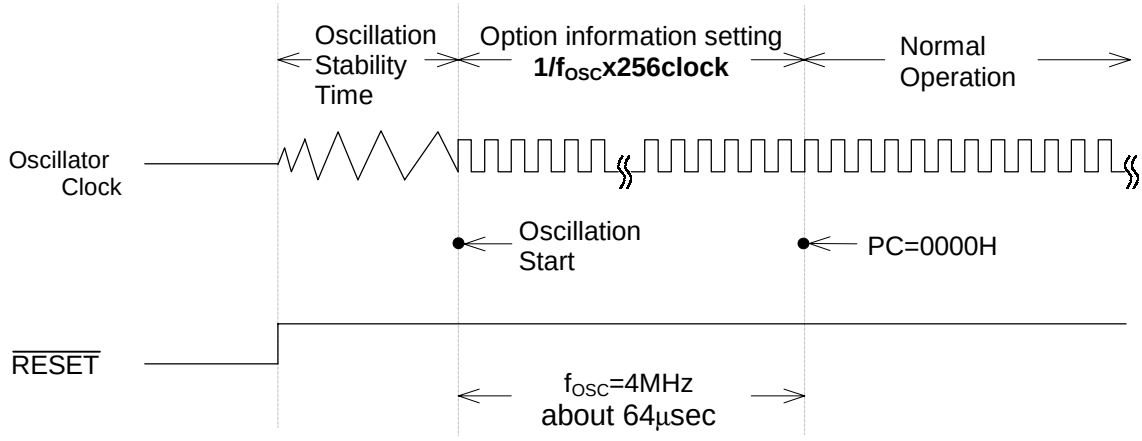
- Normal operating mode
  The "TEST" terminal is set to low level. (The terminal is recommended to connect to GND.)
  Operating voltage range; 2.7V ~ 5.5V.

- OTP Programming mode
  User program is read out from or written into the OTP by the universal programmer "SUPERPRO/L" and converting adapter made by XELTEK co,.(USA).

● Option information set in the initialization

When the initialization is performed($\overline{\text{RESET}}$ terminal is "L"), the operation information stored in option area is set as shown in the following timing chart . The option information is set in the term of **1 / f_{osc} x 256clock** after RESET releasing and oscillation stability time. After information set, the program counter is set to 0000H and the **NJU3151** operates in normal.

[TIMING CHART]



■ ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V_{DD}	-0.3 ~ +7.0	V
Input Voltage	V_{IN}	-0.3 ~ V_{DD} + 0.3	V
Output Voltage	V_{OUT}	-0.3 ~ V_{DD} + 0.3	V
Operating Temperature	T_{opr}	-20 ~ +75	°C
Storage Temperature	T_{stg}	-55 ~ +125	°C

Note)

The difference of electrical characteristics between **NJU3151** (OTP version) and **NJU3101** (MASK version)

		NJU3101		**NJU3151**
•Supply Voltage (V_{DD}) MIN.		2.4V	→	2.7V
•Supply Current				
5V	(I_{DD1}) Max.	4.0mA	→	30mA
	(I_{DD2}) Max.	4.0mA	→	30mA
	(I_{DD3}) Max.	3.8mA	→	30mA
	(I_{DD4}) Max.	4.0μA		20μA
3V	(I_{DD1}) Max.	2.0mA	→	20mA
	(I_{DD2}) Max.	2.0mA	→	20mA
	(I_{DD3}) Max.	1.8mA		20mA
	(I_{DD4}) Max.	2.0μA	→	20μA

■ ELECTRICAL CHARACTERISTICS DC CHARACTERISTICS 1

(V_{DD}=3.6~5.5V, V_{SS}=0V, Ta=-20~75°C)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT	NOTE
Supply Voltage	V_{DD}	V_{DD}	3.6		5.5	V	
Supply Current	I_{DD1}	V_{DD} V_{DD}=5V, f_{OSC}=2MHz X'tal Oscillation in Reset			30	mA	*3
	I_{DD2}	V_{DD} V_{DD}=5V, f_{OSC}=2MHz Ceramic Oscillation in Reset			30	mA	*3
	I_{DD3}	V_{DD} V_{DD}=5V, f_{OSC}=2MHz CR Oscillation in Reset			30	mA	*3
	I_{DD4}	V_{DD} V_{DD}=5V, STANDBY Mode			20	μA	*3
	I_{DD5}	V_{DD} V_{DD}=5V, f_{OSC}=4MHz, Operating			30	mA	*3
High-Level Input Voltage	V_{IH1}	PA0~PA3, PB0, PC0, PD0, PD1	$0.7V_{DD}$		V_{DD}	V	*1
	V_{IH2}	PE0, PE1, $\overline{RESET}$	$0.8V_{DD}$		V_{DD}	V	*1
	V_{IH3}	OSC1	V_{DD}-1.0		V_{DD}	V	
Low-level Input Voltage	V_{IL1}	PA0~PA3, PB0, PC0, PD0, PD1	0		$0.3V_{DD}$	V	*1
	V_{IL2}	PE0, PE1, $\overline{RESET}$	0		$0.2V_{DD}$	V	*1
	V_{IL3}	OSC1	0		1.0	V	
High-Level Input Current	I_{IH}	V_{DD}=5.5V, V_{IN}=5.5V PA0~PA3, PB0, PC0, PD0, PD1, PE0, PE1, $\overline{RESET}$			10	μA	*1
Low-Level Input Current	I_{IL1}	V_{DD}=5.5V, V_{IN}=0V Without pull-up resistance PA0~PA3, PB0, PC0, PD0, PD1, PE0, PE1, $\overline{RESET}$			-10	μA	*1
	I_{IL2}	V_{DD}=5.5V, V_{IN}=0V With pull-up resistance PA0~PA3, PB0, PC0, PD0, PD1, PE0, PE1			-100	μA	*1
High-Level Output Voltage	V_{OH}	I_{OH}=-100μA PA0~PA3, PD0, PD1, PE0, PE1	V_{DD}-0.5			V	*2
Low-Level Output Voltage	V_{OL1}	I_{OL1}=400μA PA0~PA3, PD0, PD1, PE0, PE1			0.5	V	*2
	V_{OL2}	I_{OL2}=15mA PB0, PC0			2.0	V	*2
Output Leakage Current	I_{OD}	V_{DD}=5.5V, V_{OH}=5.5V PB0, PC0			10	μA	*2
Input Capacitance	C_{IN}	Except V_{DD}, V_{SS} terminals f_{OSC}=1MHz Other terminals : 0V		10	20	pF	

*1 Input/output port is set as an Input terminal.
*2 Input/output port is set as an Output terminal.
*3 Except the current through Pull-up resister.

■ ELECTRICAL CHARACTERISTICS DC CHARACTERISTICS 2

(V_{DD}=2.7~3.6V, V_{SS}=0V, Ta=-20~75°C)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT	NOTE
Supply Voltage	V_{DD}	V_{DD}	2.7		3.6	V	
Supply Current	I_{DD1}	V_{DD} V_{DD}=3V, f_{OSC}=1MHz X'tal Oscillation in Reset			20	mA	*3
	I_{DD2}	V_{DD} V_{DD}=3V, f_{OSC}=1MHz Ceramic Oscillation in Reset			20	mA	*3
	I_{DD3}	V_{DD} V_{DD}=3V, f_{OSC}=1MHz CR Oscillation in Reset			20	mA	*3
	I_{DD4}	V_{DD} V_{DD}=3V, STANDBY Mode			20	μA	*3
	I_{DD5}	V_{DD} V_{DD}=3V, f_{OSC}=4MHz, Operating			20	mA	*3
High-Level Input Voltage	V_{IH1}	PA0~PA3, PB0, PC0, PD0, PD1	$0.8V_{DD}$		V_{DD}	V	*1
	V_{IH2}	PE0, PE1, $\overline{RESET}$	$0.85V_{DD}$		V_{DD}	V	*1
	V_{IH3}	OSC1	V_{DD}-0.3		V_{DD}	V	
Low-level Input Voltage	V_{IL1}	PA0~PA3, PB0, PC0, PD0, PD1	0		$0.2V_{DD}$	V	*1
	V_{IL2}	PE0, PE1, $\overline{RESET}$	0		$0.15V_{DD}$	V	*1
	V_{IL3}	OSC1	0		0.3	V	
High-Level Input Current	I_{IH}	V_{DD}=3.6V, V_{IN}=3.6V PA0~PA3, PB0, PC0, $\overline{\quad\quad}$ PD0, PD1, PE0, PE1, $\overline{RESET}$			10	μA	*1
Low-Level Input Current	I_{IL1}	V_{DD}=3.6V, V_{IN}=0V Without pull-up resistance PA0~PA3, PB0, PC0, $\overline{\quad\quad}$ PD0, PD1, PE0, PE1, $\overline{RESET}$			-10	μA	*1
	I_{IL2}	V_{DD}=3.6V, V_{IN}=0V With pull-up resistance PA0~PA3, PB0, PC0, PD0, PD1, PE0, PE1			-100	μA	*1
High-Level Output Voltage	V_{OH}	I_{OH}=-80μA PA0~PA3, PD0, PD1, PE0, PE1	V_{DD}-0.5			V	*2
Low-Level Output Voltage	V_{OL1}	I_{OL1}=350μA PA0~PA3, PD0, PD1, PE0, PE1			0.5	V	*2
	V_{OL2}	I_{OL2}=5mA PB0, PC0			1.0	V	*2
Output Leakage Current	I_{OD}	V_{DD}=3.6V, V_{OH}=3.6V PB0, PC0			10	μA	*2
Input Capacitance	C_{IN}	Except V_{DD}, V_{SS} terminals f_{OSC}=1MHz Other terminals : 0V		10	20	pF	

*1 Input/output port is set as an Input terminal.
*2 Input/output port is set as an Output terminal.
*3 Except the current through Pull-up resister.

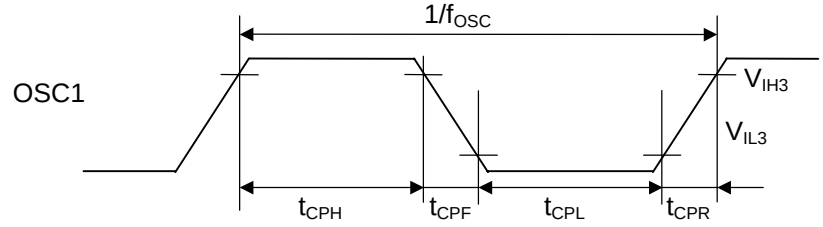
■ ELECTRICAL CHARACTERISTICS AC CHARACTERISTICS 1

(V_{SS}=0V, Ta= -20~75°C)

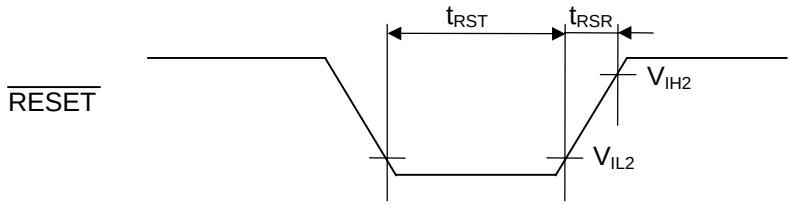
PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT
Operating Frequency	f_{OSC}	V_{DD}=2.7~3.6V	X'tal Resonator	0.03		2.0	MHz
			Ceramic Resonator	0.03		2.0	
			External Resistor Oscillation	0.03		1.0	
			External Clock	0.03		2.0	
		V_{DD}=3.6~5.5V	X'tal Resonator	0.03		4.0	
			Ceramic Resonator	0.03		4.0	
			External Resistor Oscillation	0.03		2.0	
			External Clock	0.03		4.0	
Instruction Cycle Time	t_C				$6/f_{OSC}$		s
External Clock Pulse Width	t_{CPH}	V_{DD}=2.7~3.6V		250		16600	ns
	t_{CPL}	V_{DD}=3.6~5.5V		125		16600	
External Clock Rise Time / Fall Time	t_{CPR} / t_{CPF}	V_{DD}=2.7~5.5V				20	ns
$\overline{RESET}$ Low-Level Width	t_{RST}	V_{DD}=2.7~5.5V		$4/f_{OSC}$			s
$\overline{RESET}$ Rise Time	t_{RSR}	V_{DD}=2.7~5.5V				20	ms
Port Input Level Width	t_{PIN}	V_{DD}=2.7~5.5V		$6/f_{OSC}$			s
Edge Detection (PC1) Rise Time / Fall Time	t_{EDR} / t_{EDF}	V_{DD}=2.7~5.5V				200	ns
Restart Signal (PC0) Rise Time	t_{STR}	V_{DD}=2.7~5.5V				200	ns

■ AC CHARACTERISTICS 1 TIMING CHART

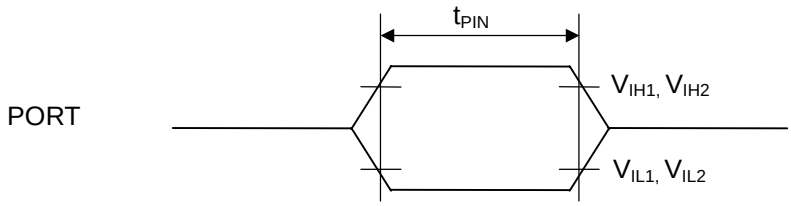
EXTERNAL CLOCK



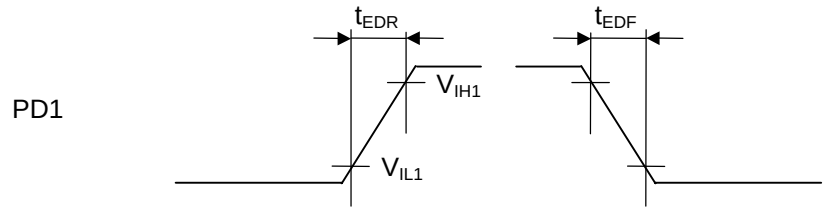
RESET INPUT



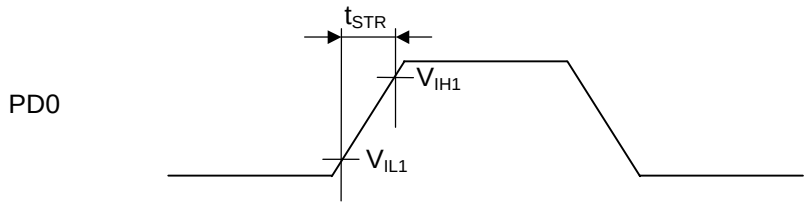
PORT INPUT



EDGE DETECTOR INPUT



RESTART SIGNAL INPUT



■ OPTION as same as mask version (NJU3101)

1) INPUT OUTPUT Terminal Selection
All of input-output terminals select a terminal type from the following table for each group as a PORT by the mask option.

[CIRCUIT TYPE TABLE]

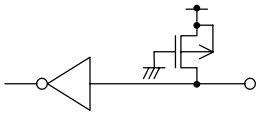
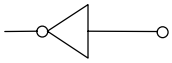
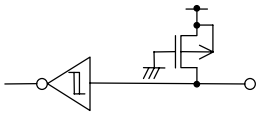
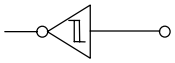
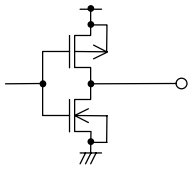
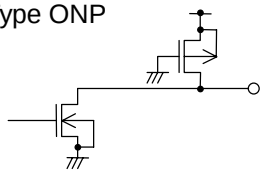
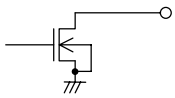
SYMBOL	TERMINAL TYPES				REMARKS	
	Input / Output Terminal*1		EXTRA FUNCTION			
	Port of Input	Port of Output				
Port A (PA0～PA3)	ICP IC	OC				
Port B (PB0)	ICP IC	ONP ON				
Port C (PC0)	ICP IC	ONP ON				
Port D (PD0, PD1)	ICP IC	OC		Restart signal input *2		
				Edge detection *2	R F	Rise edge detection Fall edge detection
Port E (PE0, PE1)	ISP IS	OC				

Note) The symbol in the above table is the same as in mask option generator software.
*1) The symbol and the detail circuits of INPUT OUTPUT TERMINAL are written in INPUT OUTPUT TERMINAL TYPE.
*2) When the PORTD(PHY4) is set as the input, the extra function are added for terminals.

[MASK OPTION LIST]

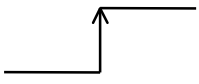
記号	機 能
ICP	C-MOS input with pull-up resistance
ISP	C-MOS Schmitt trigger input with pull-up resistance
IC	C-MOS input
IS	C-MOS Schmitt trigger input
ONP	Nch-FET Open-Drain output with pull-up resistance
OC	C-MOS output
ON	Nch-FET Open-Drain output
R	Rise edge detection
F	Fall edge detection

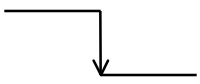
[INPUT OUTPUT TERMINAL TYPE]

	Types	With Pull-up	Without Pull-up	Terminals
INPUT TERMINAL	C-MOS	Type ICP 	Type IC 	PA0~PA3, PB0, PC0, PD0, PD1
	SCHMITT TRIGGER	Type ISP 	Type IS 	PE0, PE1
OUTPUT TERMINAL	C-MOS		Type ON 	PA0~PA3, PD0, PD1, PE0, PE1
	N-channel(Nch) OPEN DRAIN	Type ONP 	Type ON 	PB0, PC0

2) Edge Detector Selection

PD1 terminal is added the “Edge detect function” by the mask option.

Rising edge 

Falling edge 

MEMO