TENTATIVE TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TMPN3120FE5M

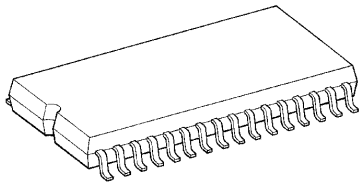
Neuron® Chip For Distributed Intelligent Control Networks (LONWORKS®)

The Neuron Chip TMPN3120FE5M provides double the performance of previous Neuron Chips. It supports a response time of 3 to 4 ms across a LONWORKS Network and has double the input / output (I / O) performance of the previous Neuron Chip in terms of both response time and data transmission speed.

The TMPN3120FE5M features an extra single-chip memory in the form of 3 Kbytes EEPROM, 4 Kbytes SRAM and 16 Kbytes ROM. It is therefore suitable for applications which require more complex operations and high speed communication control.

Neuron Chips have all the built-in communications and control functions required to implement LONWORKS nodes. These nodes may then be easily integrated into highly-reliable distributed intelligent control networks.

The typical functions for this chip are explained below.



SOP32-P-525-1.27

Weight : 1.1 g (Typ.)

FEATURES

- New features
  (In comparison with TMPN3120EIM and TMPN3120FE5M)
  - High-impedance communication port
  - ΔΣ-type AD converter
  - 3 Kbytes EEPROM
  - 4 Kbytes static RAM

- Main features of the 20 MHz Neuron Chip
  (In comparison with the TMPN3120E1M and TMPN3120FE5M)
  - Increased communication speed

    The maximum transmission speed has been increased two-fold.
    1.25 Mbps → 2.5 Mbps
  - Shortened response time

    The amount of time required from I/O input to I/O output has been greatly reduced.
    Maximum speed 7 ms → 3 ~ 4 ms
  - Increased IO object speed

    The execution time for all objects has been halved.
    Example) Serial I/O 9600 bps
    Parallel I/O 1.2 μs/byte
  - Development tool support

    The current LonBuilder® and NodeBuilder® development tools can be used to develop applications for the TMPN3120FE5M. Updated symbol table files for the Neuron Chip firmware are available from Toshiba. If your application requires a 20 MHz input clock, a utility program available from Echelon may be used to convert the programmer files.

* The conversion utilities can be obtained from the Echelon Web Site at http://www.echelon.com. * Use the 3120 programmer manufactured by Echelon when downloading to the chip.

- I/O Functions
  - Eleven programmable I/O pins.
  - Two programmable 16-bit timers and counters built in.
  - 34 different types of I/O functions to handle a wide range of input and output.
  - ROM firmware image containing pre-programmed I/O drivers, greatly simplifying application programs.
- Network functions
  - Two CPUs for communication protocol processing built in.

    The communications and application CPUs execute in parallel.
  - Equipped with a built-in LonTalk protocol which supports all seven levels of the OSI reference model with ISO.
  - The ROM firmware image contains a complete network operating system, greatly simplifying application programs.
  - Built-in twisted-pair wire transceiver with improved common mode and drive current capabilities.
  - Equipped with communications modes and communication speeds which support various types of external transceivers.
    Supports twisted-pair wire, power line, radio (RF), infrared, coaxial cables, and fiber optics.
  - Communication port transceiver modes and logical addresses stored within the EEPROM.
    Can be amended via the network.

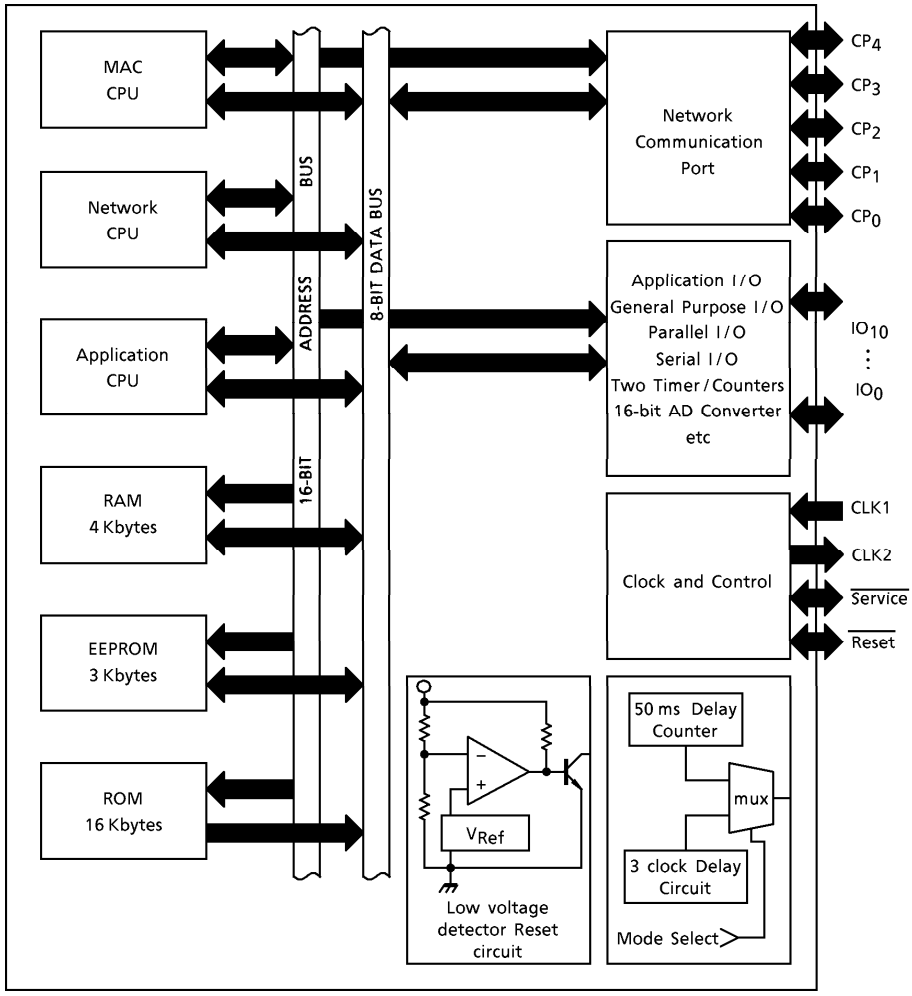
- Other functions
  - Application programs are also stored within the EEPROM.
    May be updated by downloading over the network.
  - Built-in watch-dog timer.
  - Each chip has a unique ID number.
    Effective during the logical installation of networks.
  - Low electrical consumption mode supported with a sleep mode.
  - Built in Selectable Reset time
    Prolongs the power-ON reset time for at least 50 ms and keeps the operation stable during that time. The reset time can be selected 50ms delay mode or 3 clock delay mode by program after the device is in power-ON.
  - High-impedance communication port (CP0 to CP3)
    The Communication port pins (CP0 to CP3) attain high impedance. The eliminates the need for an external relay.
  - Built-in low-voltage detection circuit.
    Prevents incorrect operations and writing errors in the EEPROM during drops in power voltage.
    The external LVD must be use, if Neuron Chip operated at 20 MHz.
    Because of the possibility of improper operation at power supply voltages below 4.5 V, a low voltage detector (LVD) capability is built in to the chip to assert reset when power falls below the specified voltage.
  - Firmware version 10.
- Timing for the main I/O objects during 20 MHz Neuron Chip operations

I/O MODEL	10 MHz TIMING	20 MHz TIMING
Parallel	2.4 μs / byte	1.2 μs / byte
Bitshift	1, 10 or 15 kbps	2, 20 or 30 kbps
Magcard	Up to 8334 bps	Up to 16668 bps
Magtrack1	Up to 7246 bps	Up to 14492 bps
Neurowire Master	1, 10 or 20 kbps	2, 20 or 40 kbps
Neurowire Slave	Up to 18 kbps	Up to 36 kbps
Serial	600, 1200, 2400 or 4800 bps	1200, 2400, 4800 or 9600 bps
Touch	Supported	Not supported
Frequency Output	Resolution0.4 to 51.2 μs Max Range 26.21 to 3355 ms	Resolution0.2 to 25.6 μs Max Range 13.1 to 1678 ms
Other Timer / Counter	Resolution0.2 to 25.6 μs Max Range 13.1 to 1678 ms	Resolution0.1 to 12.8 μs Max Range 6.55 to 839 ms

The specifications for the main timers during 20 MHz operations are as follows :

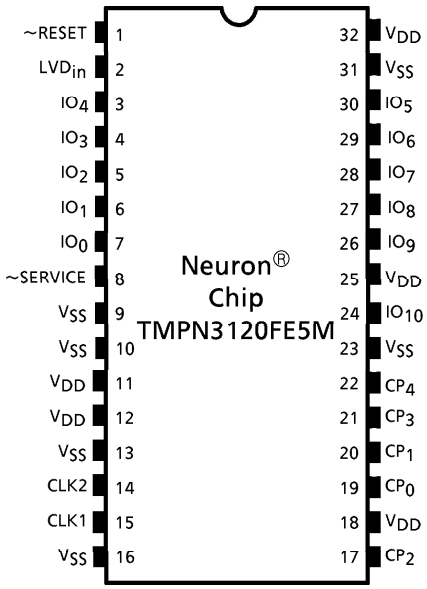
Watchdog Timer	420 ms
Millisecond Timers	1 to **32000** ms
Second Timers	1 to 65000 s
Delay ( ) Function	1 to 32767 counts
Get_Tick_Count ( ) Function	409.6 μs per count

BLOCK DIAGRAM



ITEM	TMPN3120FE5M
CPU	8-bit CPU × 3
RAM	4,096 bytes
ROM	16,384 bytes
EEPROM	3,072 bytes
16-bit Timer / Counter	2 channels
External Memory Interface	Not available
Package	32-pin SOP

PIN CONNECTION



PIN FUNCTION

PIN No.	PIN NAME	I/O	PIN FUNCTION
15	CLK1	Input	Oscillator connection, or external clock input.
14	CLK2	Output	Oscillator connection. Leave open when external clock is input to CLK1.
1	~ RESET	I/O (built-in pull-up)	Reset pin. (Active low)
8	~ SERVICE	I/O (built-in configurable pull-up)	Service pin. Indicator output during operation.
7 ~ 4	IO_0 ~ IO_3	I/O	Large current sink capacity (20 mA). General I/O port. When the AD converter is used, pin IO_3 is reserved for connection of an external resistor.
3, 30 ~ 28	IO_4 ~ IO_7	I/O (built-in configurable pull-up)	General I/O port. One of IO_4 to IO_7 can be specified as No.1 timer/counter input. Output signal can be output to IO_0. IO_4 can be used as the No.2 timer/counter input with IO_1 as output. When using the AD converter, One of IO_4 to IO_6 can be used as analog input and then IO_7 must be attached the external capacitor of proper valve and IO_3 through external resistor of proper valve.
27, 26, 24	IO_8 ~ IO_{10}	I/O	General I/O port. Can be used for serial communication with other device.
11, 12, 18, 25, 32	V_{DD}	Input	Power input (5.0 V Typ.)
9, 10, 13, 16, 23, 31	V_{SS}	Input	Power input (0 V GND)
2	LVD_{in}	Input	Input pin for programmable LVD (Normally connect to V_{DD})
19, 20, 17, 21, 22	CP_0 ~ CP_4	I/O	Bidirectional port for communications. Supports several communications protocols by specifying mode.

(*) ● The ~ SERVICE and IO_4 to IO_7 terminals are programmable pull-ups.
● All V_{DD} terminals must be externally connected.
● All V_{SS} terminals must be externally connected.

MAXIMUM RATINGS (V_{SS} = 0 V, V_{SS} typ.)

ITEM	SYMBOL	RATING	UNIT
Power Supply Voltage	V_{DD}	− 0.3 ~ 7.0	V
Input Voltage	V_{IN} (1)	− 0.3 to V_{DD} + 0.3 V	V
Input Voltage CP_0-CP_3	V_{IN} (2)	− 0.5 to V_{DD} + 1.3 V V_{IN} (2) ≦ 7.3 (Note 1)	V
Drain Current	I_{DD}	200	mA
Source Current	I_{SS}	300	mA
Power Dissipation	P_D	800	mW
Storage Temperature	T_{stg}	− 65 ~ 150	°C

(Note 1) : V_{IN} (2) don't exceed the 7.3 V.

OPERATING CONDITIONS

ITEM	SYMBOL	MIN	TYP.	MAX	UNIT
Operating Voltage	V_{DD}	4.5	5.0	5.5	V
Input Voltage (TTL)	V_{IH}	2.0	—	V_{DD}	V
	V_{IL}	V_{SS}	—	0.8	V
Input Voltage (CMOS)	V_{IH}	V_{DD} − 0.8 V	—	V_{DD}	V
	V_{IL}	V_{SS}	—	0.8	V
Input Voltage CP_0-CP_3 (differential mode)	V_{IH}	—	—	V_{DD} + 1.0 V	V
	V_{IL}	− 0.1	—	—	
Operating Frequency	f_{osc}	0.625	—	20	MHz
Operating Temperature	T_{opr}	− 40	—	85	°C

ELECTRICAL CHARACTERISTICS

DC characteristic (V_{DD} = 5.0 V ± 10%, V_{SS} = 0 V, Ta = − 40 ~ 85°C)
(Above operating conditions apply unless otherwise states.)

ITEM	SYMBOL	PINS	TEST CONDITION	MIN	MAX	UNIT
LOW Level Input Voltage (1)	V_{IL} (1)	IO_0 ~ IO_{10} CP_0, CP_3, CP_4, ~ SERVICE	—	0	0.8	V
LOW Level Input Voltage (2)	V_{IL} (2)	~ RESET	—	0	V_{DD} × 0.3	V
HIGH Level Input Voltage (1)	V_{IH} (1)	IO_0 ~ IO_{10} CP_0, CP_3, CP_4, ~ SERVICE	—	2.0	V_{DD}	V
HIGH Level Input Voltage (2)	V_{IH} (2)	~ RESET	—	V_{DD} − 0.7 V	V_{DD}	V
LOW Output Voltage (1)	V_{OL} (1)	IO_0 ~ IO_3 ~ SERVICE, ~ RESET	I_{OL} = 20 mA	0	0.8	V
			I_{OL} = 10 mA	0	0.4	
LOW Output Voltage (2)	V_{OL} (2)	CP_2, CP_3	I_{OL} = 40 mA	0	1.0	V
LOW Output Voltage (3)	V_{OL} (3)	(Note 1)	I_{OL} = 1.4 mA	0	0.4	V
HIGH Output Voltage (1)	V_{OH} (1)	IO_0 ~ IO_3	I_{OH} = − 1.4 mA	V_{DD} − 0.4 V	V_{DD}	V
HIGH Output Voltage (2)	V_{OH} (2)	~ SERVICE	I_{OH} = − 1.4 mA	V_{DD} − 0.4 V	V_{DD}	V
HIGH Output Voltage (3)	V_{OH} (3)	CP_2, CP_3	I_{OH} = − 40 mA	V_{DD} − 1.0 V	V_{DD}	V
HIGH Output Voltage (4)	V_{OH} (4)	(Note 1)	I_{OH} = − 1.4 mA	V_{DD} − 0.4 V	V_{DD}	V
Input Current	I_{IN}	(Note 2)	V_{IN} = V_{SS} ~ V_{DD}	− 10	10	μA
Pull-up Current	I_{PU} (Note 3)	IO_4 ~ IO_7 ~ SERVICE, ~ RESET	V_{IN} = 0 V	− 30	− 300	μA
Low-voltage Detection Level	V_{LVD}	V_{DD}	—	3.8	4.5	V

(Note 1) : Output voltage characteristics exclude the ~ RESET pin and CLK2 pin.
(Note 2) : Excludes pull-up input pins.
(Note 3) : The IO_4 to IO_7 and ~ SERVICE pins have programmable pull-ups. ~ RESET has a fixed pull-up.

ITEM		SYMBOL	TYP.	MAX	UNIT
Operating Mode Current Consumption	20 MHz Clock	I_{DD} (OP)	34	55	mA
	10 MHz Clock		16	30	
	5 MHz Clock		8.5	15	
	2.5 MHz Clock		4.5	8	
	1.25 MHz Clock		2.3	5	
	0.625 MHz Clock		1.3	3	
Sleep Mode Current Consumption		I_{DD} (SLP)	16	100	μA

(Note) : Test conditions for current dissipation
V_{DD} = 5 V, all output = with no load, all input = 0.2 V or below or V_{DD} − 0.2 V, programmable pull-up = off, crystal oscillator clock input, differential receiver disabled. The current value (typ.) is a typical value when Ta = 25°C.

The current value (max) applies to the rated temperature range of V_{DD} = 5.5 V.

200 μA (typ.) to 600 μA (max) is added to the current of the differential receiver when the receiver is enabled.

The differential receiver is enabled by either of the following conditions :

- When the Neuron chip is in Run mode and the communication ports are in Differential mode.
- When the Neuron chip is in Sleep mode, the communication ports are in Differential mode, and the Wakeup pins are masked.

- Echelon, Neuron, LON, LonTalk, LonBuilder, NodeBuilder, LONWORKS, 3150, 3120 and LonManager are the registered trade marks of Echelon Corporation, USA.
- The Neuron Chip is manufactured by Toshiba under license from Echelon Corporation, USA. A licensing agreement between the customer and Echelon Corporation must be concluded before purchasing any of the neuron chip products.
- This IC (TMPN3120FE5M) is covered by the patent agreement between Toshiba and Bull Cp8 Inc. Kindly understand that this product cannot be used in IC cards or other portable devices (refer to the definition below).

  "PORTABLE DEVICES"

  (Ⅰ) A portable device defined by ISO standard 7816 as having a width or length of ± 10 mm and a thickness of ± 3 mm.

  (Ⅱ) A portable device that conforms to the electrical connection placement and shape stipulated by ISO standard 7816 Part 2.

  (Ⅲ) A pocket-sized portable device in which the ID or history of the holder or the ID or history of the device can be stored as information.

  「BULL CP8 patent: America patent number 4,382,279」
- The following patent notice has been issued by Echelon Corporation, USA in relation to the use of the I^2C I /O object.

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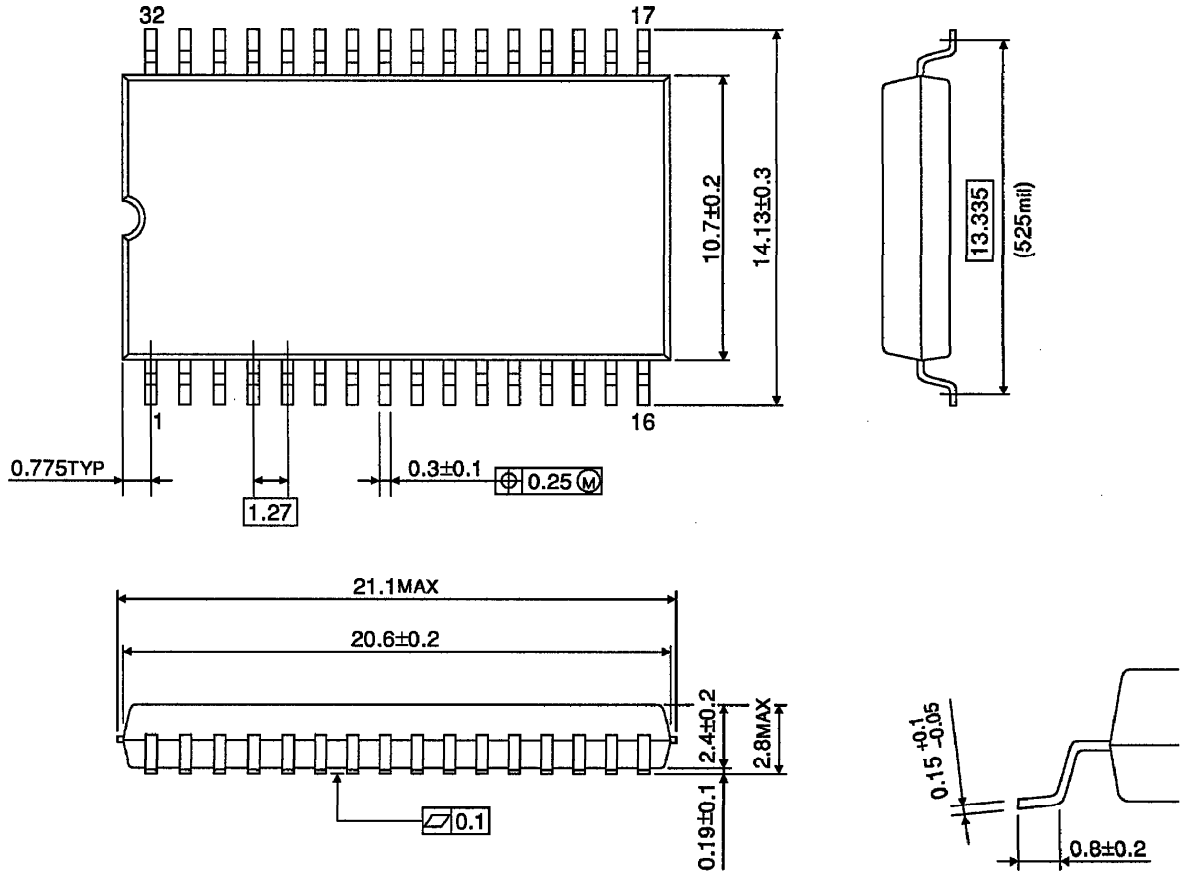
PACKAGE DIMENSIONS

SOP32-P-525-1.27 Unit : mm



Weight : 1.1 g (Typ.)