



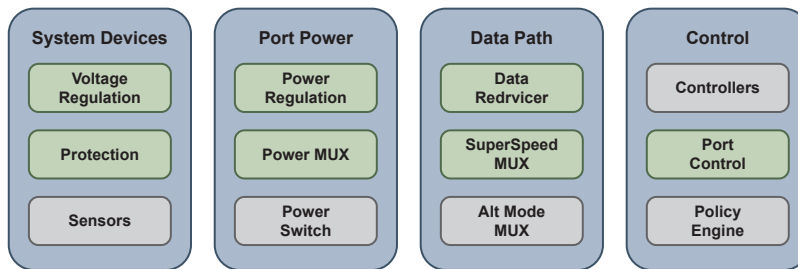
# Networking & Telecom Solutions

*Power management, protection, timing, and control solutions  
for communications infrastructure from ON Semiconductor.*



## USB-C Docking Station

Greater adaptation of USB-C (Type-C) has caused manufactures to introduce many USB-C devices, including for mobile PCs, tablets, and docking stations. There are various USB-C universal docking stations to connect multiple laptop platforms and peripherals. ON Semiconductor provides docking station solutions including the USB-C Data Hub (USB protocol & signal conditioning), as well as the charging capability for the USB-C systems that support USB Power Delivery/Alternate mode protocol.



Block Diagram



### System Devices

Function	Device	Description
Voltage Regulation	NCP81239	4-Switch Buck Boost Controller, USB Power Delivery and Type C Applications
	NCP81231	Buck Controller, USB Power Delivery and Type-C Applications
Protection	FUSB252UMX	High Speed Digital (HSD) Port Protection Switch with Type-C CC
	ESD8704	High Speed Data Line Protection, Unidirectional (3.3 V - USB 3.x)
	ESDL2011	High Speed Data Line Protection, Bidirectional (1 V - Thunderbolt 3.0), 0.2 pF
	ESDM3551	ESD Protection Diode, CC and SBU Protection (5.5 V - USB 3.x), 21 pF
	NSPM2052	ESD and Surge Protection Device, Vbat and Vbus Applications, 5 V
	NIS5452	Electronic Fuse, 5 V

### Data Path

Function	Device	Description
Data Redriver	NB7NPQ7021M	USB 3.1 Dual Channel Linear Redriver, 3.3 V
	NB7NPQ701M	USB 3.1 Single Channel Redriver, 3.3 V
	NB7NPQ702M	USB 3.1 Dual Channel Redriver, 3.3 V
	NB7VPQ701M	USB 3.1 Single Channel Redriver, 1.8 V
	NB7VPQ702M	USB 3.1 Dual Channel Redriver, 1.8 V
SuperSpeed Mux	FUSB340TMX	USB 3.1 SuperSpeed Switch, 10 Gbps

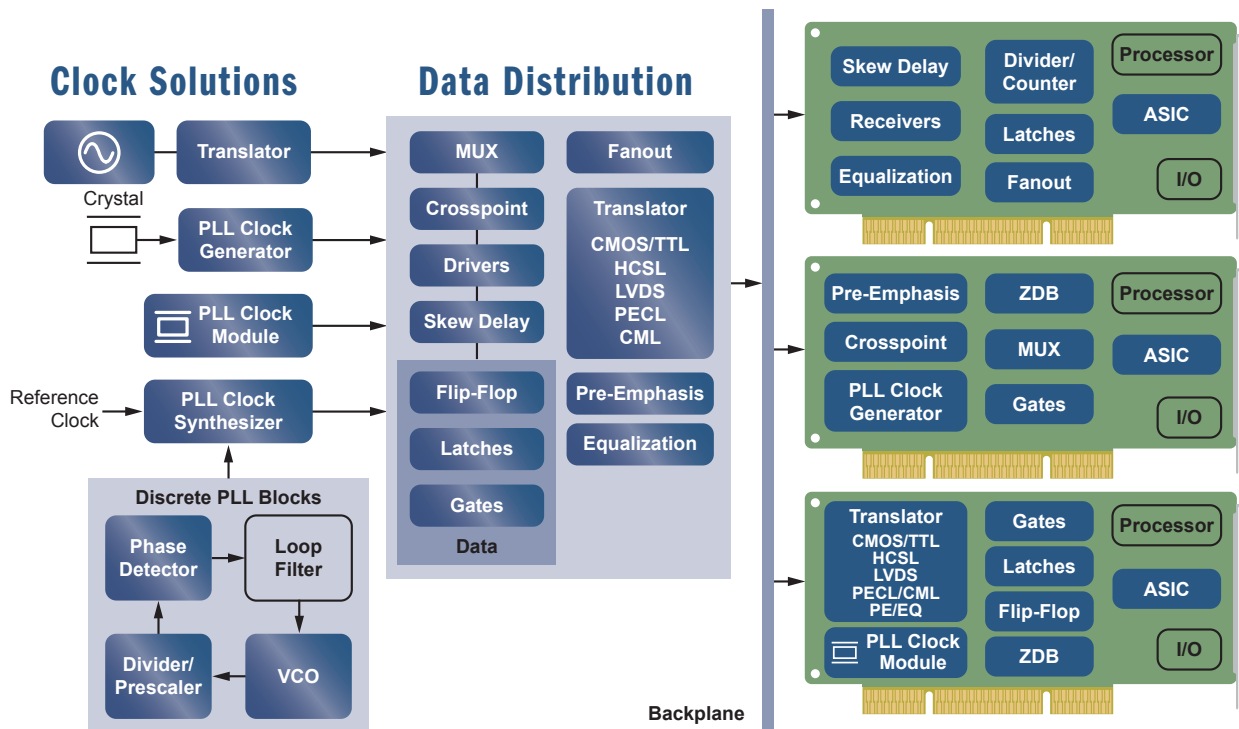
### Power Port

Function	Device	Description
Power Regulation	NCP1342	Quasi-Resonant Flyback Controller with Valley Lock-Out Switching
	NCP4305	Secondary Side Synchronous Rectification Driver for High Efficiency SMPS Topologies
	NCP4306	Secondary Side Synchronous Rectification Driver for High Efficiency SMPS Topologies
	NCP43080	Synchronous Rectifier Controller with LLD Function
	FAN65008B	Synchronous PWM Buck Regulator, High Performance, Voltage Mode, 65 V, 10 A
Power MUX	FPF2595UCX	Load Switch, Over-Voltage, Over-Current Protection with Adjustable Current-Limit Control, IntelliMAX™ 28 V
	FPF2895CUCX	Current Limit Load Switch with OVP and TRCB, 28 V, 5 A

### Control

Function	Device	Description
Port Control	FUSB302B	Programmable USB Type-C Controller with PD (Default SRK)
	FUSB302T	Programmable USB Type-C Controller with PD (Default SRC)
	FUSB303T	Autonomous USB Type-C Controller with I2C and GPIO Control
	FUSB307B	USB Type-C Port Controller with USB-PD

## Timing and Data Distribution Subsystem



ON Semiconductor provides a complete portfolio of timing and data management solutions for all aspects of the clock tree. System designers can optimize their clock circuits with industry leading clock distribution devices, demonstrating the industry's lowest jitter and skew. A broad product portfolio, with multiple output and interface options, allows system designers to build clock circuits that satisfy their specific application requirements. ON Semiconductor utilizes CMOS, Bipolar, and SiGe technology to leverage the best performance for any given application.

Expanding on more than 30 years of experience as the world's leader in high performance ECL-based clock distribution, ON Semiconductor has extended its expertise into ultra low jitter PLL clock synthesis and generation. The new PureEdge™ PLL devices utilize a fully differential architecture that enables performance that satisfies the timing requirements for the most demanding applications.

### Performance Capabilities

- Differential design for reduced noise
- ECL, PECL, CML, LVDS, M-LVDS, HSTL, HCSSL, LVTTTL/LVCMOS outputs for flexible interfacing
- Maximum clock rates >10 GHz
- Maximum data rates >12 Gbps
- Typical additive phase RMS jitter, as low as 30 fs for buffers
- Typical phase RMS jitter of 200 fs for clock generators
- Integrated termination resistors for simplified circuit design
- Edge rates as low as 28 ps
- Low phase noise floor  $\leq -174$  dBc/Hz
- Low output-output skew



## PLL Clock Synthesizers/Generators

### Key Features

- Based on phase-locked-loop techniques with zero PPM synthesis error
- Low jitter for high accuracy clock signals
- Available in industrial temperature range -40°C to +85°C
- Supports output interfaces: LVPECL, LVDS, HCSL, LVTTTL/LVCMOS
- Multiple PLLs and multiple output options

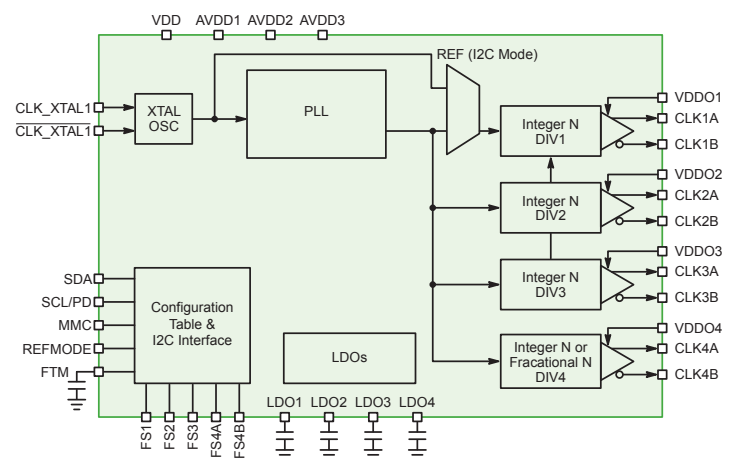


Device	Input (MHz)	Output (MHz)	Application	Input Level					Output Level	Vcc Typ (V)	Package(s)
				XTAL	CML	CMOS	LVPECL	TTL			
NB3N3002	25	25/125/200	CPU/DIMM, PCIe Gen 1, 2, 3, 4	✓		✓		✓	HCSL	3.3	TSSOP-16
NB3N5573	25	25/100/125/200	CPU/DIMM, PCIe Gen 1, 2, 3, 4	✓		✓		✓	HCSL	3.3	TSSOP-16
NB3N51032	25	25/100/125/200	CPU/DIMM, PCIe Gen 1, 2, 3, 4	✓		✓		✓	HCSL	3.3	TSSOP-16
NB3N3020	5 to 27	5 to 210	Network GigE	✓	✓	✓	✓		ECL, LVTTTL	3.3	TSSOP-16
NB3N502	5 to 27	14 to 120	Networking, Consumer, STB	✓		✓			LVCMOS	3.3	SOIC-8
NB4N507A	10 to 27	50 to 200	Networking, Consumer, STB	✓		✓			ECL	3.3, 5	SOIC-16
NB3N508S	27	216	VCXO Set Top Box	✓		✓			LVDS	3.3, 5	TSSOP-16
NB3N511	1 to 50	14 to 200	Networking, Consumer, STB	✓					CMOS	3.3, 5	SOIC-8
NB3N51034	25	100/200	CPU/DIMM, PCIe Gen 1, 2, 3, 4	✓		✓			HCSL	3.3	TSSOP-20
NB3N51044	25	100/125	CPU/DIMM, PCIe Gen 1, 2, 3, 4	✓		✓			HCSL	3.3	TSSOP-28
NB3N51054	25	100	CPU/DIMM, PCIe Gen 1, 2, 3, 4	✓					HCSL	3.3	TSSOP-24
NB3H5150	25	25 to 250	Networking, Telecom	✓	✓	✓	✓	✓	ECL, CMOS	3.3, 2.5	QFN-32
NB3H5150-01	25	25 to 250	Networking, Telecom	✓	✓	✓	✓	✓	ECL, CMOS	3.3, 2.5	QFN-32

## Programmable Multi-Rate Clock Generators

### NB3H5150, NB3H5150-01 Key Features

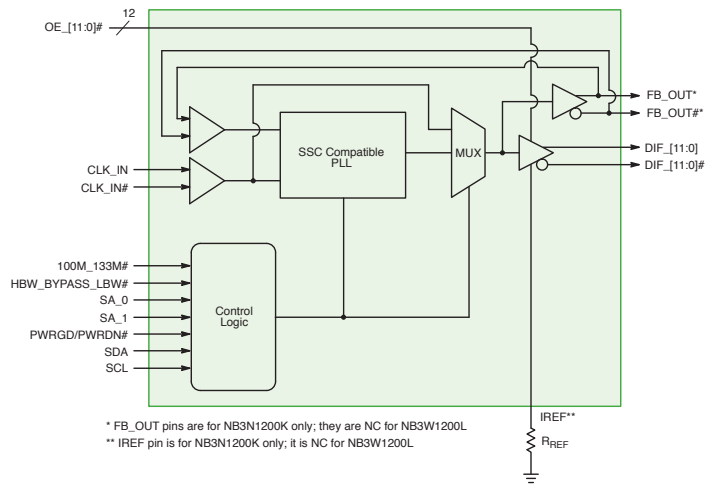
- Uses 25 MHz Crystal or reference input
- External Loop Filter is not required
- User programmable frequencies with four independent output pairs
- Each output pair can be configured either as two LVCMOS outputs (or) a differential LVPECL pair
- Supports 3.3 V or 2.5 V supply voltage operation
- Each output pair has an independent supply voltage rail (VDDOx); 3.3 V, 2.5 V, 1.8 V
- I2C enabled PLL Bypass Mode and Power Down Mode
- Free GUI software to configure device for different frequencies and output types using evaluation board
- Each device preconfigured with different default frequencies, that may be overridden using I2C/SMBus interface



## PCIe-Compliant Zero Delay Buffers

### Key Features

- Differential SRC clock support
- DB800ZL, DB1200Z/ZL, DB1900Z/ZL compliant with 8, 12, and 19 HSCL/low-power NMOS push-pull output pairs respectively
- Optimized for 100 MHz and 133.33 MHz to meet PCIe Gen 2/3/4 and QPI/UPI phase jitter specifications
- Spread-spectrum compatible for low EMI
- Pseudo-external fixed-feedback for low input-to-output delay variation
- Individual OE control pin for each output
- SMBus programmability for frequency selection, power down mode, PLL BW modes, and PLL/Bypass mode



NB3N1200K/NB3W1200L Simplified Block Diagram

Device	Channels	Output	tJitter(Cy-Cy) Typ (ps)	tSkew(I-o) Max (ps)	tSkew(o-o) Max (ps)	Edge Rate Max (V/ns)	Package
NB3W800L	8	Low power NMOS push-pull	34	±100	50	4	QFN-48
NB3N1200K	12	HCSL	50	±100	50	4	QFN-64
NB3W1200L	12	Low power NMOS push-pull	50	±100	50	4	QFN-64
NB3N1900K	19	HCSL	50	±100	85	4	QFN-72
NB3W1900L	19	Low power NMOS push-pull	50	±100	85	4	QFN-72

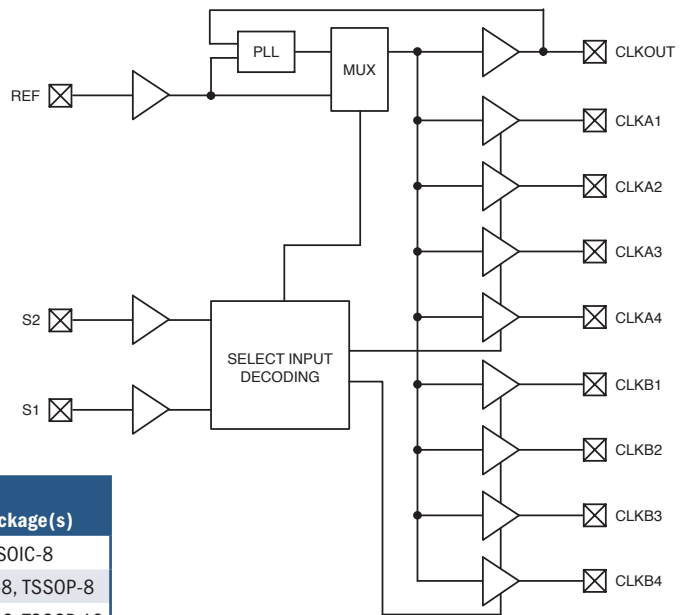
## General Purpose Zero Delay Buffers



### Key Features

- Industry standard functions and pin-outs
- Zero input-output propagation delay, adjustable by capacitive load
- Multiple configurations available for maximum flexibility
- Operating frequency to 133 MHz for CPU and PCI compatibility

Device	Input Level	Output Level	VCC Typ (V)	fMax Typ (MHz)	Channels	tSkew 0-0 Max (ps)	Package(s)
NB2304A	CMOS	CMOS	3.3	133.3	4	200	SOIC-8
NB2305A	CMOS	CMOS	3.3	133.3	5	250	SOIC-8, TSSOP-8
NB2309A	CMOS	CMOS	3.3	133.3	9	250	SOIC-16, TSSOP-16



NB2309A Functional Diagram

## Clock and Data Distribution

### Key Features

- Complete portfolio of fanout buffers, multiplexers, cross point switches
- Supporting frequencies from DC to 12 GHz/Gbps
- PCIe buffers with 1:2, 1:4, 1:6, 1:8, 1:10 and 1:21 fanouts
- PCIe Gen 1, Gen 2, Gen 3, Gen 4 Jitter Compliant
- Pre-Emphasis and Equalization blocks available
- Offer new direct X-tal interface capabilities
- Industry leading additive jitter as low as 30 fs typical
- Device noise floor as low as -174 dBc
- Industry leading output-to-output skew as low as 3 ps minimum
- Direct device interface eliminates external termination components and simplifies BOM



Device	Outputs per Channel	Output Level	Input Level								Vcc Typ (V)	t <sub>skew</sub> 0-0 (ps)	f <sub>Max</sub> Typ (GHz)	Package(s)
			CML	CMOS	LVPECL	HCSL	HSTL	LVDS	XTAL	TTL				
NB3N106K/108K NB3N111K/121K	6, 8, 10, 21	HCSL		✓	✓	✓	✓	✓	✓	✓	3.3	100	0.4	QFN-52, QFN-32, QFN-24
NB3L202K/204K	2, 4	HCSL		✓	✓	✓	✓	✓	✓	✓	2.5, 3.3	100	0.4	QFN-16
NB3L208K	8	HCSL			✓	✓		✓			2.5, 3.3	100	0.35	QFN-32
NB3M8T3910G	10	HCSL, CMOS, LVDS, ECL			✓	✓		✓			2.5, 3.3	50	1.4	QFN-48
NB6L11S	2	LVDS	✓	✓	✓		✓	✓		✓	2.5	25	2	QFN-16
NB6L14S/6N14S	4	LVDS	✓	✓	✓	✓	✓	✓		✓	2.5/3.3	20	2	QFN-16
NB3L8504S	4	LVDS			✓	✓	✓	✓			2.5, 3.3	50	0.7	TSSOP-16
NB3L8543S	4	LVDS	✓		✓	✓	✓	✓			2.5, 3.3	40	0.65	TSSOP-20
NB3V1102C/1103C NB3V1104C/1106C	2, 3, 4, 6	CMOS		✓							1.8, 2.5, 3.3	50	0.25	TSSOP-14, TSSOP-8
NB3M8302C/8304C	2, 4	CMOS, LVTTTL		✓						✓	2.5, 3.3	45, 85	0.2	SOIC-8
NB3U1548C	4	CMOS, LVTTTL		✓						✓	1.5, 1.8, 2.5, 3.3	250	0.16	TSSOP-8, SOIC-8
NB3N4666C	4	CMOS, LVTTTL			✓	✓		✓			3.3	250	0.2	TSSOP-16
NB3F8L3005C	5	CMOS		✓	✓	✓	✓	✓	✓	✓	1.5, 1.8, 2.5, 3.3	55	0.2	QFN-24
NB3H83905C	6	CMOS, LVTTTL		✓						✓	1.8, 2.5, 3.3	80	100	TSSOP-16, SOIC-16, QFN-20
NB3F8L3010C	10	CMOS		✓	✓	✓	✓	✓	✓	✓	1.5, 1.8, 2.5, 3.3	55	0.2	QFN-32
NB3L83948C	12	CMOS		✓	✓	✓	✓	✓		✓	2.5, 3.3	100	0.35	LQFP-32
NB3V8312C	12	CMOS		✓						✓	1.8, 2.5, 3.3	150	0.25	LQFP-32, QFN-32
NB4N11M	2	CML	✓	✓	✓			✓		✓	3.3	25	2.5	TSSOP-8
NB6L11M	2	CML	✓	✓	✓			✓		✓	2.5, 3.3	15	4	QFN-16
NB7L11M	2	CML	✓	✓	✓			✓		✓	2.5, 3.3	15	8	QFN-16
NB7L72M	2	CML	✓	✓	✓			✓		✓	2.5, 3.3	10	7	QFN-16
NB7VQ572M	2	CML	✓		✓			✓			1.8, 2.5, 3.3	15	6	QFN-32
NB6HQ14M	4	CML	✓	✓	✓			✓		✓	2.5	15	5	QFN-16
NB7HQ14M	4	CML	✓		✓			✓			2.5	15	7	QFN-16
NB7V585M	6	CML	✓		✓			✓			1.8, 2.5	30	7	QFN-32
NB7V586M	6	CML	✓		✓			✓			1.8	30	6	QFN-32
NB7VQ1006M	6	CML	✓		✓			✓			1.8, 2.5	25	7.5	QFN-24
NB7L111M	10	CML	✓	✓	✓			✓		✓	2.5, 3.3	20	5.5	QFN-52
NB6L14/6L14M	4	ECL/CML	✓	✓	✓			✓		✓	2.5, 3.3	20	3	QFN-16
NB7L14/7L14M	4	ECL/CML	✓	✓	✓			✓		✓	2.5, 3.3	15	7/8	QFN-16
NB7L1008/7L1008M	8	ECL/CML	✓		✓			✓			2.5, 3.3	20/25	7/8	QFN-32
NB6L56	1	ECL	✓		✓			✓			2.5, 3.3	25	2.5	QFN-32
NBSG11	2	ECL	✓	✓	✓			✓		✓	2.5, 3.3	15	12	QFN-16
NB6L11	2	ECL	✓	✓	✓			✓		✓	2.5, 3.3	15	6	TSSOP-8, SOIC-8
NB6L611	2	ECL	✓	✓	✓			✓		✓	2.5, 3.3	15	3	QFN-16
NB7L572	2	ECL	✓	✓	✓			✓		✓	2.5, 3.3	15	7	QFN-32
NBSG14	4	ECL	✓	✓	✓			✓		✓	2.5, 3.3	15	12	QFN-16
NB3N853501E	4	ECL		✓						✓	3.3	30	0.266	TSSOP-20
NB3N853531E	4	ECL		✓					✓	✓	3.3	30	0.266	TSSOP-20
NB4L339	4	ECL	✓		✓			✓			2.5, 3.3	60	0.7	QFN-32
NB3L8533	4	ECL	✓		✓	✓	✓	✓			2.5, 3.3	30	0.65	TSSOP-20
NB3L853141	5	ECL		✓	✓	✓	✓	✓		✓	2.5, 3.3	30	700	TSSOP-20

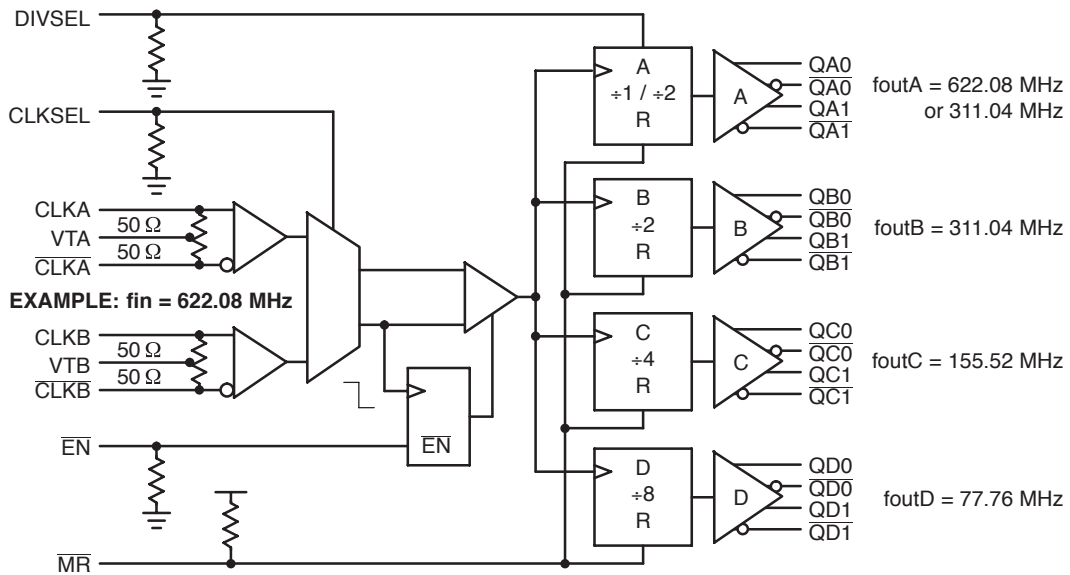
## Dividers and Counters



### Key Features

- Low jitter and skew for highly accurate phase matching
- Multiple outputs and ratios combined for integrated circuit designs
- Supports interface and voltage translation

Device	Input Level				Output Level	VCC Typ (V)	f <sub>Max</sub> Typ (GHz)	Div Ratios	Package(s)
	CML	CMOS	LVPECL	LVDS					
NB4L339	✓	✓	✓	✓	ECL	2.5, 3.3	0.7	1 or 2; 2; 4; 8	QFN-32
NB7V32M	✓	✓	✓	✓	CML	1.8, 2.5	10	2	QFN-16
NB7N017M	✓	✓	✓	✓	CML	3.3	3.5	2 to 256	QFN-52
NB7L32M	✓	✓	✓	✓	CML	2.5, 3.3	14	2	QFN-16
NB6N239S	✓	✓	✓	✓	LVDS	3.3	3	1/2/4/8; 2/4/8/16	QFN-16
NB6L239	✓	✓	✓	✓	ECL	2.5, 3.3	3	1/2/4/8; 2/4/8/16	QFN-16

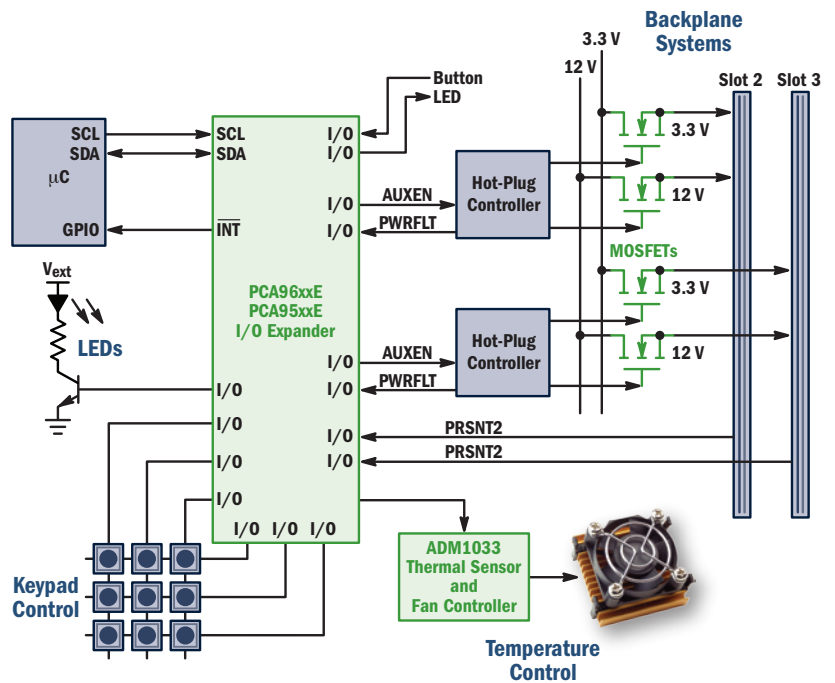


NB4L339 Functional Diagram

## Cascadable I/O Expanders

### Key Features

- I2C and SMBus interfaces
- 1 MHz SCL clock frequency
- 30 mA SDA sink capability



Device	I/O	Cascadable	Vcc Min (V)	Vcc Max (V)	Interrupt Output	I/O Pullups	Package
PCA9535E	16	64 Programmable Slave Addresses	1.65	5.5	✓		QFN-24, SOIC-24, TSSOP-24
PCA9655E	16	64 Programmable Slave Addresses	1.65	5.5	✓		QFN-24, SOIC-24, TSSOP-24
PCA9654E	8	8 Slave ID Addresses	1.65	5.5	✓	✓	SOIC-16, WQFN-16, TSSOP-16



## Standard Logic and MiniGate™

### Available logic functions

- Logic Gates, Buffers, Flip-Flops
- Arithmetic Functions
- Bus Transceivers
- Latches and Registers
- Multiplexers and Analog Switches
- Logic Level Translators

Standard Logic Family	Device Prefix	V <sub>CC</sub>		t <sub>PD</sub> (nS)	I <sub>OUT</sub> (mA)	Input Logic Level	Packages
		Min (V)	Max (V)				
Metal Gate	MC14	3	18	50 @ V <sub>CC</sub> = 15 V	±4.2 @ V <sub>CC</sub> = 15 V	CMOS	SOIC, TSSOP, QFN
AC	MC74AC/74AC	2	6	6 @ V <sub>CC</sub> = 5 V	±24 @ V <sub>CC</sub> = 4.5 V	CMOS	
ACT	MC74ACT/74ACT	4.5	5.5	5.5 @ V <sub>CC</sub> = 5 V	±24 @ V <sub>CC</sub> = 4.5 V	TTL	
HC	MC74HC/MM74HC	2	6	13 @ V <sub>CC</sub> = 6 V	±5.2 @ V <sub>CC</sub> = 6 V (Std)	CMOS	
					±7.8 @ V <sub>CC</sub> = 6 V (Bus Driver)		
HCT	MC74HCT/MM74HCT	4.5	5.5	15 @ V <sub>CC</sub> = 5 V	±4.0 @ V <sub>CC</sub> = 4.5 V (Std)	TTL	
					±6.0 @ V <sub>CC</sub> = 4.5 V (Bus Driver)		
LCX	MC74LCX/74LCX	2.3	3.6	5.5 @ V <sub>CC</sub> = 3 V	±24 @ V <sub>CC</sub> = 3 V	LVTTTL	
LVX	MC74LVX/74LVX	2	3.6	6.6 @ V <sub>CC</sub> = 3 V	±4 @ V <sub>CC</sub> = 3 V	LVTTTL	
VCX	MC74VCX/74VCX	1.65	3.6	3.5 @ V <sub>CC</sub> = 3 V	±24 @ V <sub>CC</sub> = 3 V	LVTTTL	
VHC	MC74VHC/74VHC	2	5.5	5.2 @ V <sub>CC</sub> = 4.5 V	±8 @ V <sub>CC</sub> = 4.5 V	CMOS	
VHCT	MC74VHCT/74VHCT	4.5	5.5	3.6 @ V <sub>CC</sub> = 4.5 V	±8 @ V <sub>CC</sub> = 4.5 V	TTL	
LVT	74LVT	2.7	3.6	3.6 @ V <sub>CC</sub> = 3.0 V	-32/64 @ V <sub>CC</sub> = 3.0 V	TTL	

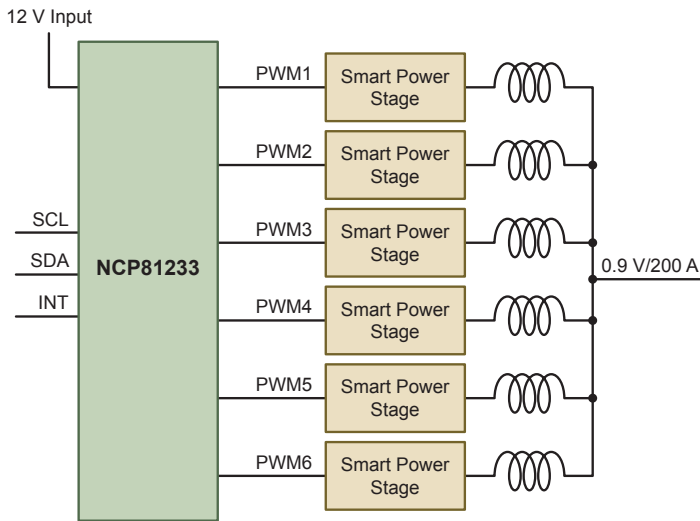
MiniGate Family	Number of Gates	Device Prefix	V <sub>CC</sub>		t <sub>PD</sub> (nS)	I <sub>OUT</sub> (mA)	Input Logic Level	Packages
			Min (V)	Max (V)				
HC	1	MC74HC1G/NC7S	2	6	6.5 @ V <sub>CC</sub> = 5 V	±5.2 @ V <sub>CC</sub> = 6 V	CMOS	TSOP, SC-88, SC-74, SOT-553, SOT-953, US8, UDFN, UQFN, MicroPak
HCT	1	NC7ST	4.5	5.5	6.5 @ V <sub>CC</sub> = 5 V	±2 @ V <sub>CC</sub> = 6 V	TTL	
VHC	1	MC74VHC1G/NLU1G/NL17SH	1.65	5.5	3.8 @ V <sub>CC</sub> = 4.5 V	±8 @ V <sub>CC</sub> = 4.5 V	CMOS	
	2	NLU2G						
	3	NLU3G						
VHCT	1	MC74VHCT1G/NLU1GT/NL17SHT	4.5	5.5	3.6 @ V <sub>CC</sub> = 4.5 V	±8 @ V <sub>CC</sub> = 4.5 V	TTL	
	2	NLU2GT						
	3	NLU3GT						
LCX	1	NL17SZ/NC7SZ/NLX1G	1.65	5.5	2.4 @ V <sub>CC</sub> = 3 V	±24 @ V <sub>CC</sub> = 3 V	CMOS	
	2	NC27WZ/NC7WZ/NLX2G						
	3	NL37WZ/NC7NZ/NLX3G						
VCX	1	NL17SV/NC7SV	0.9	3.6	1.0 @ V <sub>CC</sub> = 3 V	±24 @ V <sub>CC</sub> = 3 V	LVTTTL	
SG	1	NL17SGxx	0.9	3.6	2.2 @ V <sub>CC</sub> = 3 V	±8 @ V <sub>CC</sub> = 3 V	LVTTTL	
SP	1	NC7SP	0.9	3.6	3.0 @ V <sub>CC</sub> = 3 V	±2.6 @ V <sub>CC</sub> = 3 V	LVTTTL	
	2	NC7WP						
	3	NC7NP						
AUP	1	74AUP1G	0.8	3.6	2.9 @ V <sub>CC</sub> = 3 V	±4 @ V <sub>CC</sub> = 3 V	Schmitt	
	1	74AUP1T	2.3	3.6	3.3 @ V <sub>CC</sub> = 3 V	±4 @ V <sub>CC</sub> = 3 V	Schmitt	

## Multiphase Controllers with Smart Power Stages

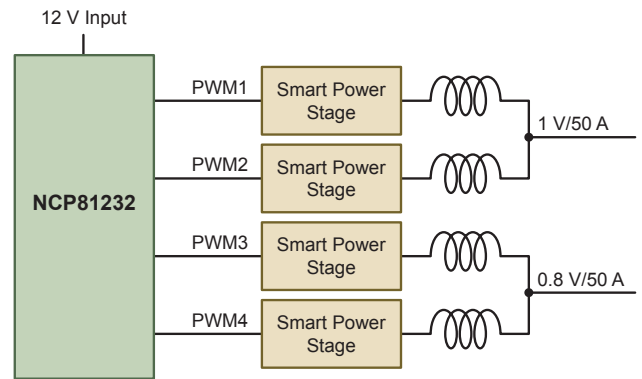
for Powering CPUs, FPGAs, Core Processors, and DDR Memory

### Key Features

- Solution supports up to 6 phases; NCP81162 phase doublers allows up to 12 phases
- Remote sense for output accuracy
- Dual edge modulation for good load transient
- Supports DCR or IMON current sensing from power stage



**NCP81233 Supports Up to 6 Phase Solution, I2C Interface for Configuration and Telemetry**



**NCP81232 Supports Up to 4 Phases with 2 Control Loops (Can Be Paralleled for Single Output)**

### Multiphase Controllers

Device	Phases	Features	Package
NCP81233	Up to 6	I2C for configuration and telemetry	QFN-52
NCP81232	Up to 4	Dual output or combinable	QFN-40
NCP81234	Up to 2	Dual output or combinable	QFN-28

### Power Stages

Device	I <sub>OUT</sub> Range (A)	Current Sensing	Package
NCP302150	45 (average)	DCR	PQFN-31
NCP302155	55 (average)	DCR	PQFN-31
NCP303150*	80 (peak)	IMON	PQFN-39
FDMF3170	70 (peak)	IMON	PQFN-39
FDMF3180	70 (peak)	IMON	PQFN-39

\* Pending 4Q18

## High Efficiency Point-of-Load Regulators

### FAN23xx Key Features

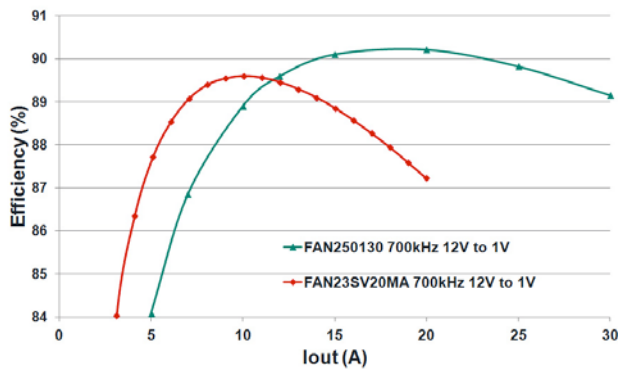
- Constant on time controller – Gen 1
- PFM mode for light load efficiency
- External ripple generation
- Reference,  $\pm 1\%$  over temperature
- Low shutdown current
- Minimizes external component count
- Compatible with all output capacitor types (MLCC, POSCAP, etc.)
- Protection:  $V_{IN}$  UVLO;  $V_{OUT}$  OV&UV; Adjustable Output Current Limit; Thermal Shutdown

### FAN25xx Key Features

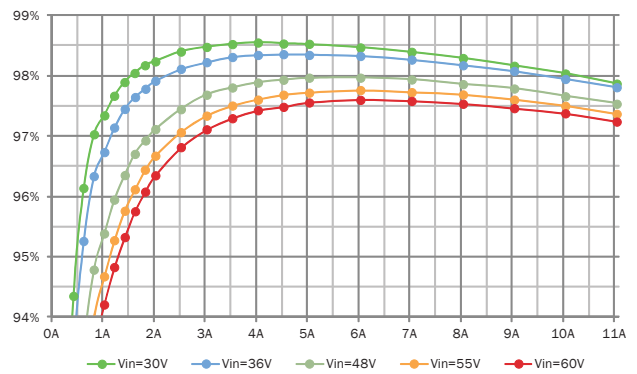
- Constant on time controller – Gen 2
- PFM mode for light load efficiency
- Internal ripple generation
- Reference,  $\pm 0.5\%$  over temperature
- Low shutdown current
- Minimizes external component count
- Compatible with all output capacitor types (MLCC, POSCAP, etc.)
- Remote sense for excellent load regulation
- Adjustable soft start
- Protection:  $V_{IN}$  UVLO;  $V_{OUT}$  OV&UV; Adjustable Output Current Limit; Thermal Shutdown

### FAN6500xx Key Features

- Voltage mode PWM controller
- High efficiency and thermal performance
- Dual LDO: VCC regulators with auto switchover
- Single-pin master/slave synchronization mode
- Programmable fixed frequency
- Single-supply operation simplifies board design
- Protection:  $V_{IN}$  UVLO;  $V_{OUT}$  OV&UV; Adjustable Output Current Limit; Thermal Shutdown



FAN23 vs FAN25 Efficiency



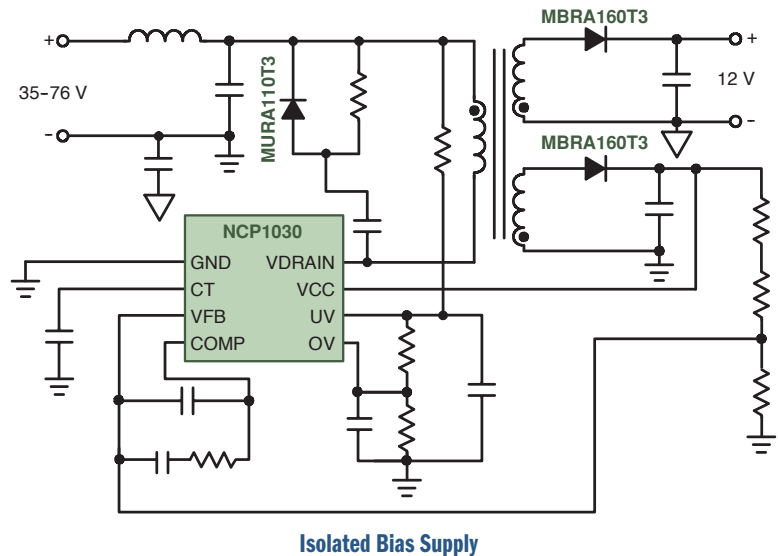
FAN65008B Efficiency –  $V_{OUT} = 28\text{ V}$ ,  $F_{SW} = 300\text{ kHz}$

Device	Load Current (A)	$V_{IN}$ Range (V)	Ultrasonic Mode	External 5 V Bias	Tracking	Ripple Compensation	Frequency (kHz)	Package
FAN2306A/10A/15A	6/10/15	4.5 to 18	✓	✓		External	200 - 1500	PQFN-34L
FAN2306MA	6	4.5 to 18		✓		External	200 - 1500	PQFN-34L
FAN2356A/60A/65A	6/10/15	4.5 to 24	✓	✓		External	200 - 1500	PQFN-34L
FAN23SV06A	6	7 to 18	✓			External	200 - 1500	PQFN-34L
FAN23SV04TA*	4	7 to 18	✓		✓	External	200 - 1500	PQFN-34L
FAN23SV06PA*/10MA/15MA/20MA	6/10/15/20	7 to 18				External	200 - 1500	PQFN-34L
FAN23SV56A/SV60A/SV65A/SV70A	6/10/15/20	7 to 18	✓			External	200 - 1500	PQFN-34L
FAN250130S	30	4.5 to 18	✓	✓		Internal Pin Programmable	200 - 2000	PQFN-34L

\* No PFM Mode.

Device	$V_{IN}$ Range (V)	Frequency (kHz)	Peak Current (A)	Package
FAN65004B	4.5 - 65	100 -1000	6	PQFN-35
FAN65005A	4.5 - 65	100 -1000	8	PQFN-35
FAN65008B	4.5 - 65	100 -1000	10	PQFN-35

## DC-DC Power Conversion



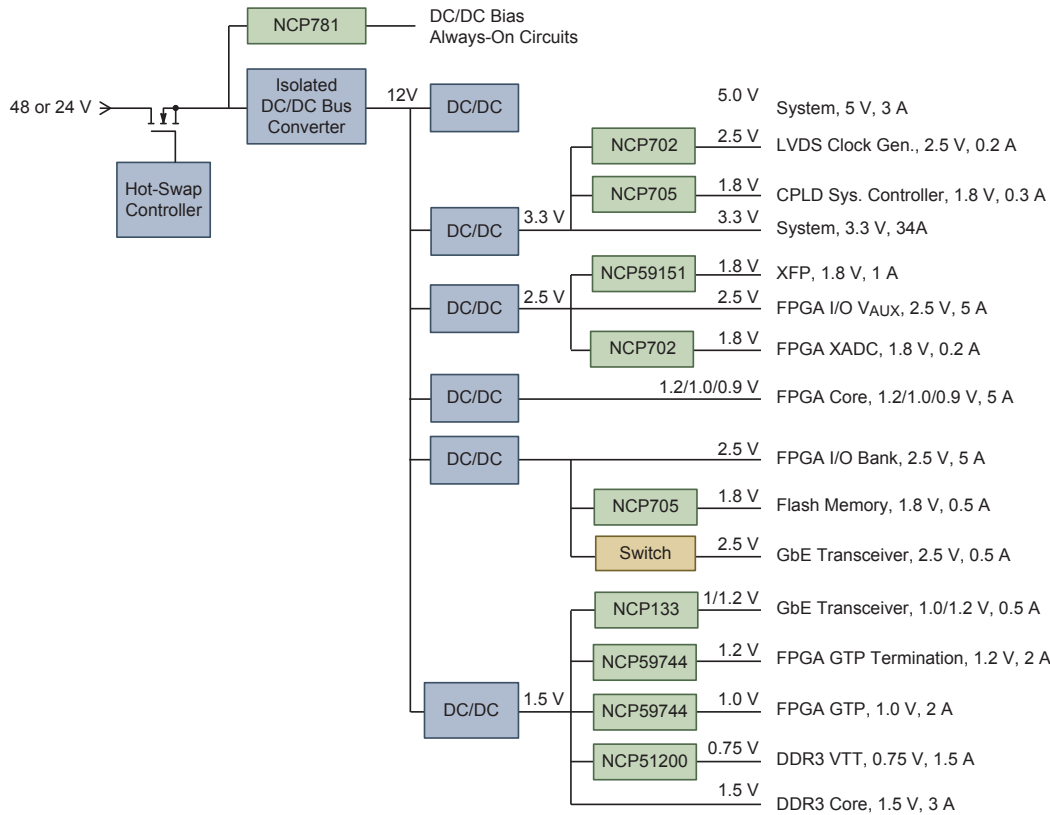
### Regulators

Device	Topology	I <sub>o</sub> Typ (A)	f <sub>sw</sub> Typ (kHz)	V <sub>cc</sub> Min (V)	V <sub>cc</sub> Max (V)	Features	Package(s)
NCP3230	Step-Down	30	500	4.5	18	0.6 V internal voltage reference @ up to 30 A	QFN-40
NCP3231	Step-Down	25	500	4.5	18	0.6 V internal voltage reference @ up to 25 A	QFN-40
NCP3233	Step-Down	20	500	3.0	16	0.6 V internal voltage reference @ up to 20 A	QFN-40
NCP3232N	Step-Down	15	500	4.5	21	0.6 V internal voltage reference @ up to 15 A	QFN-40
NCP3135	Step-Down	5.0	1100	2.9	5.5	5 A continuous output	QFN-16
NCP3133A	Step-Down	3.0	1000	2.9	5.5	3 A continuous output; internal soft start	QFN-16
NCP3170A/B	Step-Down	3.0	500/1000	4.5	18	Output down to 0.8 V	SOIC-8
NCP1032	Flyback; Forward; Step-Down	1.0	Up to 1000	-	200	Integrated 200 V switch; internal soft start	WDFN-8
NCP1031	Flyback; Forward; Step-Down	1.0	Up to 1000	-	200	Integrated 200 V switch	DFN-8, SOIC-8
NCP1030	Flyback; Forward; Step-Down	0.5	300	-	200	2nd side bias supply	Micro8

### PWM Controllers

Device	Topology	V <sub>cc</sub> Min (V)	V <sub>cc</sub> Max (V)	f <sub>sw</sub> Typ (kHz)	Features	Package(s)
CS5124	Flyback; Forward; Step-Down	7.6	75	400	Small package	SOIC-8
NCP1034	Step-Down	8.0	100	Up to 500	Non-isolated buck	SOIC-16
NCP1294	Flyback; Forward; Buck-Boost; Boost	3.3	7.5	Up to 1000	Enhanced UC384x	SOIC-16, TSSOP-16
NCP3011	Step-Down	4.7	28	400	EN, PG, SYNC	TSSOP-14
NCP3020	Step-Down	4.7	28	300; 600	Capable of 20 A output	SOIC-8
NCP81232	Multiphase Step-Down	4.5	20	1200	Compatible to 3.3/5 V DrMOS, Dual Outputs	QFN-40
TL494	Flyback; Forward; Half-Bridge; Push-Pull; Step-Down; Step-Up	7.0	40	Up to 200	Versatile controller	PDIP-16, SOIC-16
TL594	Flyback; Forward; Half-Bridge; Push-Pull; Step-Down; Step-Up	7.0	40	Up to 300	Versatile controller	PDIP-16, SOIC-16, TSSOP-16

## Linear Voltage Regulators



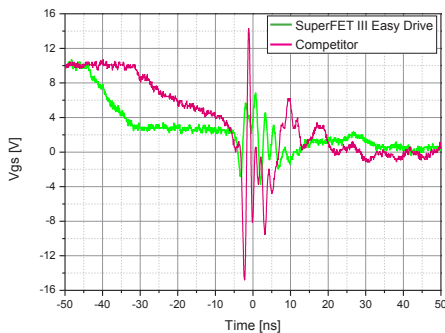
Device	I <sub>O Typ</sub>	Function	Features	Package
TPS2399	–	Hot Swap	-36 to -80 V Supply Voltage	MSOP-8
TPS2398	–	Hot Swap	-36 to -80 V Supply Voltage	MSOP-8
NCP785A	10 mA	High Voltage LDO	Up to 450 V V <sub>IN</sub> ; High PSRR	SC-89
NCP715	50 mA	Ultra-low Quiescent Current LDO	Ultra-low quiescent current; Wide input voltage range	SC-70-5, DFN-6
NCP716	80 mA	Ultra-low Quiescent Current LDO	Ultra-low quiescent current; Wide input voltage range	WDFN-6
NCP781	100 mA	High Voltage LDO	Up to 150 V V <sub>IN</sub> , High PSRR	DFN-6
NCP702	200 mA	Ultra-low Noise LDO	High PSRR; Ultra-low noise	SOT-23-5, WDFN-6
NCP160	250 mA	Ultra-high PSRR	92 db PSRR; Low Noise	WLCSP-4, XDFN-4
NCP163	250 mA	Ultra-low Noise	92 db PSRR; 6.5 μVrms Noise	WLCSP-4, XDFN-4
NCP703	300 mA	Ultra-low Noise LDO	Ultra-low noise; High PSRR	SOT-23-5, WDFN-6
NCP718	300 mA	Ultra-low Quiescent Current LDO	Ultra-low quiescent current, Wide input voltage range	WDFN-6, TSOT-23-5
NCP161	450 mA	Ultra-high PSRR	92 db PSRR; Low Noise	WLCSP-4, XDFN-4
NCP133	500 mA	Ultra-Low Dropout Voltage Regulator with Bias Rail	Typical dropout: 140 mV @ 500 mA; High PSRR; Very fast transient response	XDFN-6
NCP705	500 mA	Ultra-low Noise LDO	Ultra-low noise; High PSRR	WDFN-6
NCP708	1 A	Precision LDO	1% Accuracy, Soft start	UDFN-6
NCP186	1 A	Precision LDO	1% Accuracy, Fast transient response, Ultra low VDO	XDFN-8
NCP59800	1 A	Low Noise, RF LDO	Typical dropout: 200 mV @ 1 A; High PSRR; Ultra-low noise	DFN-8
NCP59748	1.5 A	Ultra-Low Dropout Voltage Regulator with Bias Rail	Typical dropout: 60 mV @ 500 mA; High PSRR; Very fast transient response	DFN-10, QFN-20
NCP51200	3 A	DDR3 Termination Regulator	Fast load transient response; Soft start; Remote sensing	DFN-10
NCP51401	3 A	DDR4 Termination Regulator	Fast load transient response; Soft start; Remote sensing	DFN-10
NCP59744	3 A	Ultra-Low Dropout Voltage Regulator with Bias Rail	Typical dropout: 115 mV @ 3 A; High PSRR; Very fast transient response	QFN-20
NCP59749	3 A	Ultra-Low Dropout Voltage Regulator with Bias Rail	Typical dropout: 120 mV @ 3 A; High PSRR; Very fast transient response	DFN-10, QFN-20

## Wide Selection of High Voltage Power MOSFETs

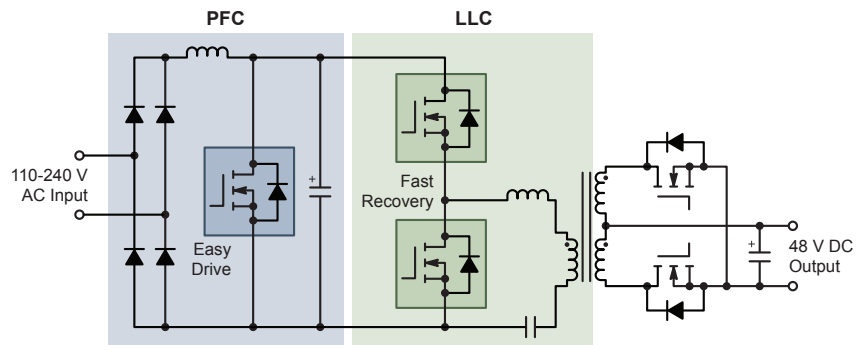
ON Semiconductor offers an expansive portfolio of Power MOSFETs, utilizing advanced SuperJunction technology. Devices enable increased system level efficiency through low switching and low conduction losses, and are available in a range of standard and innovative packages.

### Key Features

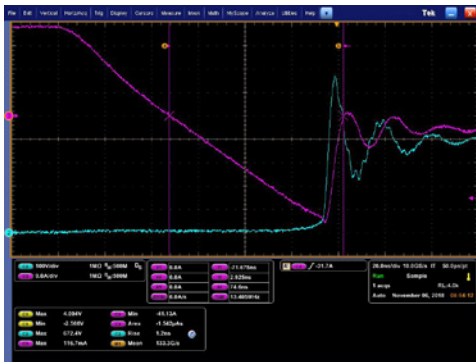
- SuperFET® III Easy Drive
  - Outstanding ease of use and low EMI
  - Excellent Figure-of-Merit ( $R_{DS(ON)}$  Max X  $Q_g$  Typ)
  - Well balanced switching behavior
  - $V_{(BR)DSS}$  of 650 V at  $T_j = 25^\circ\text{C}$ , 700 V at  $T_j = 150^\circ\text{C}$
  - Robust body diode
- SuperFET® III FRFET®
  - No need additional circuit in LLC resonant converter
  - Improving system reliability
  - Best in class body diode performance ( $t_{rr}$ ,  $Q_{rr}$ , robustness)
  - Soft recovery and low peak  $V_{DS}$  during body diode turn-off transient
  - $V_{(BR)DSS}$  of 650 V at  $T_j = 25^\circ\text{C}$ , 700 V at  $T_j = 150^\circ\text{C}$



Gate oscillation during turn-off transient



AC-DC Rectifier Typical Block Diagram



SuperFET III Fast Recovery



Best Competitor

### Body Diode Performance

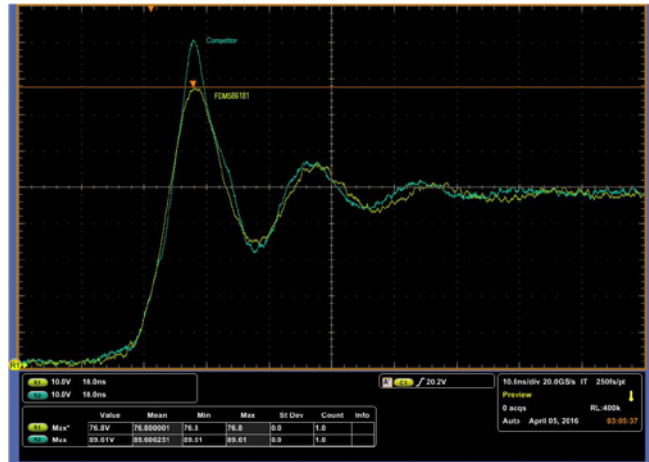
Device	Voltage Range	Current Range	Key Features	Functions	Packages
SuperJunction MOSFET	600 - 800 V	1.6 - 75 A	<ul style="list-style-type: none"> <li>• Outstanding ease of use and low EMI</li> <li>• Excellent FOM (<math>R_{DS(ON)}</math> max. X <math>Q_g</math> typ.)</li> <li>• Well balanced switching behavior</li> <li>• Robust body diode</li> <li>• Soft recovery and small <math>Q_{rr}</math> for FRFET</li> </ul>	High voltage switch for industrial power supply	D2PAK, DPAK, IPAK, TO-220, TO-220F, TO-247, Power88

## Wide Selection of Medium Voltage Power MOSFETs

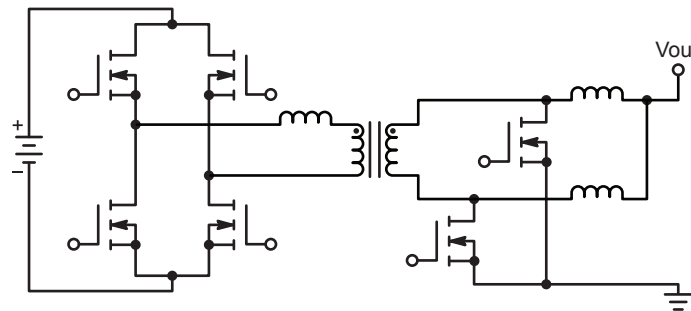
ON Semiconductor offers an expansive portfolio of Power MOSFETs, utilizing advanced shielded gate technology. Devices enable increased system level efficiency through low conduction and low switching losses, and are available in a range of standard and innovative packages.

### Key Features

- T6 and T8, 40 to 80 V technology
- 80 V to 120V PTNG
  - Optimised low  $R_{DS(ON)}$  and  $Q_g$
  - Ultra soft body diode with PTNG
  - Lowest  $R_{DS(ON)}$  in SO-8FL with T6
  - Provides low ringing
  - Improved EMI performance
  - Lower conduction losses
  - Lower switching losses
  - Best in class body diode
  - Soft recovery and small  $Q_{rr}$
  - Ultra low gate resistance for fast switching



Overshoot Reduction Enabled by Shielded Gate MOSFET Technology



Isolated DC-DC Schematic

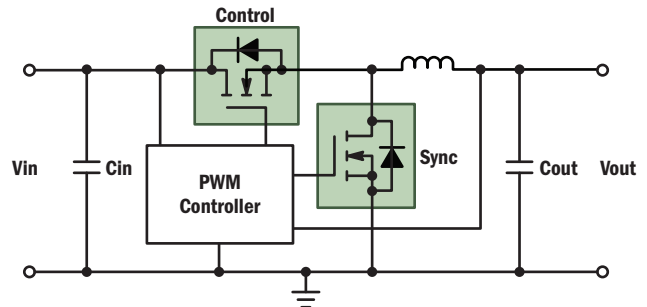
Device	Voltage Range	Current Range	Key Features	Functions	Packages
Medium Voltage MOSFET	40 - 250 V	2 - 52 A	<ul style="list-style-type: none"> <li>• Outstanding switching performance and low EMI</li> <li>• Excellent FOM (<math>R_{DS(ON)}</math> max. X <math>Q_g</math> typ.)</li> <li>• Well balanced switching behavior</li> <li>• Robust body diode</li> <li>• Soft recovery and small <math>Q_{rr}</math></li> </ul>	Primary and secondary MOSFET for DC-DC power supply	TO-220, D2PAK, DPAK, TOLL, SO-8FL, $\mu$ 8FL, Power56, Power33, Power22, SO-8, SSOT-6, SSOT-3

## N-Channel MOSFETs for Power Conversion

Non-Isolated Topology "Buck" DC-DC

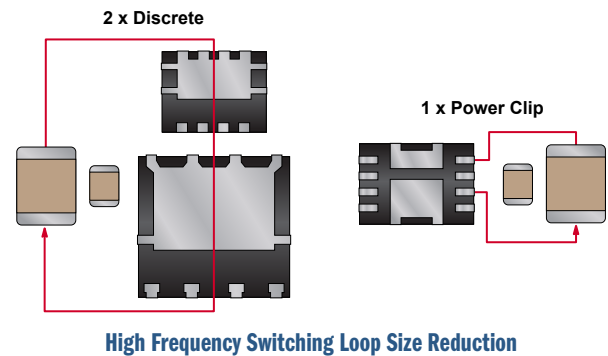
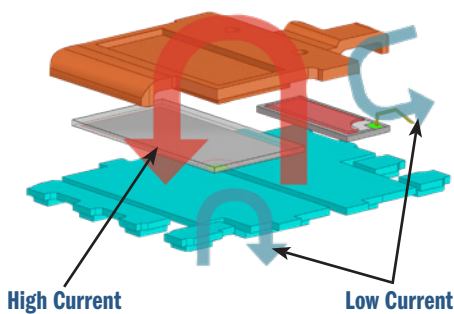
### Key Features

- Low RDS(ON) for low conduction loss
- Low capacitance for low switching loss
- Integrated Schottky for enhanced light load efficiency



### Increasing Power Density with PowerClip Dual MOSFETs

- Single optimized clip reduces interconnect parasitics
  - Up to 40 A in 5x6 mm & 25 A in 3x3 mm
- Flipped low side die reduces source inductance & improves thermals



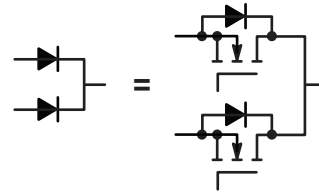
Device	Package	I <sub>max</sub> (A)	BV <sub>DSS</sub> (V)	V <sub>GS</sub> Max (V)	R <sub>DS(ON)</sub> Max @ V <sub>GS</sub> = 4.5 V (mΩ)		Q <sub>g</sub> Typ @ V <sub>GS</sub> = 4.5 V (nC)		C <sub>oss</sub> Typ (pF)
					High Side	Low Side	High Side	Low Side	Low Side
FDPC8012S	Power Clip 33	15-20	25	12	7	2.2	8	25	885
FDPC8013S		10-15	30	20	9.6	2.7	6	21	997
FDPC3D5N025X9D		10	25	12	3.7	3.7	17	17	612
FDPC8016S	Power Clip 56	20-30	25	12	4.7	1.7	11	31	1195
FDPC8014S		>30	25	12	4.7	1.4	11	43	1720
FDPC8014AS		>30	25	12	4.7	1.2	11	44	2170
FDMS001N025DSD		>30	25	16	4	1.1	10	35	1810
FDMS1D2N03DSD		>30	30	16	4	1.2	11	39	1845
FDPC5018SG		25	30	12	6.5	2	8	28	1210
FDPC5030SG	20	30	12	6.5	3	8	18	801	



## ORing MOSFETs

### Key Features

- Ultra low  $R_{DS(ON)}$  for low conduction loss
- 25 V and 30 V for IM bus ORing
- 100 V for 48 V bus ORing
- Much more efficient and reliable solution than power diodes



MOSFETs as ORing Diodes

Device	Configuration	$V_{DS}$ (V)	$V_{GS}$ (V)	$R_{DS(ON)}$		$Q_g$ (nC)	$Q_{gd}$ (nC)	Package
				$V_{GS} @ 10 V$	$V_{GS} @ 4.5 V$			
				Max (m $\Omega$ )	Max (m $\Omega$ )			
NTMFS4H01N	Single	25	20	0.7	0.9	39	8.5	S08-FL
NTMFS4H02N	Single	25	20	1.3	1.9	26	5.8	S08-FL
FDMS8050	Single	30	20	0.65	0.9	93	18	Power56
NTMFS4C020N	Single	30	20	0.7	1	63	13	S08-FL
FDMC8010	Single	30	20	1.3	1.8	32	9.5	Power33
NTTFS4C02N	Single	30	20	2.3	3.1	20	4	U8FL
NTMFS5C404NL	Single	40	20	0.67	1	81	23.8	S08-FL
NTMFS5H400NL	Single	40	20	0.8	1.1	54	13	S08-FL
NTMFS5C604NL	Single	60	20	1.2	1.7	52	12.7	S08-FL
NTMFS5H600NL	Single	60	20	1.3	1.7	40	6.5	S08-FL
NTMTS6H800N	Single	80	20	2.1	–	85	16	S08-FL
FDMS86180	Single	100	20	3.2	–	60	12	Power56

## Advanced P-Channel MOSFETs for Power Load Switch

### Key Features

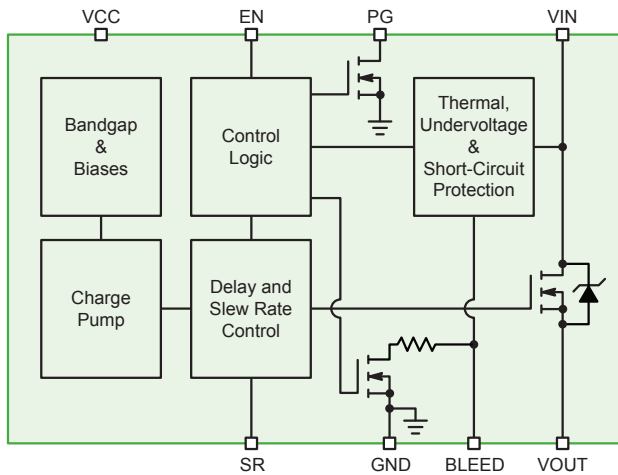
- Ultra low  $R_{DS(ON)}$  to improve system efficiency
- Advanced package technology for space saving and excellent thermal conduction

Device	Configuration	Polarity	$V_{DS}$ (V)	$V_{GS}$ (V)	$R_{DS(ON)}$		$Q_g$ (nC)	$C_{iss}$ (pF)	Package
					$V_{GS} @ 10 V$	$V_{GS} @ 4.5 V$			
					Max (m $\Omega$ )	Max (m $\Omega$ )			
FDMC610P	Single	P	12	8	–	3.9	71	890	Power33
NTLUS3C18PZ	Single	P	12	10	–	24	16	1570	UDFN-6
FDMC4D9P20X8	Single	P	20	12	–	4.9	78	7535	PQFN-8
FDMA008P20LZ	Single	P	20	8	–	13	28	3131	PQFN-6
NTMFS002P03P8Z	Single	P	30	25	1.7	2.8	242	14712	SO-8FL HE
NTTFS008P03P8P	Single	P	30	25	4.5	7.2	85	5246	Power33
FDMA6676PZ	Single	P	30	25	13.5	27	20	1440	PQFN-6
NTLUD3A50PZ	Dual	P	20	8	–	48	10.4	920	UDFN-6

## Advanced Load Switches

ON Semiconductor provides a comprehensive range of load switches, suitable for a variety of different power trees.

- Copackaged MOSFET plus CMOS controllers – value-added features plus high performance
- Monolithic CMOS smart load switches – value added features, low cost
- Discrete MOSFETs – simple, high performance



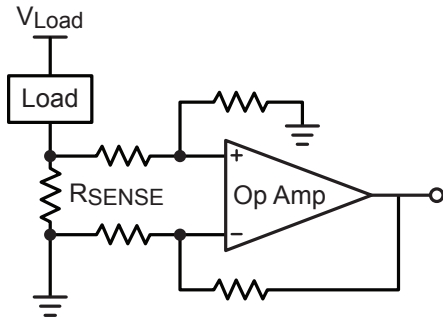
### NCP45xxx Integrated Load Switch Key Features

- Simple/clean design
- No current consumption in standby power mode
- Small PCB footprint
- Low RDS(ON) due to charge pump driving NMOS
- Adjustable soft-start time (SR)
- Adjustable integrated discharge
- Fault protection
- Power rail monitoring & sequencing

Type	Device	r <sub>on</sub> (mΩ)	I Max (A)	V <sub>I</sub> Min (V)	V <sub>I</sub> Max (V)	I <sub>Q</sub> (μA)	Discharge	Slew Rate (μs)	Features	Package(s)
Smart Load Switch	NCP333	55 at 3.3 V	1.5	1.2	5.5	1	Auto	95	–	WLCSP-4
	FPF1504	15 at 3.3 V	1.5	1	3.6	0.1	Auto	130	–	WLCSP-4
	NCP433	50 at 1.8 V	1.5	1	3.6	0.6	Auto	20	–	WLCSP-4
	NCP334	47 at 3.3 V	2	1.2	5.5	1	–	71	–	WLCSP-4
	NCP335	47 at 3.3 V	2	1.2	5.5	1	Auto	71	–	WLCSP-4
	NCP435	43 at 1.8 V	2	1	3.6	0.6	Auto	61	–	WLCSP-4
	FPF1204	45 at 5.5 V	2.2	1.2	5.5	1.5	Auto	100	–	WLCSP-4
	NCP330	26 at 3.3 V	3	1.8	5.5	100	–	2000	Reverse blocking	TDFN-4
	NCP336	23 at 3.3 V	3	1.2	5.5	1	–	810	–	WLCSP-6
	NCP337	23 at 3.3 V	3	1.2	5.5	1	Auto	810	–	WLCSP-6
	NCP339	26 at 3.3 V	3	1.2	5.5	2	–	2700	Reverse blocking	WLCSP-6
	FPF1038	20 at 5.5 V	3.5	1.2	5.5	5.5	–	2700	–	WLCSP-6
	FPF1039	20 at 5.5 V	3.5	1.2	5.5	5.5	Auto	2700	–	WLCSP-6
	FPF2411	10 at 5.0 V	6	2.3	5.5	1	–	3000	Reverse blocking	WLCSP-12
	ecoSWITCH™ Integrated Load Switch	NCP45524	18.0	6	0.5	13.5	–	Adj	–	Power good
NCP45525		18.0	6	0.5	13.5	–	Adj	Adj	–	DFN-8
NCP45560		2.4	24	0.5	13.5	–	Adj	Adj	Power good; Fault	DFN-12
NCP45540		3.3	20	0.5	13.5	–	Adj	Adj	Power good; Fault	DFN-12
NCP45541		3.3	20	0.5	13.5	–	Adj	Adj	Power good	DFN-12
NCP45520		9.5	10.5	0.5	13.5	–	Adj	–	Power good; Fault	DFN-8
NCP45521		9.5	10.5	0.5	13.5	–	Adj	Adj	Fault	DFN-8

## Current Sensing Solutions Using Amplifiers

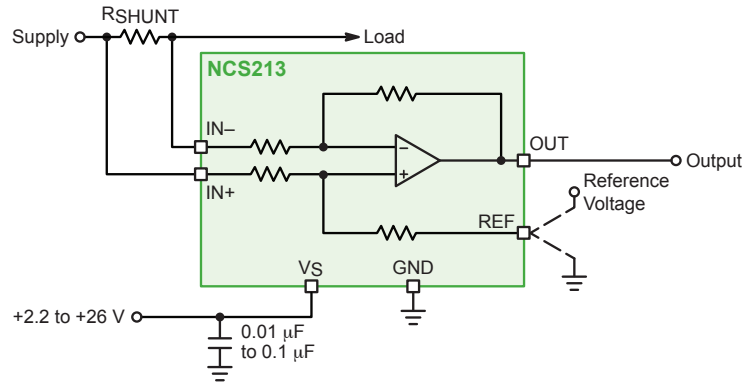
As part of an expansive portfolio, amplifiers from ON Semiconductor offer precision performance over time and temperature, making them ideal for current sensing in system monitoring and protection circuits.



Current Sensing Solution with External Gain Setting Resistors

**NCSx333 Zero Drift Op Amp**  
 $V_{OS} = 10 \mu V$   
 50 mV Shunt Drop  
 Only 0.02% Offset Error

**NCS200xx Low Power Op Amp**  
 $V_{OS} = 4 mV$   
 50 mV Shunt Drop  
 8% Offset Error



Current Sensing Solution with Integrated Gain Setting Resistors

**NCS21x Current Sense Amplifiers**  
 $V_{OS} = 35 \mu V$   
 50 mV Shunt Drop  
 0.07% Offset Error

### Zero Drift Current Sense Amplifiers (Integrated and Precision Performance)

Device	Channels	$V_S$ Min (V)	$V_S$ Max (V)	Input CM Range (V)	GBW (kHz)	$V_{OS}$ Max ( $\mu V$ )	$V_{OS}$ Drift ( $\mu V/^\circ C$ )	Gain Error (%)	CMRR (dB)	Features	Package
NCS21x	1	2.2	26	2.2 to 26	14	35	0.5	1	140	Low $V_{OS}$	SOT-363

### Low Voltage, Zero Drift Amplifiers (High Precision)

Device	Channels	$V_S$ Min (V)	$V_S$ Max (V)	Input CM Range (V)	$I_Q$ /Channel ( $\mu A$ )	GBW (kHz)	$V_{OS}$ Max ( $\mu V$ )	$V_{OS}$ Drift ( $\mu V/^\circ C$ )	CMRR (dB)	$e_{p-p}$ ( $\mu V_{pp}$ )	Features	Package
NCS325	1	1.8	5.5	$V_{SS}-0.1$ to $V_{DD}+0.1$	21	350	50	0.02	110	1	Low $V_{OS}$	SOT-23
NCSx333	1, 2, 4	1.8	5.5	$V_{SS}-0.1$ to $V_{DD}+0.1$	21	350	10	0.03	120	1	Low $V_{OS}$	SOT-23-5, SC-70-5, DFN-8, Micro8, SOIC-8, SOIC-14

### Low Voltage Amplifiers (Standard)

Device	Channels	$V_S$ Min (V)	$V_S$ Max (V)	$I_Q$ /Channel ( $\mu A$ )	GBW (MHz)	$V_{OS}$ Max (mV)	$V_{OS}$ Drift ( $\mu V/^\circ C$ )	$I_B$ (nA)	CMRR (dB)	Rail-to-Rail	Features	Package
NCS2009x	1,2	1.8	5.5	20	0.35	4	1	0.001	80	I/O	Low $I_Q$ & $V_{OS}$	SOT-23-5, SC-70-5, UDFN-6, Micro8, TSSOP-8, SO-8
NCS2008x	1,2	1.8	5.5	50	1.2	4	1	0.001	80	I/O	Low $I_Q$ & $V_{OS}$	SOT-23-5, SC-70-5, UDFN-6, Micro8, TSSOP-8, SO-8
NCS2006x	1,2	1.8	5.5	140	3	4	1	0.001	80	I/O	Low $I_Q$ & $V_{OS}$	SOT-23-5, SC-70-5, UDFN-6, Micro8, TSSOP-8, SO-8
NCS2003x	1, 2, 4	1.7	5.5	275	7	5	2	0.001	80	Output	Fast Slew Rate, Low $V_S$ & $I_B$	SOT-23-5, SOT-553, Micro8, SOIC-8, TSSOP-8
NCS2007x	1, 2, 4	2.7	36	400	3	4	2	0.005	110	Output	Wide $V_S$ range	SOT-553, TSOP-5, Micro8, SO-8, TSSOP-8

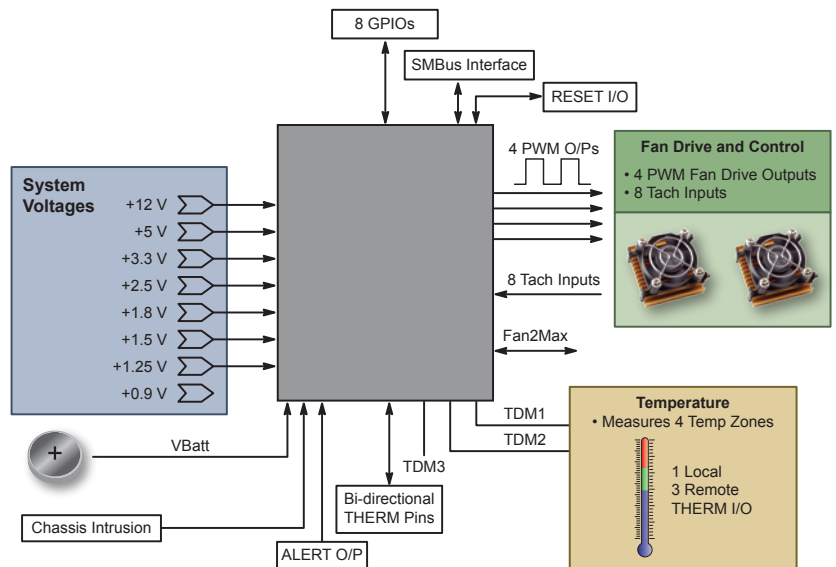
## Thermal Management

### Extensive Portfolio

**Remote Sensors** provide temperature information of a transistor located at a different position on the board; also includes local sensor capability

**Fan Controllers** integrate the temperature sensor with a fan controller/monitor

**System Monitors** integrate combinations of remote and/or local temperature sensing, voltage monitoring, fan control & monitoring, reset control, and GPIO functions

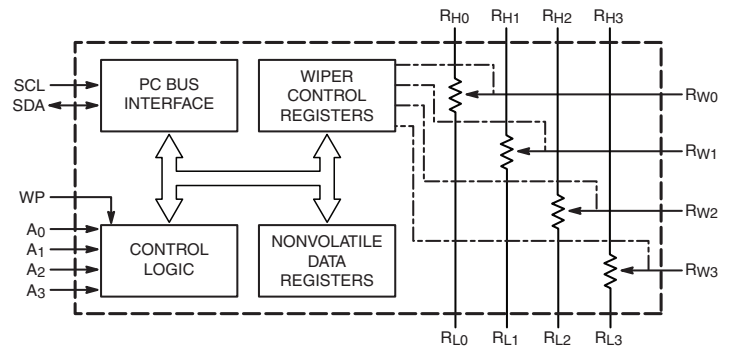


	Device	Supply Range (V)	Temperature Range (°C)	Local Accuracy (°C)	Interface	Number of Addresses	SRC (Ω)	Remote Accuracy	Remote Channels	Fan Channels	TACH Channels	Voltage Monitoring Channels	GPIOs	Package
<b>System Monitors</b>	ADM1026	3 - 5.5	-40 to +120	±3	I2C/SMBUS	3	—	±3	2	8	8	19	17	LQFP-48
	ADT7462	3 - 5.5	-40 to +125	±2.25	I2C/SMBUS	2	2 k	±2.25	3	4	8	13	8	LFCSOP-32
	NCT80	2.8 - 5.75	-40 to +125	±2	I2C/SMBUS	8	—	—	—	—	2	7	1	TSSOP-24
	ADT7476	3 - 3.6	-40 to +120	±1.5	I2C/SMBUS	3	—	±1.5	2	3	4	5	—	QSOP-24
<b>Fan Controllers</b>	ADT7473	3 - 3.6	-40 to +120	±1.5	I2C/SMBUS	3	3 k	±1.5	2	3	4			QSOP-16
	ADT7475	3 - 3.6	-40 to +120	±1.5	I2C/SMBUS	1	—	±1.5	2	3	4			QSOP-16
	ADM1033	3 - 3.6	-40 to +120	±1	I2C/SMBUS	8	1 k	±1	1	1	1			QSOP-16
<b>Remote Sensors</b>	NCT72	2.8 - 3.6	-40 to +125	±1	I2C/SMBUS	2	1.5 k	±1	1					DFN-8, WDFN-8
	NCT218	1.4 - 2.75	-40 to +125	±1.75	I2C/SMBUS	2	150	±1	1					WDFN-8, WLCSOP-8
	ADM1032	3 - 5.5	-40 to +125	±3	I2C/SMBUS	2	—	±1	1					SOIC-8, MSOP-8
	ADT7461	3 - 5.5	-40 to +125	±3	I2C/SMBUS	2	3 k	±1	1					SOIC-8, MSOP-8
	ADT7481	3 - 3.6	-40 to +125	±1	I2C/SMBUS	2	—	±1	2					MSOP-10
	ADT7483	3 - 3.6	-40 to +125	±1	I2C/SMBUS	9	—	±1	2					QSOP-16

## Digital Potentiometers (POTs) for Trimming and Calibration

### Key Features

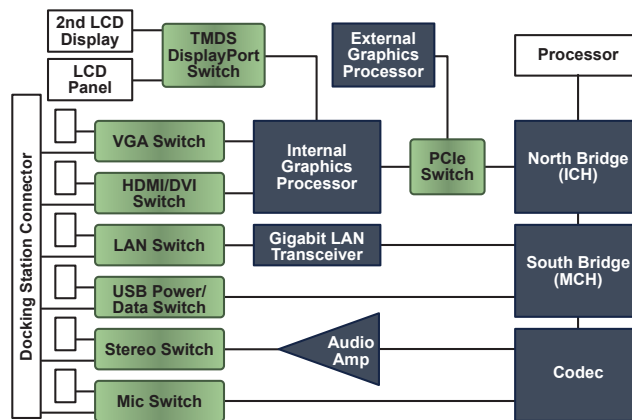
- No drift over time or temperature
- No changes due to mechanical stress or shock
- Systems can be calibrated real-time, in the field
- Broad portfolio provides for selection of optimal number of pots and taps



Device	Number of Pots	Number of Taps	Resistance (kΩ)	Buffered Wiper	Interface	Volatile	Non-Volatile	Packages
CAT5120/1/2	1	16	10, 50, 100		UP/DOWN	✓		SOT-23-6, SC-70-6
CAT5110	1	32	10, 50, 100		UP/DOWN	✓		SOT-23-6, SC-70-6
CAT5112	1	32	10, 50, 100	✓	UP/DOWN		✓	PDIP-8, SOIC-8, MSOP-8, TSSOP-8
CAT5114	1	32	10, 50, 100		UP/DOWN		✓	PDIP-8, SOIC-8, MSOP-8, TDFN-8, TSSOP-8
CAT5115	1	32	10, 50, 100		UP/DOWN	✓		PDIP-8, SOIC-8, MSOP-8, TSSOP-8
CAT5118/9	1	32	10, 50, 100		UP/DOWN	✓		SOT-23-5, SC-70-5
CAT5123/4	1	32	10, 50, 100		UP/DOWN	✓		SOT-23-5
CAT5125	1	32	10, 50, 100		UP/DOWN	✓		SOT-23-6
CAT5126	1	32	10, 50, 100		UP/DOWN		OTP	MSOP-8, TDFN-8
CAT5127	1	32	10, 50, 100		UP/DOWN		✓	MSOP-8, TDFN-8
CAT5128	1	32	10, 50, 100		UP/DOWN	✓		SOT-23-8
CAT5129	1	32	10, 50, 100		UP/DOWN		✓	TSOT-23-6
N57M5114	1	32			UP/DOWN		✓	SOIC-8, MSOP-8, TDFN-8, TSSOP-8
N57L5125	1	32			UP/DOWN	✓		SOIC-8, MSOP-8, TDFN-8, TSSOP-8
N57M5127	1	32			UP/DOWN		✓	SOIC-8, MSOP-8, TDFN-8, TSSOP-8
N57L5128	1	32			UP/DOWN	✓		SOT-23-8
CAT5111	1	100	10, 50, 100	✓	UP/DOWN		✓	PDIP-8, SOIC-8, MSOP-8, TSSOP-8
CAT5113	1	100	1, 10, 50, 100		UP/DOWN		✓	PDIP-8, SOIC-8, MSOP-8, TSSOP-8
CAT5116	1	100	32 (Log Taper)		UP/DOWN		✓	PDIP-8, SOIC-8, MSOP-8, TSSOP-8
CAT5132	1	128	10, 50, 100		I <sup>2</sup> C		✓	MSOP-10
CAT5133	1	128	10, 50, 100		UP/DOWN		✓	MSOP-10
CAT5137	1	128	50		I <sup>2</sup> C		✓	SC-88-6, SC-70-6
CAT5138	1	128	10		I <sup>2</sup> C		✓	SC-88-6, SC-70-6
CAT5140	1	256	50, 100		I <sup>2</sup> C		✓	MSOP-8
CAT5171	1	256	50, 100		I <sup>2</sup> C		✓	SOT-23-8
CAT5172	1	256	50		SPI		✓	SOT-23-8
CAT5221	2	64	2.5, 10, 50, 100		I <sup>2</sup> C		✓	SOIC-20, TSSOP-20
CAT5411	2	64	2.5, 10, 50, 100		SPI		✓	SOIC-24, TSSOP-24
CAT5419	2	64	2.5, 10, 50, 100		I <sup>2</sup> C		✓	SOIC-24, TSSOP-24
CAT5261	2	256	50, 100		SPI		✓	SOIC-24, TSSOP-24
CAT5269	2	256	50, 100		I <sup>2</sup> C		✓	SOIC-24, TSSOP-24
CAT5271	2	256	50, 100		I <sup>2</sup> C		✓	MSOP-10
CAT5273	2	256	50		I <sup>2</sup> C		✓	MSOP-10
CAT5241	4	64	2.5, 10, 50, 100		I <sup>2</sup> C		✓	SOIC-20, TSSOP-20
CAT5401	4	64	2.5, 10, 50, 100		SPI		✓	SOIC-24, TSSOP-24
CAT5409	4	64	2.5, 10, 50, 100		I <sup>2</sup> C		✓	SOIC-24, TSSOP-24
CAT5251	4	256	50, 100		SPI		✓	SOIC-24, TSSOP-24
CAT5259	4	256	50, 100		I <sup>2</sup> C		✓	SOIC-24, TSSOP-24

## Switching Devices

ON Semiconductor offers a range of switching devices for high speed interface in servers, desktop computing, notebook and netbook computers. Applications include PCI Express, DisplayPort, Gigabit Ethernet and USB 2.0.



### Server Implementation

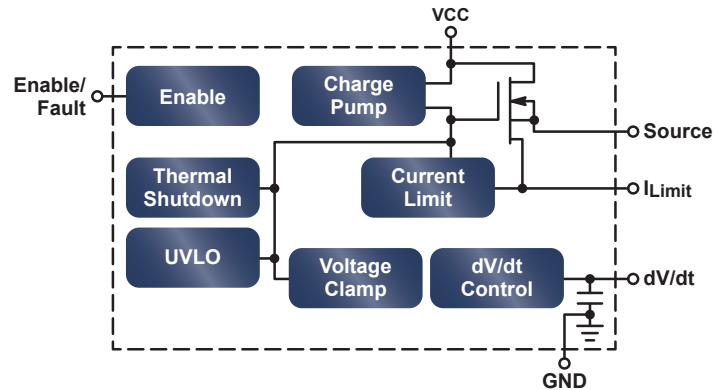
Device	Interface	Data Rate	No Channels	Quiescent Current
NCN1188	USB 2.0 / MHL	2.25 Gb/s	2	21 $\mu$ A
NS5S1153	USB 2.0	480 Mb/s	2	21 $\mu$ A
NLAS7242	USB 2.0	480 Mb/s	2	1 $\mu$ A
NLAS4684	Audio	9.5 MHz	2	180 nA

# Electronic Fuses for Inrush Current Limiting on Power Buses

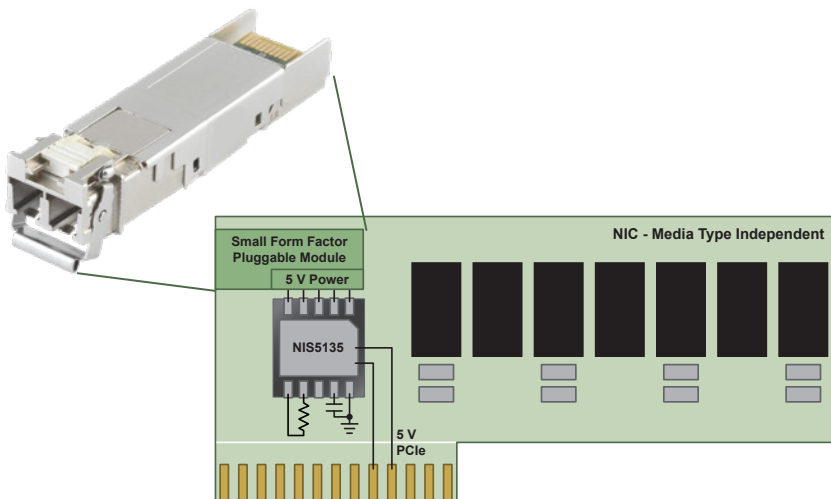
## 3-12 V Power Bus Hot Plug Protection

### Key Features

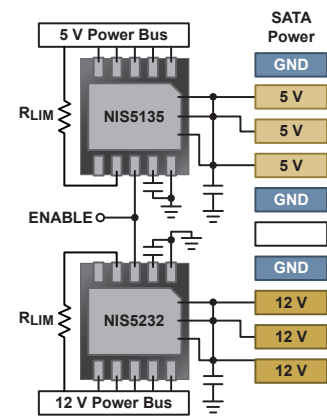
- Low RDS(ON), high operating and trip currents (IOP, ITRIP)
- Overvoltage protection
- Precise ITRIP control
- Slew rate control
- Thermal shut-down
- EN pin for synchronizing multiple eFuses
- Outperforms poly-fuses:
  - Tighter spec tolerances
  - Lower resistance
  - Shorter trip-time
  - Superior repeatability
- High efficiency with high current capability
- eFuses in parallel achieve practically any desired level of IOP and ITRIP



Typical Feature Set for eFuse



Network Interface Card Application



Hard Drive/Solid State Drive Application

Device	Nominal Voltage (V)	Input Voltage (V)	Output Clamping Voltage (V)	Continuous Current (A)	Trip Current (A)	RDS(ON) (mΩ)	Auto-Retry	Latching	Package
NIS5135	5	-0.6 to 18	6.65	3.6	Adjustable	68	✓	✓	DFN-10
NIS5132	12	-0.6 to 18	15	4.2	Adjustable	44	✓	✓	DFN-10
NIS5232	12	-0.6 to 18	15	4.2	Adjustable	44	✓	✓	DFN-10
NIS5820*	12	-0.3 to 20	14	8	Adjustable	24	✓	✓	WDFN-10
NIS5020*	12	-0.3 to 20	14	10	Adjustable	14	✓	✓	WDFN-10
NIS5021*	12	-0.3 to 20	14	12	Adjustable	14	✓	✓	WDFN-10

\* Pending 1Q19.

## Ethernet: 10/100BASE-T, 1000BASE-TX, and Gigabit

### Surge/ESD Protection for Four Pairs

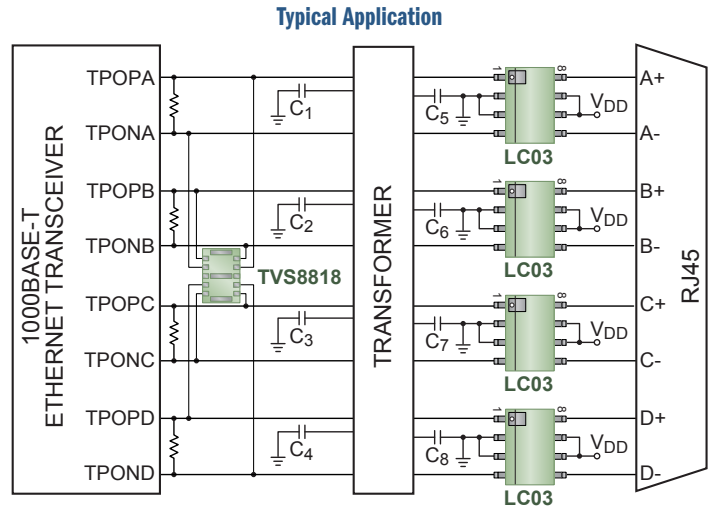
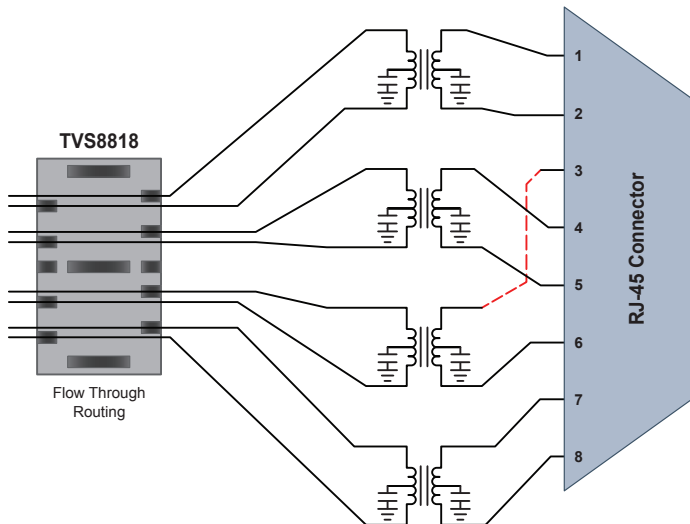
The 1000BASE-T or Gigabit Ethernet interface operating at higher bitrates is susceptible to ESD strikes, cable-discharge events and lightning-induced transients. Our products help meet IEC 61000-4-5, GR-1089-CORE and other Standards.

#### Key Features

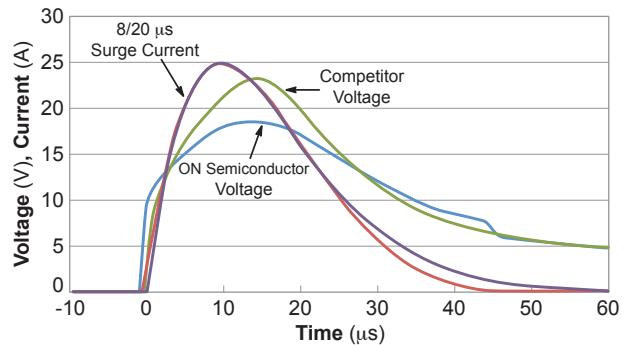
- Line-to-line capacitance < 3 pF
- $V_{clamp}$  (25 A surge) < 11 V
- IEC 61000-4-2 rating > 30 kV
- No latching danger
- Surge rating maintained to 125°C

#### Benefits

- Compatible with Gb Ethernet and beyond
- Enhanced protection for downstream electronics
- Accommodates operating transients above 3.3 V
- Small form-factor allows integration into connectors



Line Side : LC03-6 (optional)  
Transformer Side: TVS8818  
Protection against metallic (transverse) strikes



Line-to-Line Surge

#### Surge Protection Devices

Device	V <sub>DC</sub> Max (V)	Line Transient Max (V)	Surge I <sub>pp</sub> , 8/20 μs (A)	Typical Line-Line Capacitance (pF)	ESD Contact Rating (kV)	Package
LC03-6	6.7	7.0	100	8.0	±30	SOIC-8
TVS8814	3.0	3.2	35	1.5	±30	UDFN-8
TVS8818	3.0	3.2	35	1.5	±30	UDFN-10
SRDA3.3	3.3	5.0	25	4.0	±8	SOIC-8
SRDA05	5.0	7.0	23	5.0	±8	SOIC-8
NUP4114H	5.0	5.0	12*	0.4	±13	TSOP-6

\* On Pin 5.



## T1/E1, T3/E3, and xDSL Ports

*Surge protection for GR-1089, TIA-968-A, ITU-T and IEC 61000-4-5*

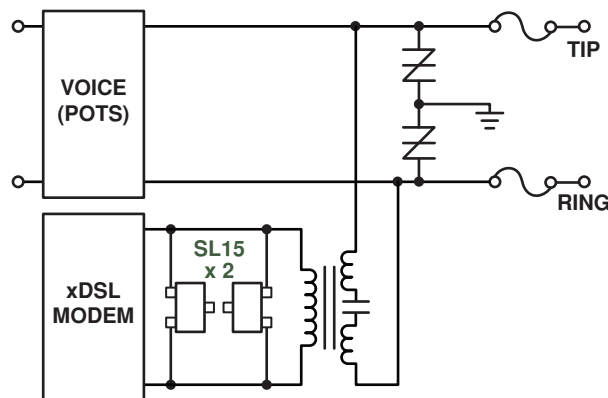
T1/E1 links (< 2 Mbps), T3/E3 links (< 43 Mbps) and xDSL lines (< 52 Mbps) are susceptible to ESD strikes, cable-discharge events and lightning-induced transients.

### Surge Protection Features

- Capable of all T1/E1 and xDSL voltages with a variety of capacitance values, for driver-side protection

### Benefits

- Surge protection devices provide high levels of tertiary protection without latching



Typical xDSL + POTS Application

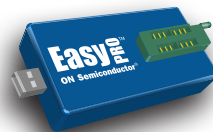
### Surge Protection Devices

Device	V <sub>DC</sub> Max (V)	Surge I <sub>pp</sub> , 8/20 μs (A)	Line-Line Capacitance (pF)	ESD Contact Rating (kV)	Package
SRDA3.3	3.3	25	4.0	±8	SOIC-8
SRDA05	5.0	23	5.0	±8	SOIC-8
LC03-6	5.0	100	8.0	±30	SOIC-8
SL05 to SL24	5 to 24	5 to 17	3.5	±8	SOT-23

## EEPROMs for Configuration and Calibration

### Key Features

- Broad density range: 1 kb to 2 Mb
- Wide operating Vcc range: 1.7 V to 5.5 V
- High endurance: 1 million program/erase cycles
- Wide temperature range: industrial and extended



EasyPRO™ is a user-friendly, portable programming tool for ON Semiconductor serial EEPROMs (I<sup>2</sup>C, SPI, Microwire)

### EEPROMs

Data Transmission Standard	Density	Organization*	V <sub>CC</sub> Min (V)	V <sub>CC</sub> Max (V)	f <sub>CLK</sub> Max (MHz)	Package(s)
I <sup>2</sup> C	1 Mb	128k x 8	1.7, 1.8	5.5	0.4, 1	US8, SOIC-8, TSSOP-8, UDFN-8, TSOT23-5, WLCSP-4, WLCSP-5
	512 kb	64k x 8				
	256 kb	32k x 8				
	128 kb	16k x 8				
	64 kb	8k x 8				
	32 kb	4k x 8				
	16 kb	2k x 8				
	8 kb	1k x 8				
	4 kb	512 x 8				
	2 kb	256 x 8				
SPI	2 Mb	256k x 8	1.7, 1.8	5.5	10, 20	SOIC-8, TSSOP-8, UDFN-8
	1 Mb	128k x 8				
	512 kb	64k x 8				
	256 kb	32k x 8				
	128 kb	16k x 8				
	64 kb	8k x 8				
	32 kb	4k x 8				
	16 kb	2k x 8				
	8 kb	1k x 8				
	4 kb	512 x 8				
	2 kb	256 x 8				
1 kb	128 x 8					
Microwire	16 kb	2k x 8 / 1k x 16	1.65, 1.8	5.5	2, 3, 4	SOIC-8, TSSOP-8, UDFN-8
	16 kb	2k x 8 / 1k x 16				
	8 kb	1k x 8 / 512 x 16				
	8 kb	1k x 8 / 512 x 16				
	4 kb	512 x 8 / 256 x 16				
	2 kb	256 x 8 / 128 x 16				
	1 kb	128 x 8 / 64 x 16				
1 kb	128 x 8 / 64 x 16					

\* Organization for Microwire devices is selectable.

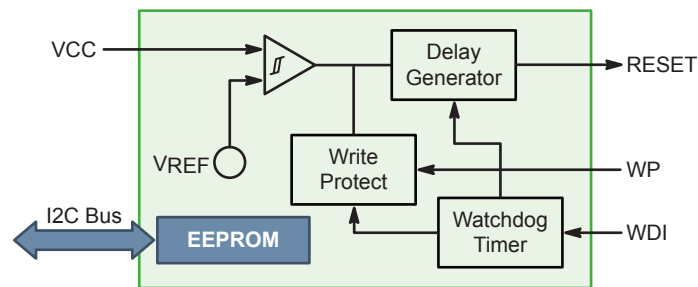
## Voltage Supervisors with I2C Serial EEPROM and Watchdog Timer

### Supervisory Features

- Precision power supply voltage monitor
- Available voltage thresholds: 4.50 V, 4.25 V, 3.0 V, 2.85 V, 2.55 V
- Active High or Low Reset, Manual Reset
- Watchdog Timer (N84C161, N84C163)

### 16 kb Serial EEPROM Features

- Supply Voltage: VCC = 2.7 to 6.0 V
- 400 KHz, 100 KHz I2C Serial Protocol
- Endurance: 1 million Write cycles
- Retention: 100 years
- Hardware Write Protect



Device	Watchdog Timer	Manual Reset	Write Protect	Package
N84C161	SDA	✓	✓	SOIC-8
N84C162	–	✓	✓	SOIC-8
N84C163	–	✓	✓	SOIC-8

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