FT 5000 Smart Transceivers
Neuron® 5000 Processors

Technical Overview

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Agenda

- Series 5000 products overview
- Key new features of FT 5000 / Neuron 5000 products
- Benefits to customers
- New memory architecture
  - Using external serial memories
  - Allowed memory configurations
  - Programming external memories
- FT-X3 communication transformer
- Summary

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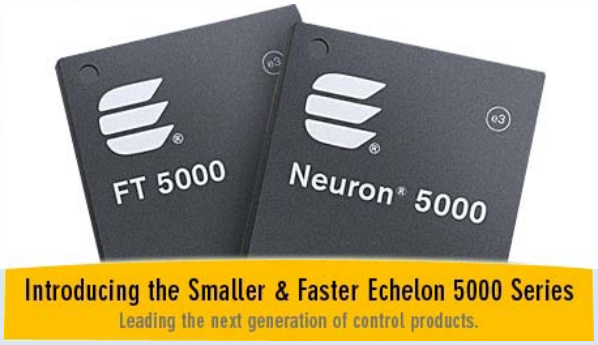
Series 5000 Products Offering



254 Network Variables
62 Network Variables

Features & Performance

Higher Performance Neuron Core

FT 5000
3.3V chip
4-32x faster

Neuron 5000
3.3V chip
4-32x faster

FT 31x0
5V chip
62 NVs

2002

Product Introduction

2010

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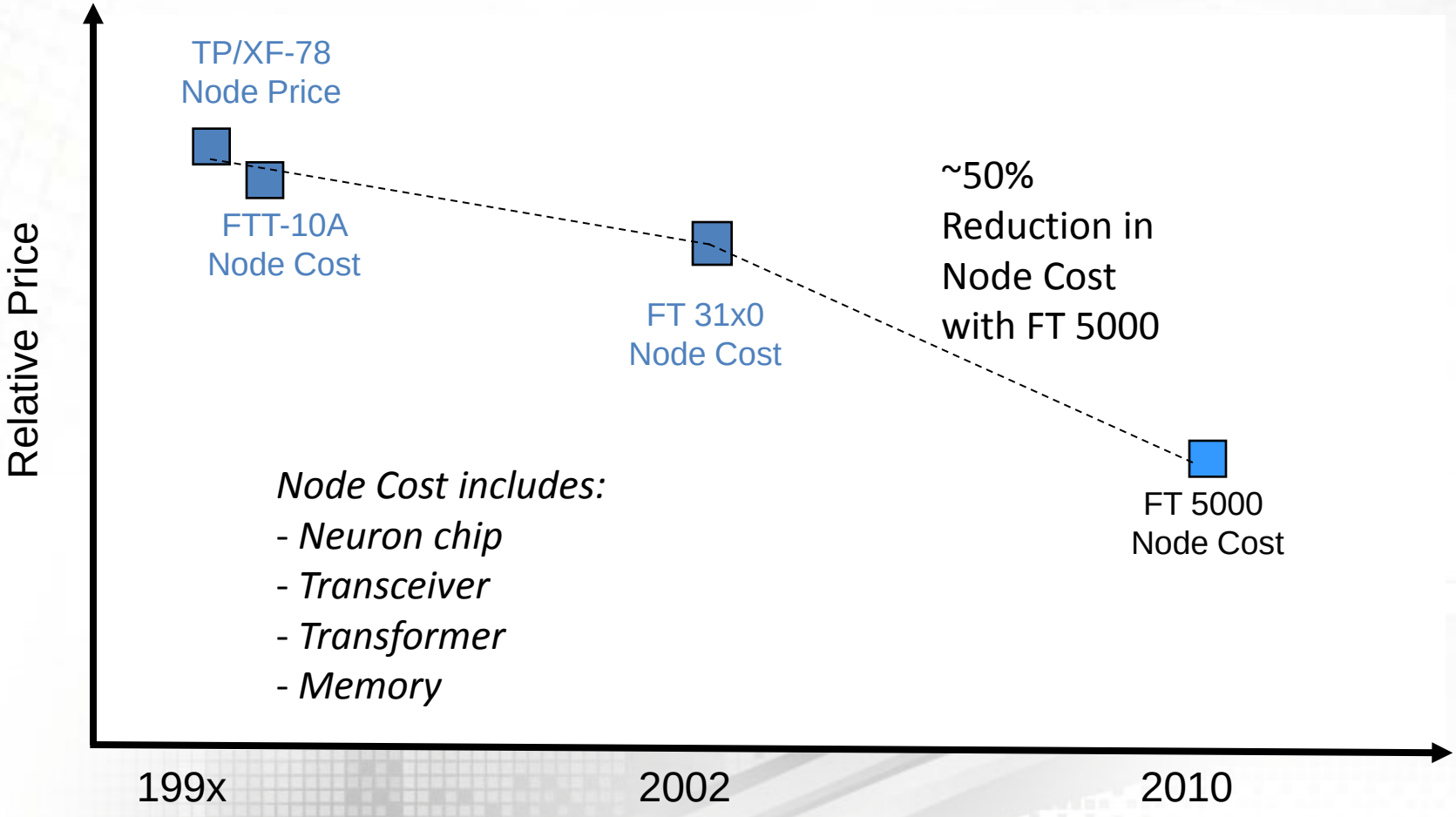
FT 5000 Smart Transceiver Pricing Guidance



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Key Features – 5000 Series

- 3.3V chip
- New memory architecture
  - Less expensive
  - Easily sourced from multiple vendors
  - Enables faster chip operation
  - 64KB on-chip RAM
- Performance enhancement
  - 80MHz maximum internal clock frequency (can be scaled down for power savings)
  - Supports 254 NVs without the use of ShortStack® Micro Server
  - Hardware multiplier and divider on chip
  - User interrupts supported
- Significant reduction in node cost
  - Up to a 50% node cost
- Small 7mm x 7mm QFN package

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Key Features (cont'd)

- Backward compatibility with
  - Communication Channel (FT 5000 Smart Transceiver only)
  - Instruction Set
  - I/O support
- Increased performance of Serial I/O models
  - Hardware support for SPI and SCI/UART serial interfaces
  - 16-entry FIFO at input and output
- FT 5000 combines the functionality of FT 3120® and FT 3150® Smart Transceivers
  - No non-volatile memory (NVM) on-chip for 5000 family of chips
  - External Serial NVM for non-volatile data (application code/data, configuration data)
    - Increased flexibility in choosing serial NVM based on application size
    - Easy upgrade in application memory size without new board layout
  - Same or less board space consumed by (FT 5000 + Serial memory) compared to 32 pin FT 3120 chip

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5000 Series Benefits to Customers

- Cost Reduction
  - 3.3V chip
    - Less interface circuitry and/or on-board power supplies
  - Significant Node cost reduction
    - Includes FT 5000 chip, memory and transformer price
- Smaller Designs
  - Small QFN package
  - Uses small external memories: 8-pin SOIC package
- New functionality
  - Using a variety of higher performance features
    - HW Multipliers and Dividers
    - Interrupts
  - Increases memory space for application and data

FT 5000 IC

FT 3150 IC

Series 5000 vs. Series 3100 Comparison

Specification		Series 3100		Series 5000
		3120 Core	3150 Core	
Supply Voltage		5.0V		3.3V
External Memory	Interface	None	Parallel	Serial
	Pricing (64KB NVM)	N/A	$1 - $2	**≤ $0.60**
	Packages	N/A	32 PLCC 32 TSOP	8-pin SOIC
Internal memory	RAM	2KB		64KB
	ROM	12KB	None	16KB
	NVM	4KB	0.5KB	None
Performance	Internal clock speed (max)	20MHz	10MHz	80MHz
	Interrupts	No		Yes
	Hardware Multiplier	No		Yes
Packages		32 SOIC 44 TQFP	64 TQFP	48 QFN
Network Variables		62		254

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Series 5000 vs. Series 3100 Comparison

- Series 5000 IO pin changes:
  - 3.3V output, 5V tolerant inputs, all are 8mA source / sink
  - No pullups on IOs (only on SERVICE~ and RESET~)
- Series 5000 transceiver changes:
  - No internal differential transceiver (for DC or TP/XF channels)
- Series 5000 timing changes:
  - WDT reset period is now fixed across clock rates (840ms)
  - BIST flash on SERVICE~ pin is 76Hz, not 2kHz
- Other Series 5000 differences:
  - Sleep mode not supported (wasn't supported on FT 31x0 either)
  - Xtal oscillator output doesn't support driving buffer (may change)

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Series 5000 Current Consumption

- FT 5000 Current Consumption Comparison
  - Remember that the FT 31x0 chips' internal clock is ½ of the external clock rate
  - The Series 5000 chips have good current consumption in addition to faster processing power...

Current Consumption	FT 5000 Typical	FT 5000 Maximum	FT 3120 Maximum
In receive mode			
5 MHz	9 mA	15 mA	35 mA
10 MHz	9 mA	15 mA	42 mA
20 MHz	15 mA	23 mA	60 mA
40 MHz	23 mA	33 mA	
80 MHz	38 mA	52 mA	
In transmit mode	$I_{DD3\text{-}RX}$ + 15 mA	$I_{DD3\text{-}RX}$ + 18 mA	$I_{DD3\text{-}RX}$ + 15 mA

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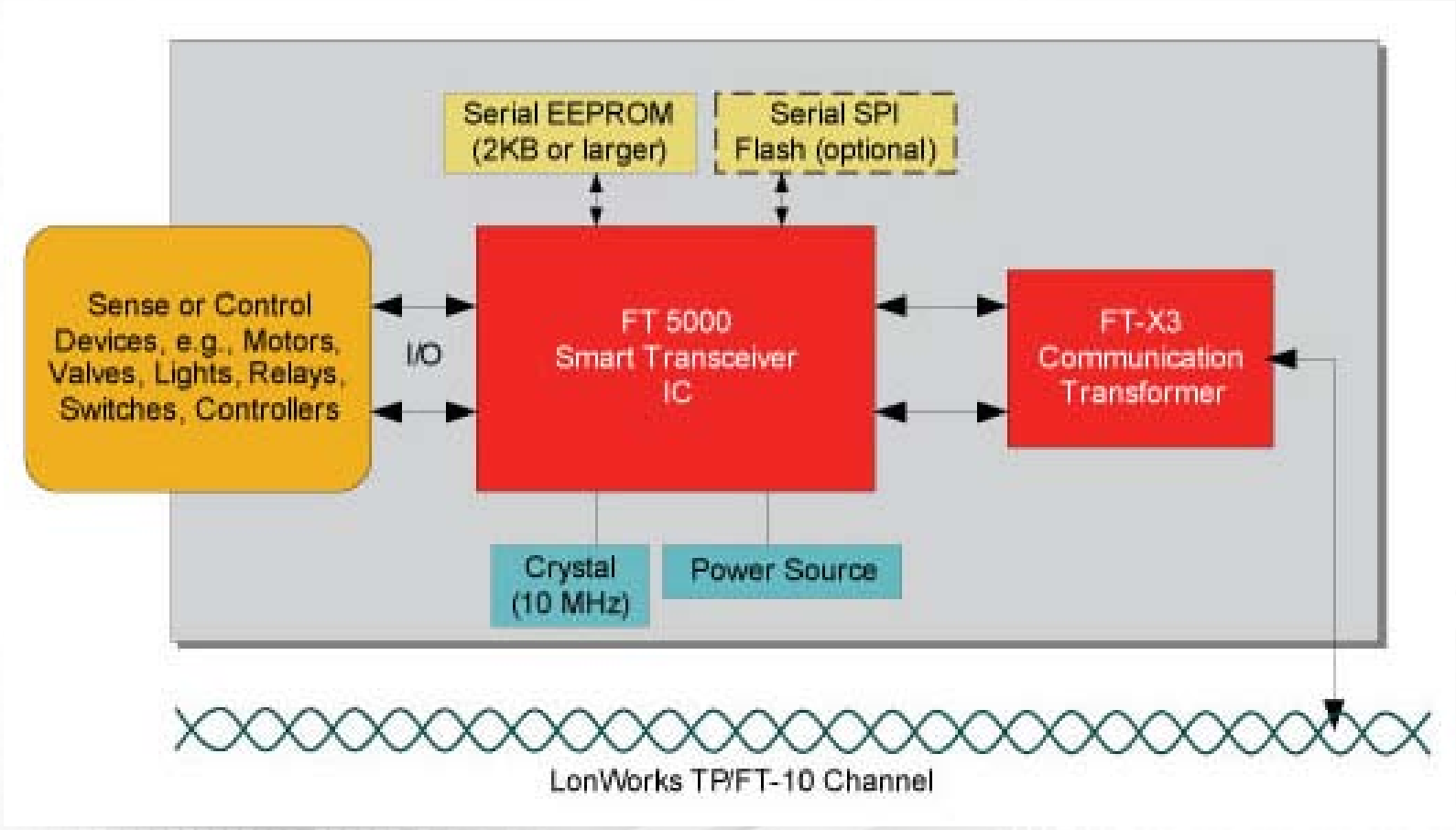
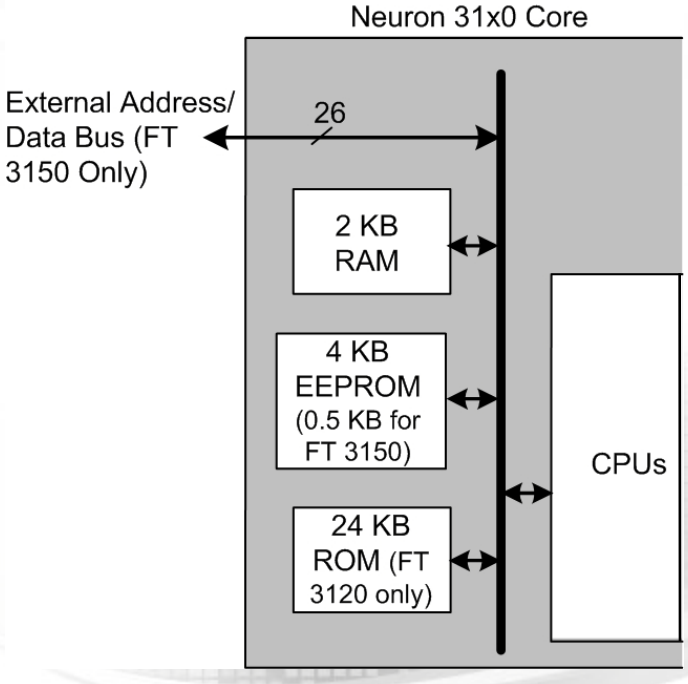
LonWorks Node with FT 5000 Smart Transceiver

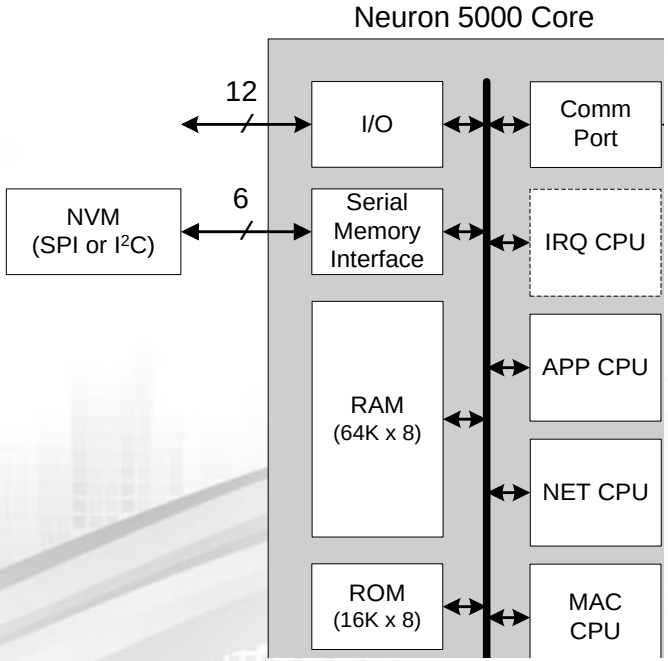


5000 Series - New Memory Architecture Support

- Neuron 3120+ Core
  - Internal NVM (4KB only)
- Neuron 3150+ Core
  - External Parallel Flash/EEPROM
  - Performance limited by external memory access time
  - Limited availability of 3.3V parallel memories



- Neuron 5000+ Core
  - External Serial Flash/EEPROM
  - External memory image copied into internal RAM to execute the application
  - Performance NOT limited by external memory access time



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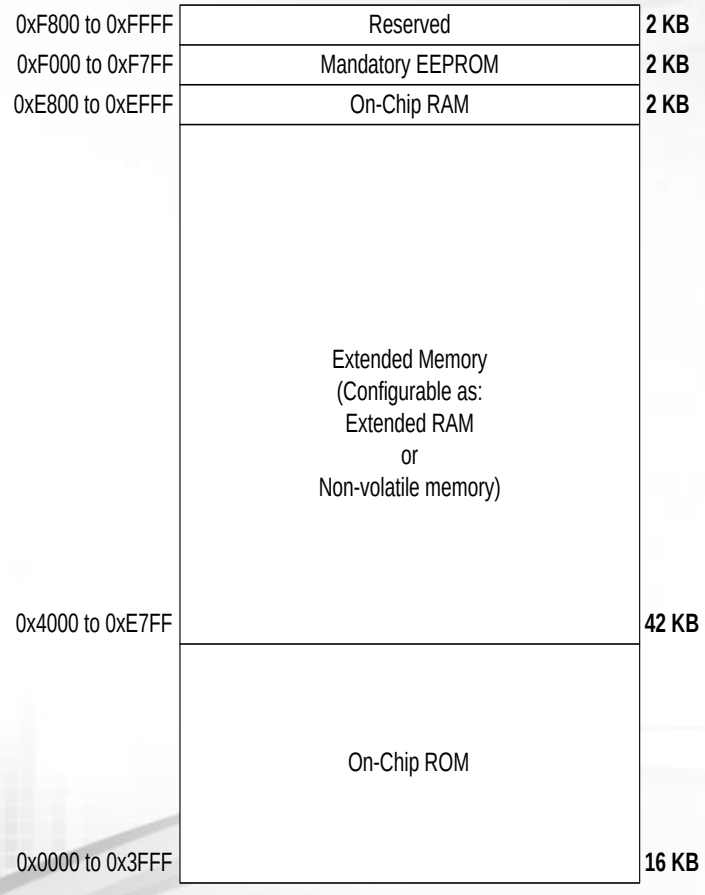
5000 Series On-Chip Memory Support

- 16KB ROM
  - Holds default V19 firmware system image
- 64KB RAM
  - Shadows entire memory space for fast CPU operation
  - 44KB user accessible
- No on-chip non-volatile memory
  - Except to store Neuron IDs



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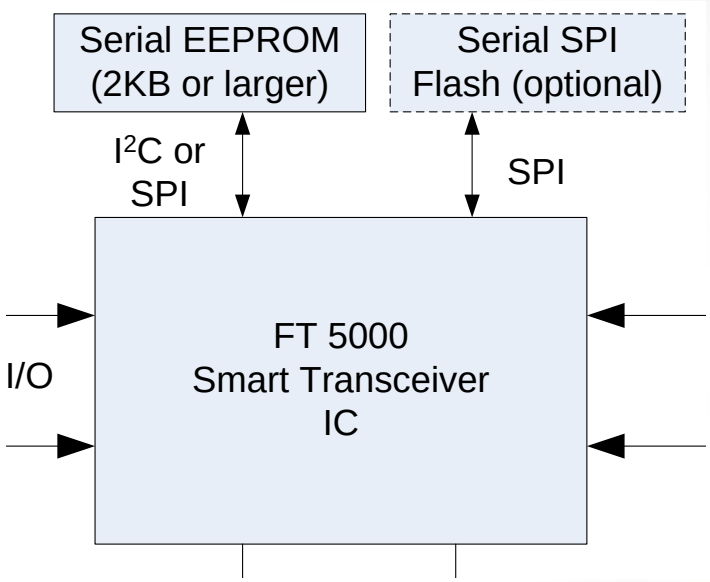
5000 Series - Using External Serial Memory

- Serial Interfaces supported
  - I^2C (Inter-Integrated Circuit)
  - SPI (Serial Peripheral Interface)
- Types of serial memories supported
  - EEPROM (can use either I^2C or SPI interface)
  - Flash (only use SPI interface)
- Required (to store configuration data)
  - At least 2KB off-chip EEPROM
- Optional (to store application code)
  - Larger capacity EEPROM OR additional flash memory
    - Only first 2KB of EEPROM of the Flash is used



5000 Series – Supported Memory Configurations

EEPROM		Flash	
I²C	**SPI**	**SPI**	**Notes**
√			A single I²C EEPROM memory device, from 2 KB to 64 KB in size
√		√	One I²C EEPROM (at least 2 KB in size, up to 64 KB in size, but the system uses only the first 2 KB of the EEPROM memory) One SPI flash memory device
	√		A single SPI EEPROM memory device, from 2 KB to 64 KB in size
	√	√	One SPI EEPROM (at least 2 KB in size, up to 64 KB in size, but the system uses only the first 2 KB of the EEPROM memory) One SPI flash memory device

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5000 Series – External Serial Memory Interface Support

- 6 Pins dedicated for external serial memory interfaces

Pin Name	Used For	Description
CS0~	SPI	SPI slave select 0 (active low)
SDA_CS1~	SPI, I^2C	I^2C: serial data (SDA) SPI: slave select 1 (CS1~, active low)
SCL	I^2C	I^2C: serial clock (SCL)
MISO	SPI	SPI master input, slave output
SCK	SPI	SPI serial clock
MOSI	SPI	SPI master output, slave input

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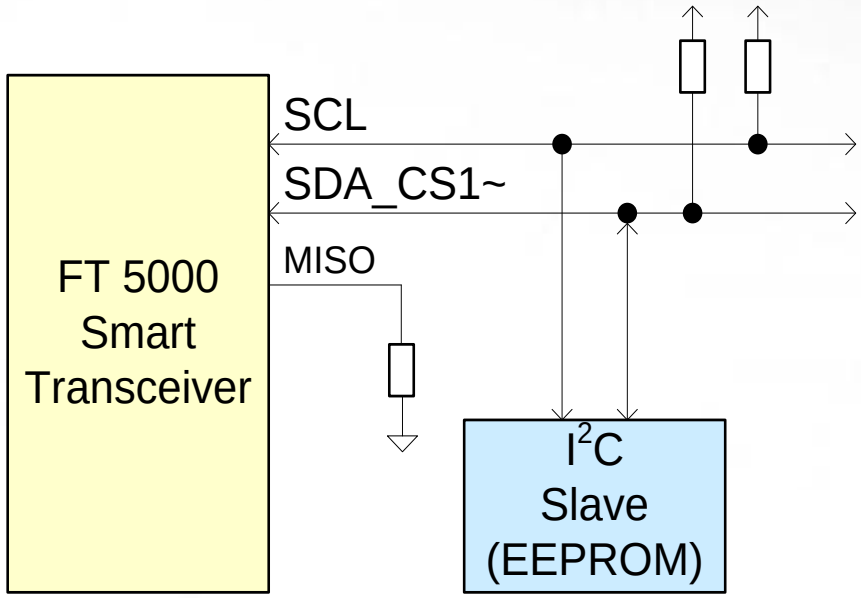
5000 Series – Using the I²C interface

- Neuron 5000/ FT 5000 chip as the I²C master
- Uses 2 out of 6 pins dedicated for external memory connections
- EEPROM can be 2KB to 64KB in size
  - Only 42KB can be used by application



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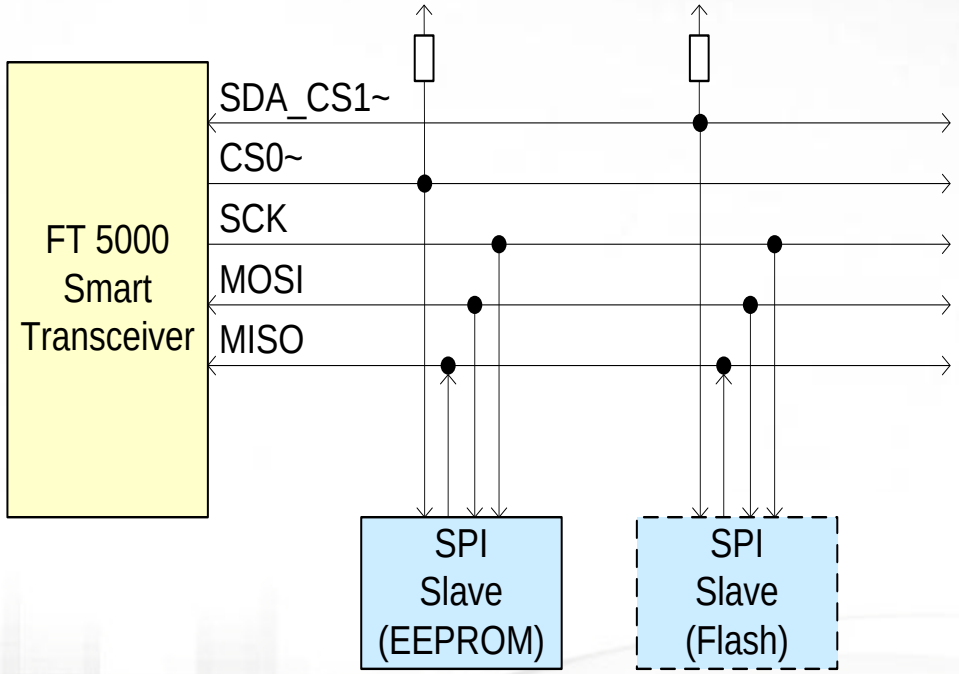
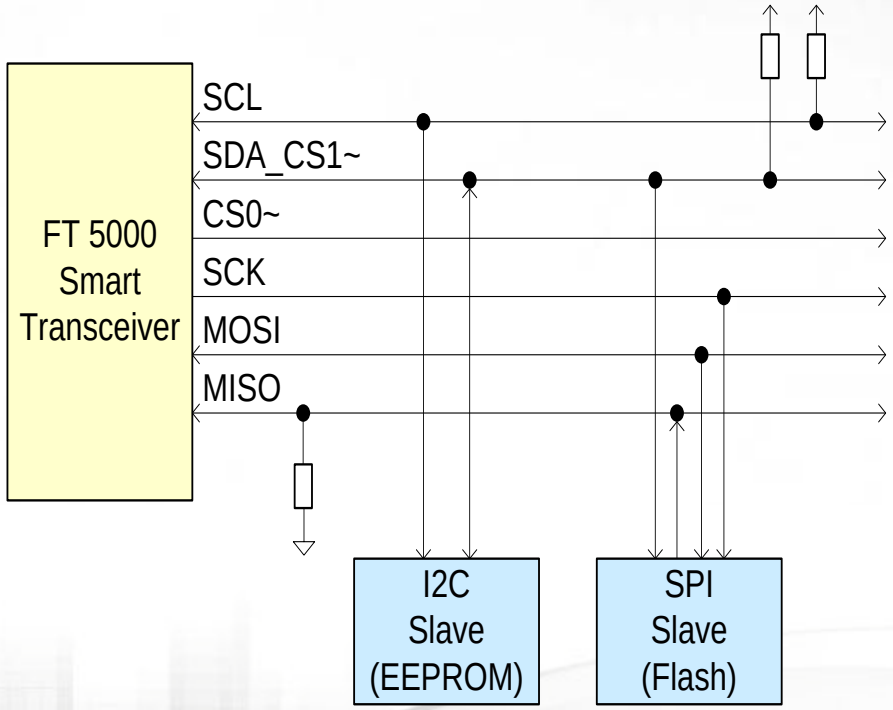
5000 Series – Using the SPI interface

- Neuron 5000 / FT 5000 Chip as the SPI Master (not multi-master)
- Can either use EEPROM only or both EEPROM and flash memory
- Only 2KB of EEPROM used in case flash is also present



5000 Series - Using Both SPI and I²C interfaces

- Neuron 5000 / FT 5000 chip as the I²C/SPI master
- Uses all 6 pins dedicated for external memory connections
- Only 2KB of EEPROM used (even if larger EEPROM is present)
- Pin SDA_CS1~ shared between SPI and I²C
  - Only SPI or I²C transfer can be active at any time



Comparing Memory Technology - EEPROM vs Flash

- EEPROM
  - Has smaller sector size
  - Used commonly for data logging and configuration data
- Flash Memory
  - Larger sector sizes
  - Have to write entire sector even if writing one byte in the sector
    - May result in lower total write cycles over life time compared to EEPROM
  - Used commonly for application code
  - Minimum size available 64KB
  - Less expensive than similar sized serial EEPROM

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Factors Influencing Choice of Memory

- Use of single external memory versus two memories
  - At least 2KB EEPROM is required
  - Example: if 40 KB application space is needed
    - Option 1: Use a 64KB EEPROM
    - Option 2: Use a 2KB EEPROM and a 64KB flash
- Cost comparison between a large EEPROM device and a combination of a small EEPROM and large flash devices
  - Using example above (note pricing may vary):
    - Option 1 cost: $0.75 (64KB EEPROM)
    - Option 2 cost: $0.10 (2KB EEPROM) + $0.36 (64KB Flash) = $0.46
- Use of non-volatile variables by the application
  - Is the memory needed for application code (flash memory preferred) or for data-logging (EEPROM preferred)?

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Programming External Memories

- Multiple ways to program external memories
  - Pre-programming before soldering on the board
    - Uses any programmer that programs serial EEPROM/Flash
  - In-circuit programming on the boards
    - Use either pins, headers or test points on the boards to program the serial memory chip
  - Over the network
    - Programmed through FT 5000 Smart Transceivers

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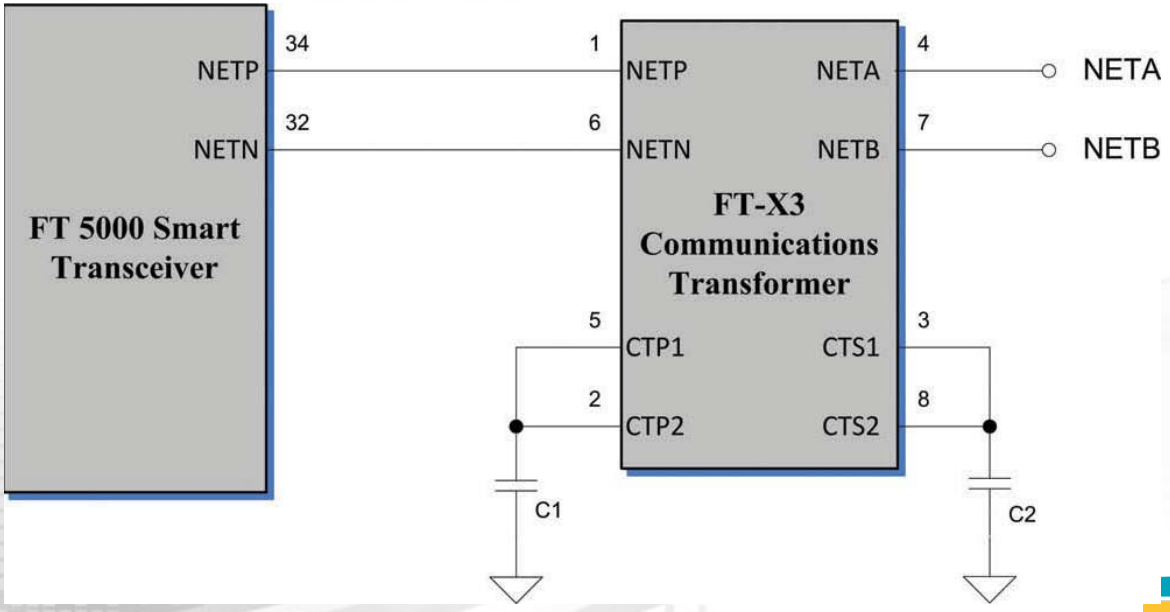
Details of FT-X3 Communications Transformer

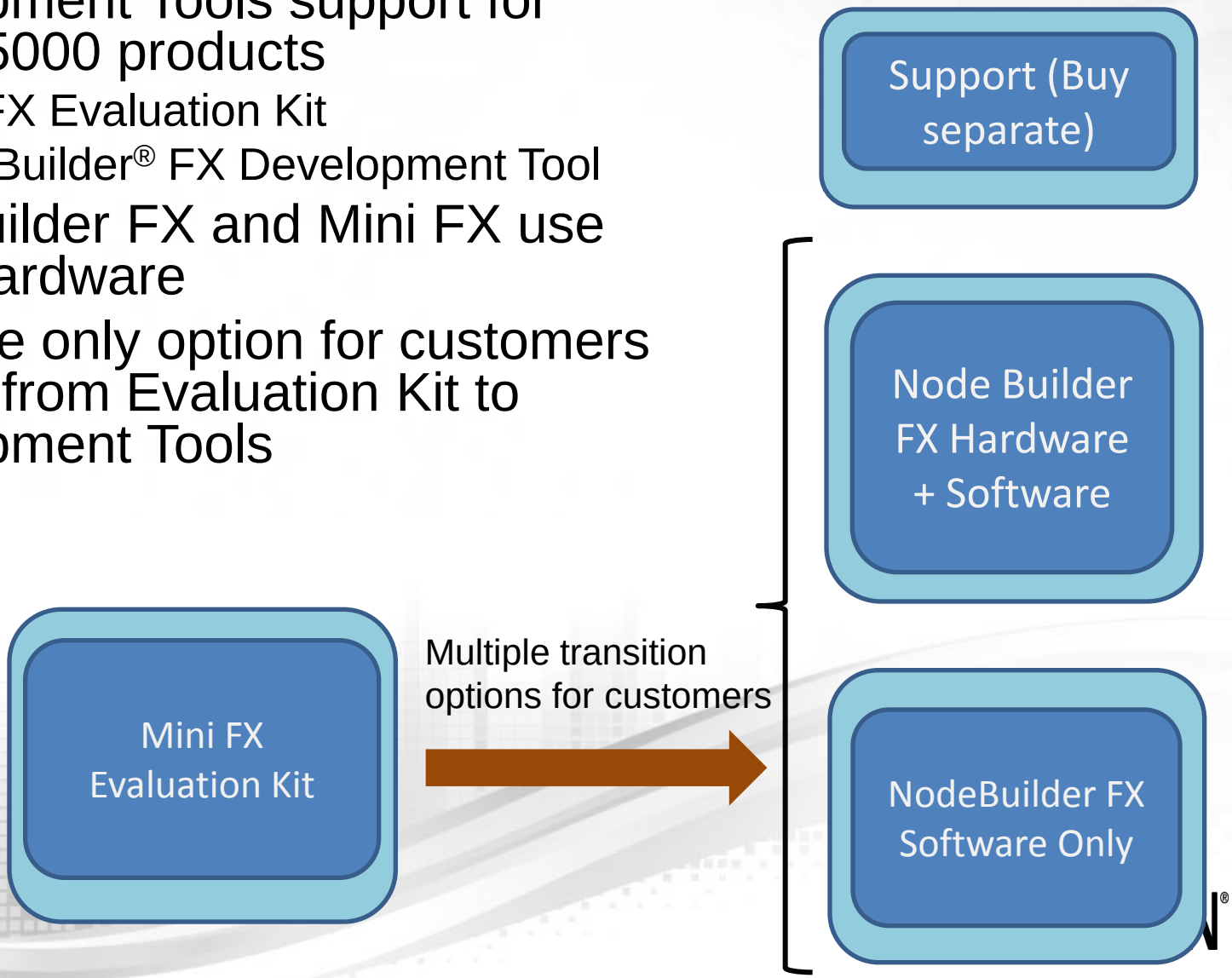
- Surface mount
  - Not pin compatible with FT-X1 / X2
- Same magnetic noise immunity as FT-X1 or FT-X2 communication transformer
- Backward compatible with FT31x0 transceivers



FT-X3 Communications Transformer Pinout Diagram

5000 Series Development Tools Support

- Development Tools support for Series 5000 products
  - Mini FX Evaluation Kit
  - NodeBuilder® FX Development Tool
- NodeBuilder FX and Mini FX use same hardware
- Software only option for customers moving from Evaluation Kit to Development Tools



Summary

- Echelon's technology is the most widely used for smart control worldwide
- Echelon has been a pioneer and leader in the intelligent embedded control networking market
  - Echelon in committed to this market and is looking to grow this market with leading edge solutions
- Echelon continues to bring products to market that offer customers key benefits
  - 5000 Series offers customers the benefits of lower cost and higher performance

5000 Series Ordering Information

- Neuron 5000 Processor – Model Number 14305R-2000
- FT 5000 Smart Transceiver – Model Number 14235R-2000
- FT-X3 Communications Transformer – Model Number 14255R-400
- Mini FX/FT Evaluation Kit – Model Number 10000R-40-24
- FT 5000 EVB Evaluation Board – Model Number 28022R
- NodeBuilder FX/FT Development Tool – Model Number 10020R-40-24

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