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ON Semiconductor®

Energy Efficient Innovations

Computing Solutions

Comprehensive power management, switching, timing, and protection solutions for computing platforms from ON Semiconductor.

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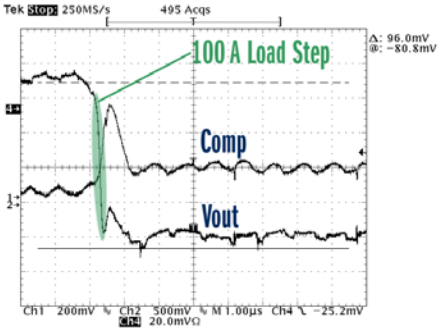
Dual-Edge & RPM Modulation Vcore Controllers

for IMVP8 Designs

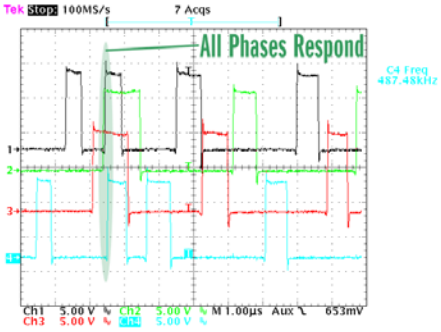
Features of Multi-Phase Dual Edge Architecture

- Current-mode dual-edge modulation for fast initial response to transient loading
- High-performance operational error amplifier
- Accurate total summing current amplifier
- High-impedance differential voltage and total current sense amplifiers
- Phase-to-phase dynamic current balancing
- "Lossless" DCR current sensing for current balancing



Features of Enhanced Single-Phase RPM Architectures

- High performance RPM control system
- Ultralow offset IOUT monitor
- Dynamic VID feed-forward
- Programmable droop gain
- Zero droop capable
- Thermal monitor
- Ultra-sonic operation
- Digitally controlled operating frequency



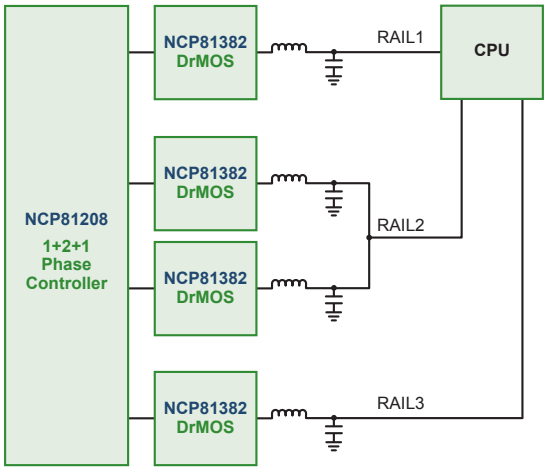
Device	Market	Function	VR Spec	Controller Architecture	Number of Rails	CPU Phases	Integrated Drivers	Interface	Package
NCP81201	Tablet	Controller	VR12.1	RPM	1	1	–	SVID	QFN-28
NCP81111	Microserver	Controller	VR12.5	Hybrid	1	1/2/3	–	SVID	QFN-32
NCP81203	Desktop	Controller	IMVP8	Dual Edge	2	3/2/1+2/1	–	SVID	QFN-52
NCP81203P	Notebook	Controller	IMVP8	Dual Edge	2	3/2/1+2/1	–	SVID	QFN-52
NCP81205	Notebook	Controller	IMVP8	Dual Edge & EN RPM	3	1/2/3+1/2/3+1	–	SVID	QFN-52
NCP81206	Ultrabook	Controller	IMVP8	Dual Edge & EN RPM	3	1+1/2+1	3 x 5V	SVID	QFN-52
NCP81208	Ultrabook	Controller	IMVP8	Dual Edge & EN RPM	3	1+1/2+1	–	SVID	QFN-48
NCP81210	Ultrabook & Notebook	Controller	IMVP8	EN RPM	1	1	1 + FETs	SVID	QFN-40

Please contact ON Semiconductor for product datasheets.

Ultrabook Solution

NCP81208 1+2+1 Phase Controller

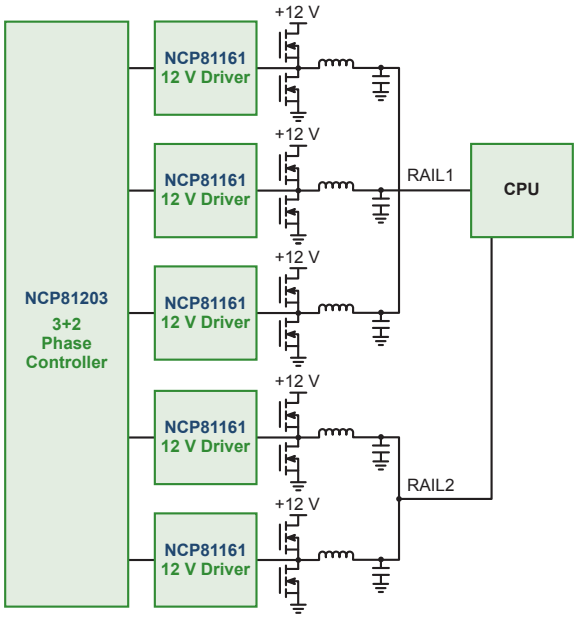
- Dual Edge & DCR current sensing for fast transient response
- EN RPM for fast transition between DCM and CCM mode
- True Differential Current Balancing
- IMVP8 compliant



Desktop Solutions

NCP81203 3+2 Phase Controller

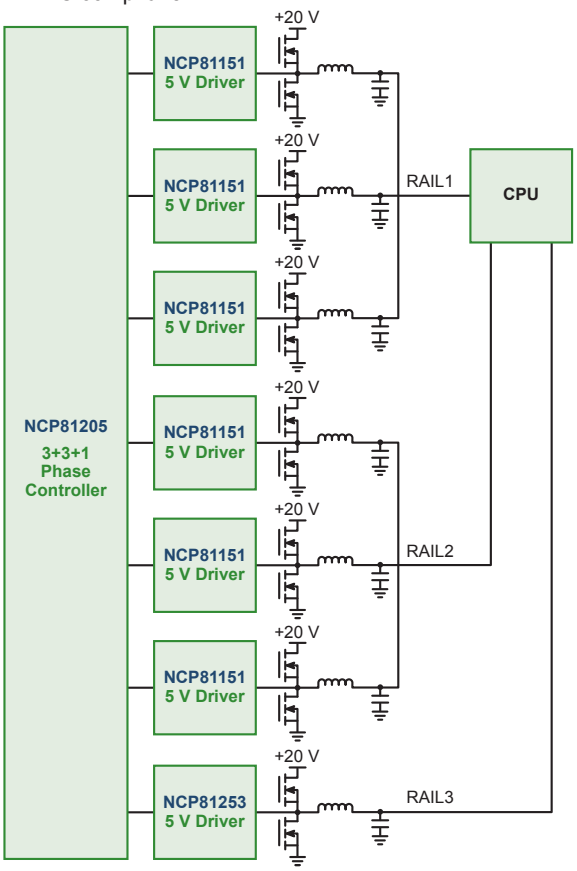
- Dual Edge for fast transient response
- Constant on-time for light load efficiency
- Supports all MLCC output capacitor solutions
- IMVP8 compliant



Notebook Solutions

NCP81205 3+3+1 Phase Controiler

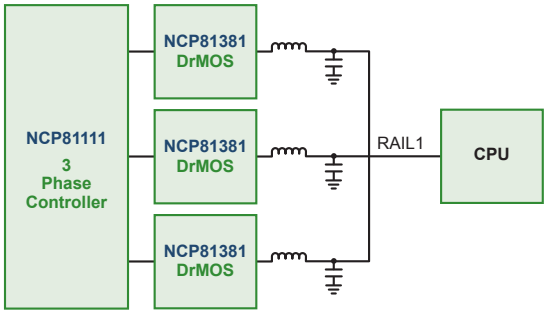
- Dual Edge & DCR current sensing for fast transient response
- EN RPM for fast transition between DCM and CCM mode
- True Differential Current Balancing
- IMVP8 compliant



Microserver Solutions

NCP81111 3-Phase Digital Controller

- Optimised to operate at 5MHz using DrMOS
- Can operate as general purpose I2C controller regulator
- Internal compensation using GUI interface
- VR12.5/6 compliant



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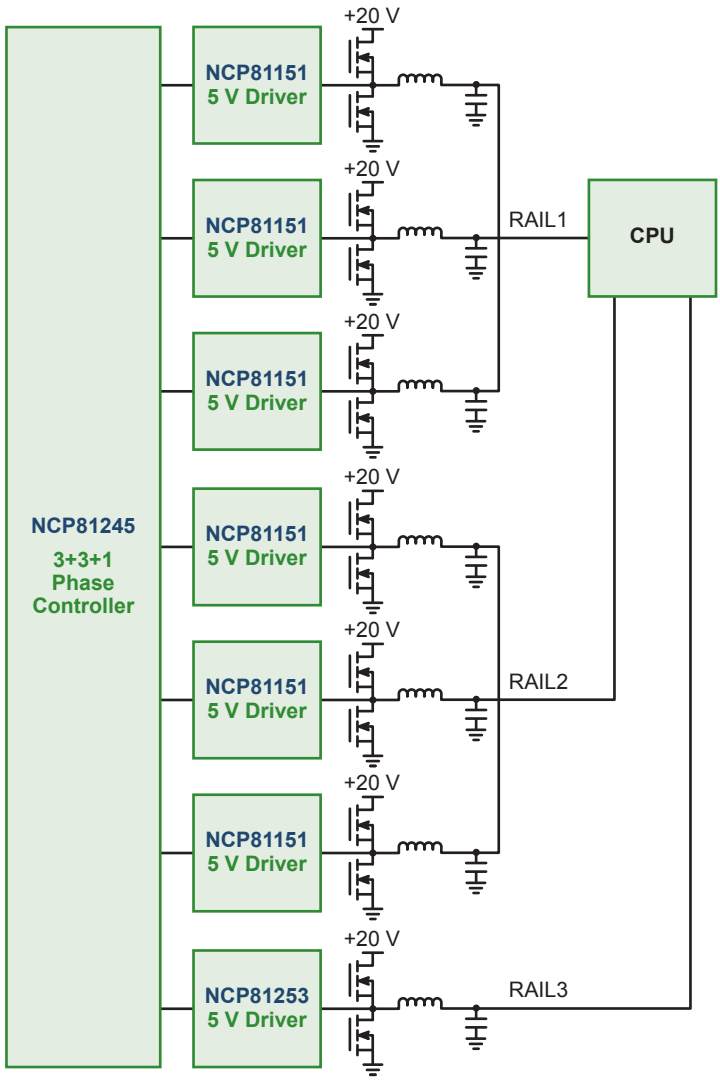
IMVP8 Multiphase Controllers for Embedded Applications

NCP81245 3+3+1 Phase Controller

- Dual Edge & DCR current sensing for fast transient response
- EN RPM for fast transition between DCM and CCM mode
- True Differential Current Balancing
- IMVP8 compliant

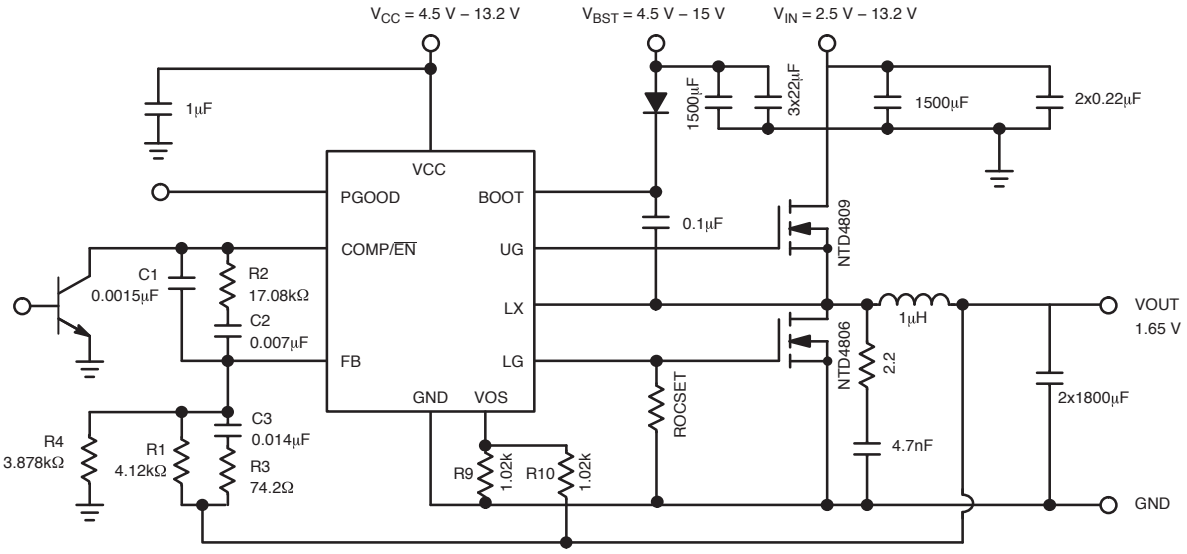


Device	Market	Function	VR Spec	Controller Architecture	Number of Rails	CPU Phases	Integrated Drivers	Interface	Package
NCP81243	Desktop	Controller	IMVP8	Dual Edge	2	3/2/1+2/1	–	SVID	QFN-52
NCP81245	Notebook	Controller	IMVP8	Dual Edge & EN RPM	3	1/2/3+1/2/3+1	–	SVID	QFN-52
NCP81246	Ultrabook	Controller	IMVP8	Dual Edge & EN RPM	3	1+1/2+1	3 x 5 V	SVID	QFN-52
NCP81248*	Ultrabook	Controller	IMVP8	Dual Edge & EN RPM	3	1+1/2+1	-	SVID	QFN-48
NCP81255*	Ultrabook & Notebook	Controller	IMVP8	EN RPM	1	1	1 + FETs	SVID	QFN-40
NCP81145	Ultrabook & Notebook	5 V Driver	–	for Dual Edge Rail	–	–	–	–	DFN-8
NCP81146	Desktop	12 V Driver	–	for Dual Edge Rail	–	–	–	–	DFN-8
NCP81253	Ultrabook & Notebook	5 V Driver	–	for EN RPM rail	–	–	–	–	DFN-8

* Pending 1H16.

System Power

System power management devices provide additional rails in computing applications, beyond Vcore and graphics. They are available with single or dual channel operation, and also in multi-phase configurations.



NCP1589A Application Diagram

Device	Description	Topology	VCC Min (V)	VCC Max (V)	fSW Typ (kHz)	Package
NCP1579	Synchronous Buck Controller, Low Voltage	Step-Down	4.5	13.2	275	SOIC-8
NCP1587	Synchronous Buck Controller, Low Voltage	Step-Down	4.5	13.2	250 - 300	SOIC-8
NCP1587A	Synchronous Buck Controller, Low Voltage	Step-Down	4.5	13.2	180 - 220	SOIC-8
NCP1589A	Synchronous Buck Controller, Low Voltage	Step-Down	4.5	13.2	–	DFN-10
NCP1589D	Snychronous Buck Controller	Step-Down	4.5	13.2	–	DFN-10
NCP1589L	Synchronous Buck Controller, Low Voltage, with Light Load Efficiency and Transient Enhancement	Step-Down	4.5	13.2	–	DFN-10
NCP5212	Single Synchronous Step Down Controller	Step-Down	4.5	27	300	QFN-16
NCP5217	Synchronous Buck Controller, Single	Step-Down	4.5	27	300	QFN-14
NCP5230	Low Voltage Synchronous Buck Controller	Step-Down	4.5	13.2	–	QFN-16
NCP5269	System Agent Controller with 2-bit VID	Step-Down	3.3	28	300 - 600	QFN-20
NCP3231	25 A Synchronous Buck Converter with Intergrated MOSFETs	Step-Down	4.5	18	500	TQFN-40
NCP3232N	15 A Synchronous Buck Converter with Intergrated MOSFETs	Step-Down	4.5	21	500	TQFN-40
NCP3133A	3 A Synchronous Buck Converter with Intergrated MOSFETs	Step-Down	2.9	5.5	1100	QFN-16
NCP3135	5 A Synchronous Buck Converter with Intergrated MOSFETs	Step-Down	2.9	5.5	1100	QFN-16

Thermal Management and System Monitoring

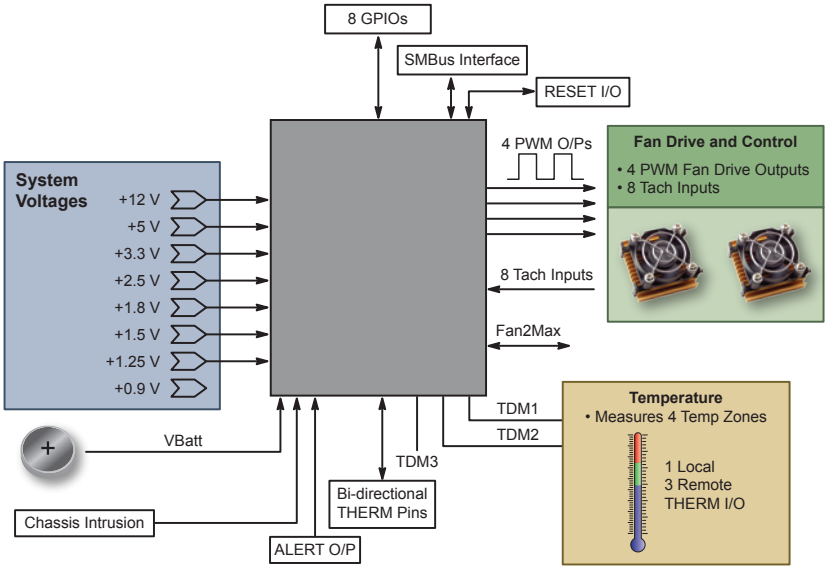
Extensive Portfolio

Local Sensors provide temperature information at the device location

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

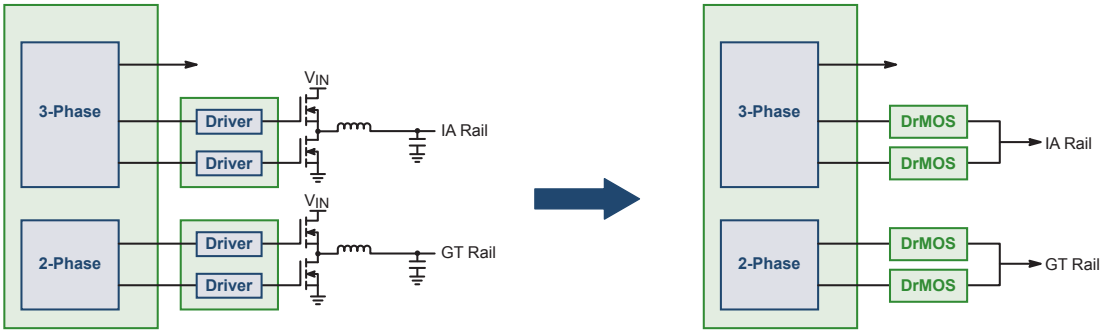


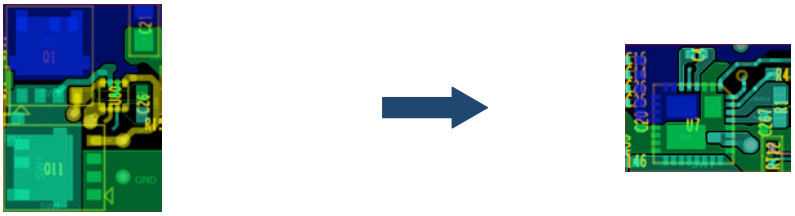
	Device	Supply Range (V)	Temperature Range (°C)	Local Accuracy (°C)	Interface	Number of Addresses	SRC (Ω)	Remote Accuracy	Remote Channels	Fan Channels	TACH Channels	Voltage Monitoring Channels	GPIOs	Package
System Monitors	ADM1026	3 - 5.5	-40 to +120	±3	I2C/SMBUS	3	–	±3	2	8	8	19	17	LQFP-48
	ADT7462	3 - 5.5	-40 to +125	±2.25	I2C/SMBUS	2	2 k	±2.25	3	4	8	13	8	LFCSP-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
Fan Controllers	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
	ADM1034	3 - 3.6	-40 to +120	±1	I2C/SMBUS	8	1 k	±1	2	2	2			QSOP-16
Remote Sensors	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, WLCSP-8
	NCT210	3 - 5.5	-55 to +125	±1	I2C/SMBUS	9	–	±3	2					QSOP-16
	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
Local Sensors	NCT375	3 - 5.5	-55 to +125	±1	SMBUS	8								DFN-8, SOIC-8, Micro8
	NCT475	3 - 5.5	-55 to +125	±1	SMBUS	4								WLCSP-6
	NCT203	1.4 - 2.75	-40 to +125	±1.75	I2C/SMBUS	1								DFN-8, SOIC-8, Micro8

Integrated MOSFET and Drivers

Features

- Integrated high- and low-side MOSFETs
- Integrated bootstrap diode
- Matched of driver and MOSFETs optimize switching performance
- Higher switching frequency enables use of smaller inductor and output capacitors
- Low-side MOSFET diode emulation mode provides asynchronous operation
- 65% lower BOM; 45% smaller footprint and simplified layout versus discrete solutions





Discrete **versus** **Integrated**

Device	PWM Input	V_{IN} Max (V)	Freq Max (MHz)	I_{OUT} Continuous Max (A)	Package
NCP5369	5 V Tri-state	25	1	40	QFN-40
NCP81081	3.3 V Tri-state	25	1	40	QFN-40
NCP5338	5 V Tri-state	20	1	40	QFN-40
NCP81380	5 V Tri-state	30	2	15	QFN-32
NCP81381	5 V Tri-state	30	2	25	QFN-32
NCP81382	5 V Tri-state	30	2	35	QFN-28

Drivers for Discrete MOSFET Implementations

Drivers specifically designed to work with controller solutions, and optimized for 5 V or 12 V gate applications.

Device	Drivers	V_{CC} Typ (V)	Integrated Bootstrap Diode	Zero Crossover Detection	Package
NCP5901	Single	12	N	Y	DFN-8
NCP5901B	Single	12	Y	Y	DFN-8
NCP81161	Single	12	Y	Y	DFN-8
NCP81151	Single	5	Y	Y	DFN-8
NCP81253	Single	5	Y	N	DFN-8
NCP81061	Dual	12	Y	Y	QFN-16
NCP81152	Dual	5	Y	Y	QFN-16

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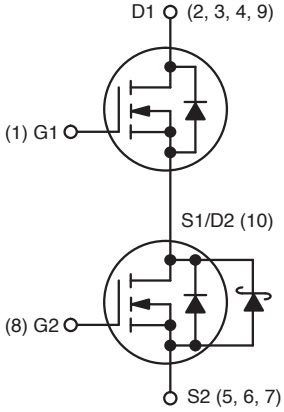
MOSFETs Provide Optimized Efficiency

Asymmetric Dual

- Co-packaged Power Stage to minimize board space
- Low Side MOSFET with Integrated Schottky
- Parasitic Inductances Minimized
- Optimized Devices to Reduce Power Losses



Device	Package	Config	Polarity	Maximum Rating				Q_g (nC)	Q_{gd} (nC)	C_{iss} (pF)	C_{rss} (pF)	R_G (Ω)	Applications
				V_{DS} (V)	V_{GS} (V)	$R_{DS(ON)}$ (mΩ) V_{GS}= 10 V	$R_{DS(ON)}$ (mΩ) V_{GS}= 4.5 V						
NTMFD4C85N	PowerPhase	Asym Dual	N	30	20	3.0	4.3	15.0	5.2	1960	102	1.0	Control Side
			N	30	20	0.8	1.2	45.2	11.8	6660	126	1.0	Synchronous Side
NTMFD4C86N	PowerPhase	Asym Dual	N	30	20	5.4	8.1	10.9	5.4	1252	126	1.0	Control Side
			N	30	20	2.1	3.0	21.6	5.5	3040	77	1.0	Synchronous Side
NTMFD4901NF	SO-8FL	Asym Dual	N	30	20	6.5	10.0	9.7	3.7	1150	105	0.8	Control Side
			N + Int Sch	30	20	2.4	3.5	20.0	5.3	2950	82	0.8	Synchronous Side
NTMFD4C87N	PowerPhase	Asym Dual	N	30	20	5.0	7.7	10.9	5.4	1252	129	1.0	Control Side
			N	30	20	3.1	4.3	13.8	3.6	1939	49	1.0	Synchronous Side
NTMFD4C20N	SO-8FL	Asym Dual	N	30	20	7.0	10.8	9.3	4.2	970	125	1.0	Control Side
			N	30	20	3.4	5.2	13.0	3.0	1950	50	1.0	Synchronous Side
NTMFD4902NF	SO-8FL	Asym Dual	N	30	20	6.5	10.0	9.7	3.7	1150	105	0.8	Control Side
			N + Int Sch	30	20	4.1	6.2	11.5	3.4	1510	83	0.8	Synchronous Side
NTLLD4901NF	μ8-FL/ WDFN-8	Asym Dual	N	30	20	20.0	30.0	5.5	1.4	605	100	0.8	Control Side
			N + Int Sch	30	20	15.0	22.0	5.9	2.9	645	16	0.8	Synchronous Side

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MOSFETs Provide Optimized Efficiency

	Device	Package	Configuration	Polarity	Maximum Rating				Q_g (nC)	Q_{gd} (nC)	C_{iss} (pF)	C_{rss} (pF)	R_G (Ω)	Applications
					V_{DS} (V)	V_{GS} (V)	$R_{DS(ON)}$ (mΩ) V_{GS}= 10 V	$R_{DS(ON)}$ (mΩ) V_{GS}= 4.5 V						
 SO-8FL 5 x 6 mm	NTMFS4C01N	SO-8FL	Single	N	30	20	0.9	1.2	65.0	18.0	9200	231	1.0	HPPC
	NTMFS4C03N	SO-8FL	Single	N	30	20	2.1	2.8	43.7	5.3	2850	72	1.0	HPPC
	NTMFS4983NF	SO-8FL	Integ Sch	N	30	20	2.1	3.1	22.6	6.9	3250	90	1.0	Synchronous Side
	NTMFS4C35N	SO-8FL	Single	N	30	20	3.2	4.2	15.0	5.5	2300	46	1.0	Synchronous Side
	NTMFS4985NF	SO-8FL	Integ Sch	N	30	20	3.4	5.0	14.2	4.2	2100	60	1.0	Synchronous Side
	NTMFS4C05N	SO-8FL	Single	N	30	20	3.4	5.0	13.0	3.0	1950	50	1.0	Synchronous Side
	NTMFS4C06N	SO-8FL	Single	N	30	20	4.0	6.0	14.5	5.5	1988	71	1.0	Synchronous Side
	NTMFS4C08N	SO-8FL	Single	N	30	20	5.8	8.5	8.7	2.8	1100	38	1.0	Synchronous Side
	NTMFS4C09N	SO-8FL	Single	N	30	20	6.0	8.8	10.9	5.4	1252	126	1.0	Control Side
	NTMFS4C10N	SO-8FL	Single	N	30	20	7.0	10.8	9.3	4.2	970	125	1.0	Control Side
	NTMFS4C13N	SO-8FL	Single	N	30	20	9.1	13.8	6.6	2.7	720	95	1.0	Control Side
 µ8FL 3.3 x 3.3 mm	NTTFS4C05N	µ8-FL	Single	N	30	20	3.6	5.1	13.0	3.0	1950	50	1.0	Synchronous Side
	NTTFS4C06N	µ8-FL	Single	N	30	20	4.0	6.0	14.5	5.5	1988	71	1.0	Synchronous Side
	NTTFS4C08N	µ8-FL	Single	N	30	20	5.8	8.5	8.7	2.8	1100	38	1.0	Synchronous Side
	NTTFS4C10N	µ8-FL	Single	N	30	20	7.4	11.0	9.3	4.2	970	125	1.0	Control Side
	NTTFS4C13N	µ8-FL	Single	N	30	20	9.1	13.8	6.6	2.7	720	95	1.0	Control Side
	NTTFS4C25N	µ8-FL	Single	N	30	20	17.0	26.5	4.0	1.3	455	60	1.0	Control Side
 DPAK	NTD4904N	DPAK	Single	N	30	20	3.7	5.5	16.8	3.0	3052	23.0	1.0	Synchronous Side
	NTD4965N	DPAK	Single	N	30	20	4.7	7.0	17.5	8.5	1684	330	0.8	Synchronous Side
	NTD4906N	DPAK	Single	N	30	20	5.5	8.0	11.0	1.8	1932	19	1.0	Synchronous Side
	NTD4969N	DPAK	Single	N	30	20	9.0	12.0	8.7	4.0	835	163	0.7	Control Side
	NTD4970N	DPAK	Single	N	30	20	11.0	15.0	7.7	3.7	743	330	0.9	Control Side
 SOIC-8 5 x 6 mm	NTMS4937N	SOIC-8	Single	N	30	20	6.5	8.7	17.4	3.3	2563	25	1.0	Synchronous Side
	NTMS4939N	SOIC-8	Single	N	30	20	8.4	11.0	12.4	1.9	2000	16	0.7	Synchronous Side
	NTMS4916N	SOIC-8	Single	N	30	20	9.0	12.0	14.0	7.0	1468	280	0.7	Control Side
	NTMS4917N	SOIC-8	Single	N	30	20	11.0	15.0	10.8	3.5	1132	216	0.7	Control Side
	NTMS4800N	SOIC-8	Single	N	30	20	20.0	27.0	7.7	3.2	940	125	1.5	Control Side
	NTMS4840N	SOIC-8	Single	N	30	20	24.0	36.0	4.8	1.9	520	70	2.0	Control Side
	NTMD4820N	SOIC-8	Dual	N	30	20	20.0	27.0	7.7	3.2	940	125	1.5	DC-DC, Load Switch
	NTMD4840N	SOIC-8	Dual	N	30	20	24.0	36.0	4.8	1.9	520	70	1.0	DC-DC, Load Switch
	NTMS4177P	SOIC-8	Single	P	-30	20	12.0	19.0	29.0	13.0	3100	370	2.0	Load Switch
	NTMS4176P	SOIC-8	Single	P	-30	25	18.0	30.0	17.0	8.4	1720	256	2.9	Load Switch

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MOSFETs Provide Optimized Efficiency

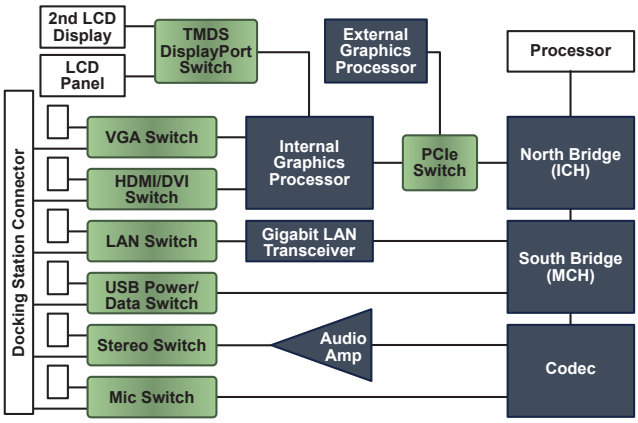
Trench 6 High Efficiency (T6HE) for Servers and Point-of-Load Modules

- High Efficiency DC-DC Conversion
- Integrated Schottky Lowsides
- Lowest RDS(on) in the industry

Device	Package	Config	Polarity	Maximum Rating				Q_g (nC)	Q_{gd} (nC)	C_{iss} (pF)	C_{rss} (pF)	R_G (Ω)	Applications
				V_{DS} (V)	V_{GS} (V)	$R_{DS(ON)}$ (mΩ) V_{GS}= 10 V	$R_{DS(ON)}$ (mΩ) V_{GS}= 4.5 V						
NTMFS4H01N	SO-8FL	Single	N	25	20	0.7	1.0	39.0	8.5	5693	212	1.2	Synchronous Side
NTMFS4H01NF	SO-8FL	Integ Sch	N	25	20	0.7	1.0	37.8	8.0	5538	175.3	1.3	Synchronous Side
NTMFS4H013NF	SO-8FL	Integ Sch	N	25	20	0.9	1.3	28.0	7.5	3780	150	1.0	Synchronous Side
NTMFS4H02N	SO-8FL	Single	N	25	20	1.4	2.2	18.0	4.2	2651	103	1.0	Synchronous Side
NTMFS4H02NF	SO-8FL	Integ Sch	N	25	20	1.4	2.3	18.7	4.3	2652	94	1.0	Synchronous Side
NTTFS4H05N	µ8-FL	Single	N	25	20	3.3	4.8	8.7	1.9	1205	45	1.0	Control Side
NTTFS4H07N	µ8-FL	Single	N	25	20	4.8	7.1	5.7	1.3	771	34	1.0	Control Side

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
NCN3612B	PCIe 3.0, DisplayPort 1.2	8 Gb/s	12	250 µA
NCN3411	PCIe 3.0	8 Gb/s	8	200 µA
NCN2612B	PCIe 2.0, DisplayPort 1.1	5 Gb/s	12	250 µA
NS3L500	Gigabit Ethernet	1 Gb/s	11	250 µA
NCN1188	USB 2.0 / MHL	2.25 Gb/s	2	21 µA
NS5S1153	USB 2.0	480 Mb/s	2	21 µA
NLAS7242	USB 2.0	480 Mb/s	2	1 µA
NLAS52231	Audio	36 MHz	2	1 µA
NLAS4684	Audio	9.5 MHz	2	180 nA

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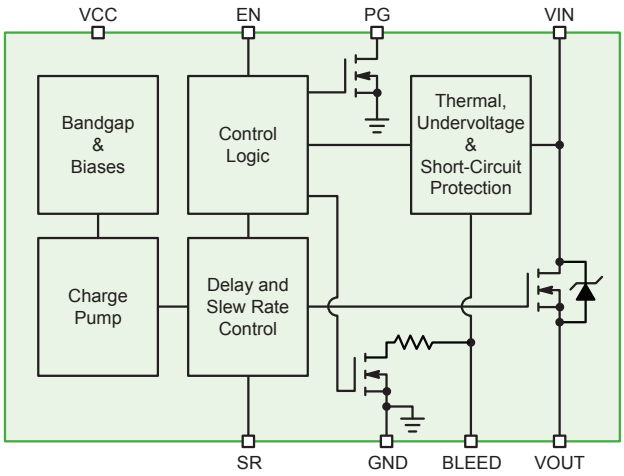
Advanced Load Switches

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

ecoSWITCH™ ADVANCED LOAD MANAGEMENT



NCP45xxx Integrated Load Switch Feature

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

Type	Device	r_{on} (mΩ)	I Max (A)	V_I Min (V)	V_I Max (V)	I_Q (μA)	Discharge	Slew Rate (μs)	Features	Package(s)
Smart Load Switch	NCP330	26 at 3.3 V	3	1.8	5.5	100	-	2000	Reverse blocking	TDFN-4
	NCP333	55 at 3.3 V	1.5	1.2	5.5	1	Auto	95	-	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
	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
	NCP338	27 at 1.8 V	2	1	3.6	0.6	Auto	20	-	WLCSP-6
	NCP339	26 at 3.3 V	3	1.2	5.5	2	-	2700	Reverse blocking	WLCSP-6
	NCP432	50 at 1.8 V	1.5	1	3.6	0.6	-	20	-	WLCSP-4
	NCP433	50 at 1.8 V	1.5	1	3.6	0.6	Auto	20	-	WLCSP-4
	NCP434	43 at 1.8 V	2	1	3.6	0.6	-	61	-	WLCSP-4
	NCP435	43 at 1.8 V	2	1	3.6	0.6	Auto	61	-	WLCSP-4
	NCP436	23 at 1.8 V	3	1	3.6	1	-	27	-	WLCSP-6
	NCP437	23 at 1.8 V	3	1	3.6	1	Auto	27	-	WLCSP-6
ecoSWITCH™ Integrated Load Switch	NCP45524	18.0	6	0.5	13.5	-	Adj	-	Power good	DFN-8
	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

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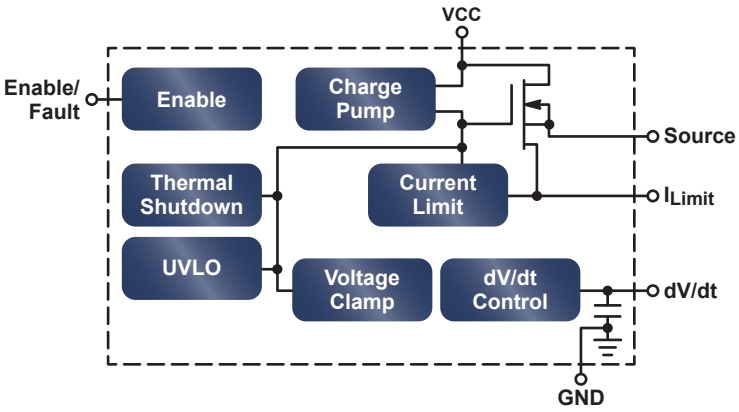
Electronic Fuse (eFuse) for SAS, SATA, eSATA, USB

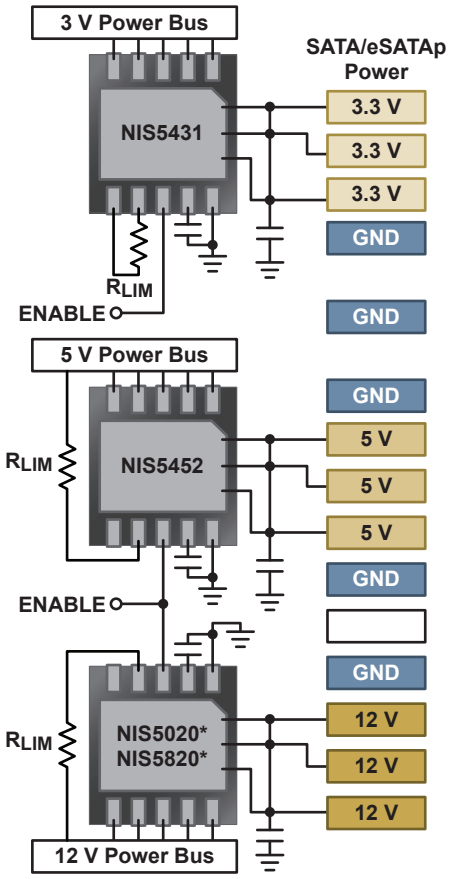
3.3 V, 5 V, and 12 V Power Bus Protection

Features

- Low $R_{DS(ON)}$, high operating and trip currents (I_{OP}, I_{TRIP})
- Overvoltage protection
- Precise I_{TRIP} control
- Slew rate control
- Thermal shut-down
- EN pin for synchronizing multiple eFuses
- Outperforms poly-fuses:
  - Tighter spec tolerances
  - Lower resistance
  - Lower trip-time
  - Superior repeatability



Typical Feature Set for eFuse



Device	Input Voltage (V)	Output Clamping Voltage (V)	I_{TRIP} Trip Current (A)	$R_{DS(ON)}$ (mΩ)	Auto Recovery Option	Latching Option	Package
NIS5112	-0.6 to 18	15	2.5 (adjustable)	28	Yes	Yes	SOIC-8
NIS5132	-0.6 to 18	15	3.5 (adjustable)	44	Yes	Yes	DFN-10
NIS5232	-0.6 to 18	15	4.0 (adjustable)	44	No	Yes	DFN-10
NIS5135	-0.6 to 18	6.65	3.5 (adjustable)	68	Yes	Yes	DFN-10
NIS5452*	-0.6 to 14	5.85	3.5 (adjustable)	33	Yes	Yes	WDFN-10
NIS5431*	-0.6 to 14	3.85	2.0 (adjustable)	40	No	Yes	WDFN-10

* Pending 1H16.

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

Four Pairs, Low Capacitance Surge and ESD Protection

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.

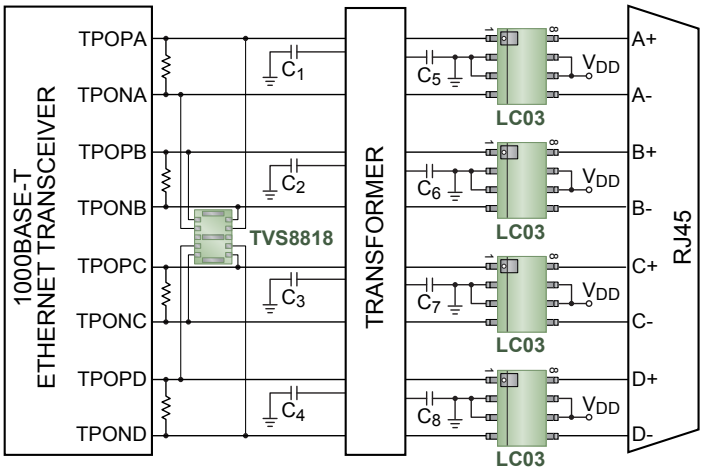
Features

- 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

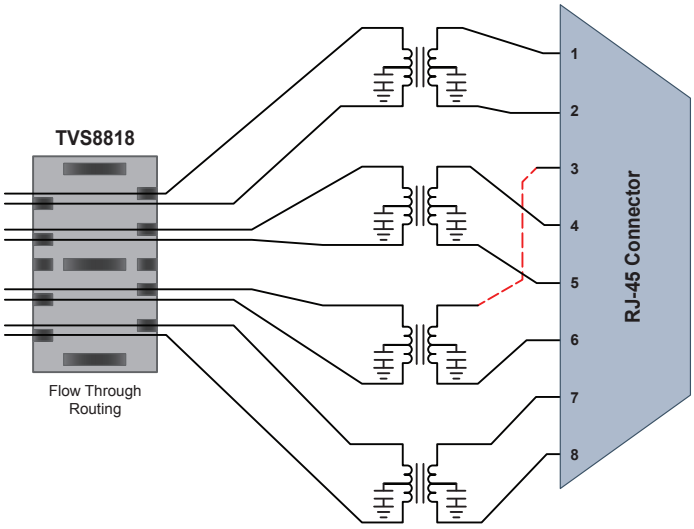
Benefits

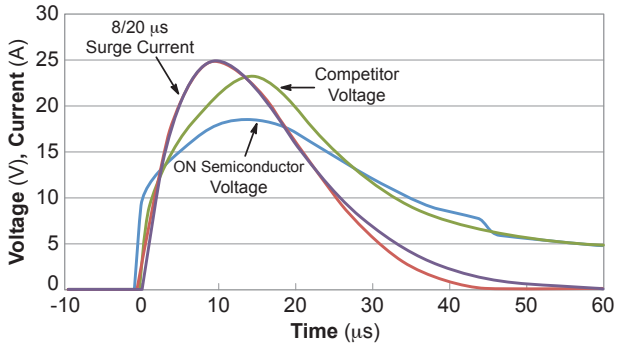
- Compatible with Gb Ethernet and beyond
- Enhanced protection for downstream electronics
- Accommodates operating transients above 3.3 V
- Small form-factor allows integration into connectors

Typical Application



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





Line-to-Line Surge

Transient Voltage Suppressors

Device	V_{DC} Max (V)	Line Transient Max (V)	Surge I_{PP}, 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
TVS4201	5.0	6.0	25	1.5	±30	TSOP-6
TVS8814	3.0	3.2	35	1.5	±30	UDFN-8
TVS8818	3.0	3.2	35	1.5	±30	UDFN-10
NUP4114H	5.0	5.0	12*	0.4	±13	TSOP-6
SRDA3.3	3.3	5.0	25	4.0	±8	SOIC-8
SRDA05	5.0	7.0	23	5.0	±8	SOIC-8

* On Pin 5.

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USB 3.x Type A Connector

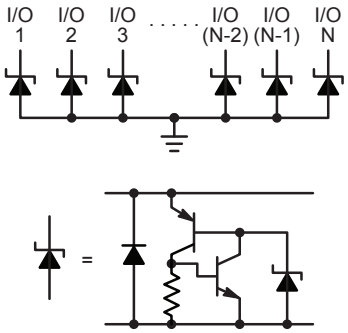
Two SuperSpeed Pairs, One High Speed Pair, V_{CC}, Low Capacitance ESD Protection

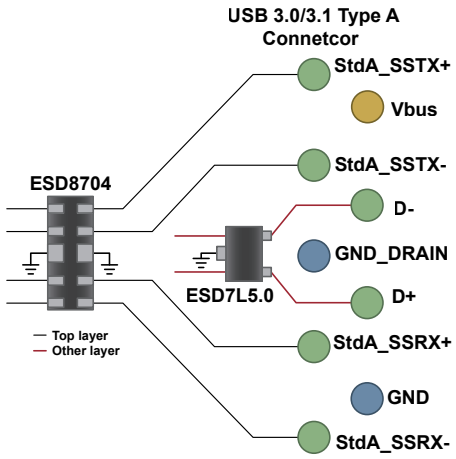
Key Requirement

- Cap < 0.7 pF

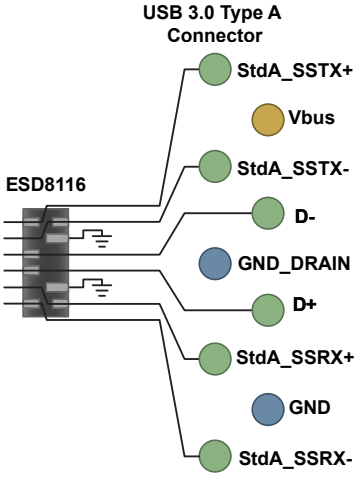
Features

- 0.35 pF
- Flow through routing
- Industry leading low clamping voltage versus competitors





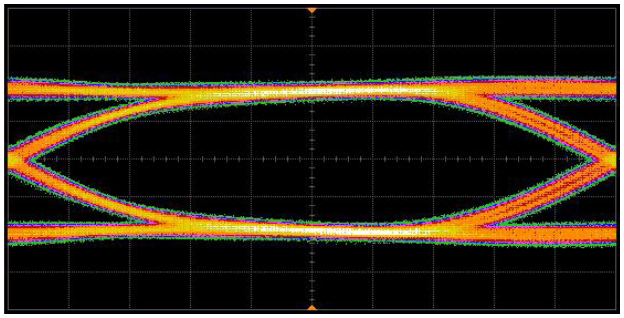
ESD8704 – 0.35 pF, 2 Layer Routing
(ESD8704; ESD7L5.0 for D+, D- Lines)



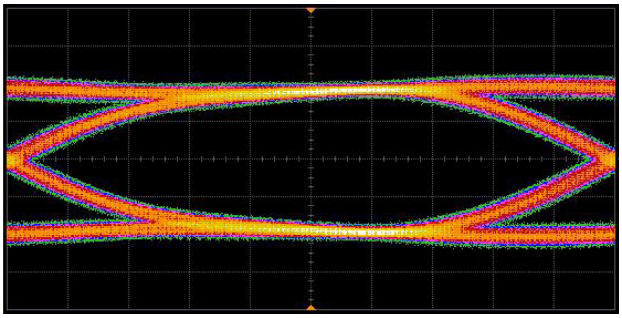
ESD8116 – 0.30 pF, 1 Layer Routing

Device	Interface	Data Lines	Capacitance (pF)	Package	Size (mm)
ESD8704*	USB 3.x	2 Pair (Tx, Rx)	0.35	UDFN-10	2.5 x 1.0
ESD7L	USB 3.x	1 Pair (D+/-)	0.5	SOT-723	1.2 x 1.2
ESD8504	USB 3.0	2 Pair (Tx, Rx)	0.4	UDFN-10	2.5 x 1.0
ESD8104	USB 3.0	2 Pair (Tx, Rx)	0.3	UDFN-10	2.5 x 1.0
ESD8116	USB 3.0	3 Pair (Tx, Rx, D+/-)	0.3	UDFN-8	2.0 x 1.2
ESD8011	USB 3.x	Single Line	0.10	X3DFN-2	0.62 x 0.32
ESD8101	USB 3.x	Single Line	0.20	DSN-2	0.43 x 0.23
ESD8111	USB 3.x	Single Line	0.20	WLCSP-2	0.6 x 0.3
ESD8006	USB 3.0	3 Pair (Tx, Rx, D+/-)	0.25	UDFN-8	3.3 x 1.0

* Pending 1H16.



Without ESD



With ESD

USB 3.0 @ 5 Gb/s

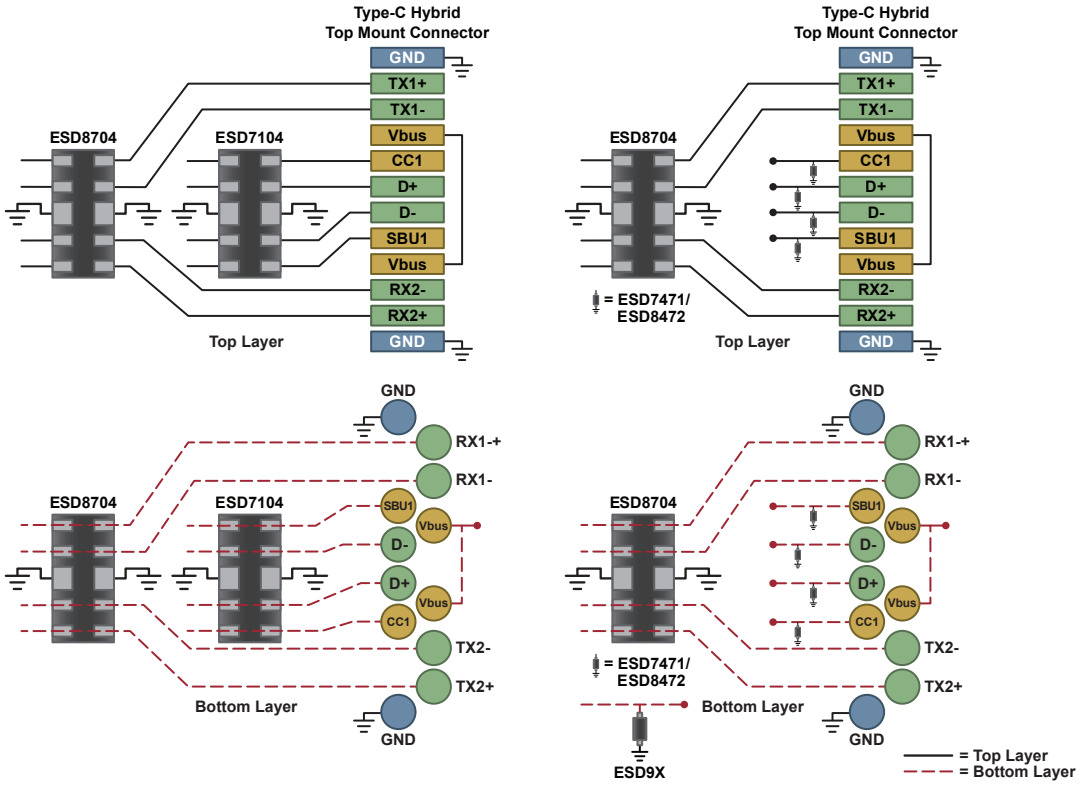
USB 3.x Type C Connector

Key Requirement

- Cap < 0.5 pF

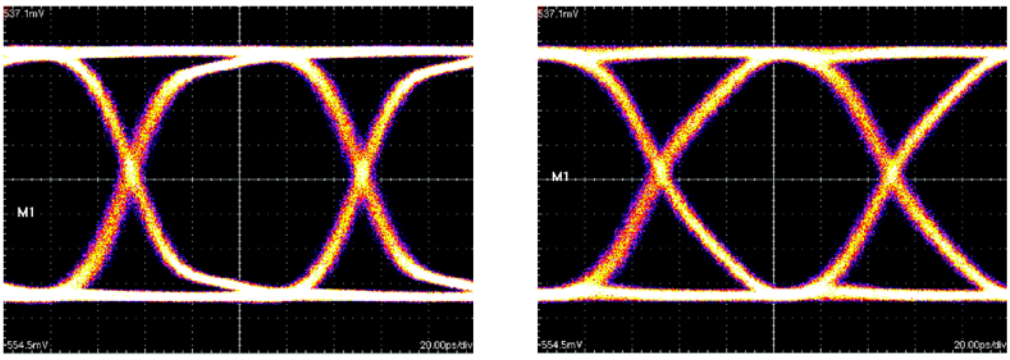
Features

- 0.35 pF
- Flow through routing
- Industry leading low clamping voltage versus competitors



Device	Data Lines	Capacitance (pF)	Package	Size (mm)
ESD8704*	2 Pair (Tx, Rx)	0.37	UDFN-10	2.5 x 1.0
ESD7104	2 Pair (CC, SBU, D+/-)	0.30	UDFN-10	2.5 x 1.0
ESD8011	Single Line (Tx, Rx)	0.10	X3DFN-2	0.62 x 0.32
ESD8101	Single Line (Tx, Rx)	0.20	DSN-2	0.43 x 0.23
ESD8111	Single Line (Tx, Rx)	0.20	WLCSP-2	0.6 x 0.3
ESD8472	Single Line (CC, SBU, D+/-)	0.20	X3DFN-2	0.62 x 0.32
ESD7471	Single Line (CC, SBU, D+/-)	0.24	XDFN-2 (SOD-882)	1.0 x 0.6

* Pending 1H16.



Without ESD | With ESD

USB3.1 Eye Diagram with and without ESD8704. 10 Gb/s

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USB 2.0

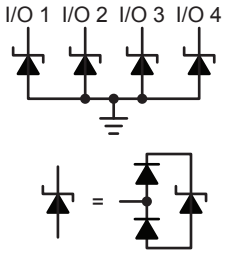
One High Speed Pair, V_{CC}, Low Capacitance ESD Protection

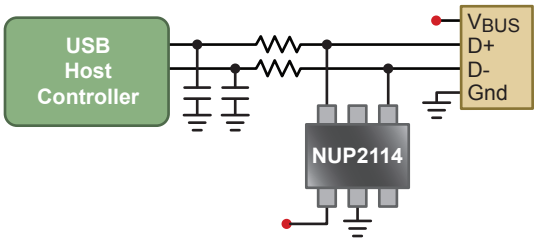
Key Requirement

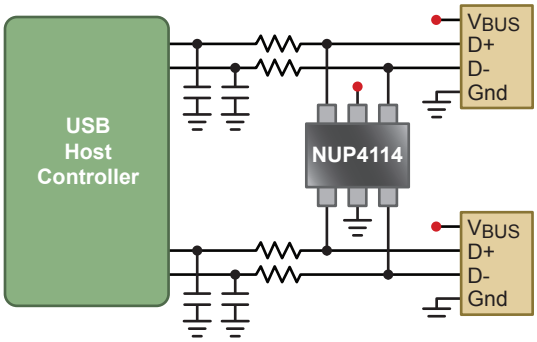
- Cap < 5 pF

Features

- 0.35 - 3.0 pF
- Multi-part solutions available
- Industry leading low clamping voltage







Device	Data Lines	Capacitance (pF)	Package	Size (mm)
NUP2114UPX	1 Pair (D+/-) + Vbus	0.8	SOT-553	1.2 x 1.6
NUP2114UCM	1 Pair (D+/-) + Vbus	0.8	TSOP-6	3.0 x 2.75
NUP4114UPX	2 Pair (D+/-) + Vbus	0.5	SOT-563	1.6 x 1.6
NUP4114UCL	2 Pair (D+/-) + Vbus	0.5	SC-88	2.0 x 2.1
NUP4114H	2 Pair (D+/-) + Vbus	0.5	TSOP-6	3.0 x 2.75
TVS4201MR6	2 Pair (D+/-) + Vbus	3	TSOP-6	3.0 x 2.75
ESD7L5.0	2	0.5	SOT-723	1.2 x 1.2
ESD8351MUT	1	0.37	X3DFN-2	0.6 x 0.3
ESD8351P2T	1	0.37	SOD-923	1.0 x 0.6
ESD9L5.0	1	0.5	SOD-923	1.0 x 0.6

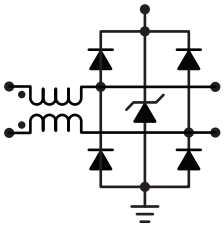
One High Speed Pair, V_{CC}, Common Mode Filter + ESD Protection

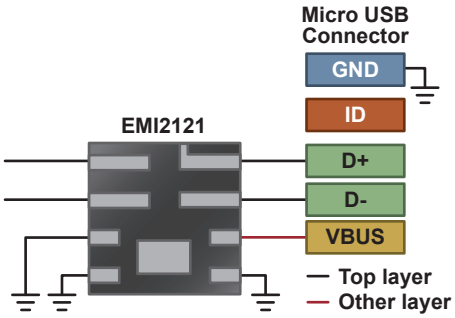
Key Requirement

- Cap < 5 pF
- Common Mode Filtering

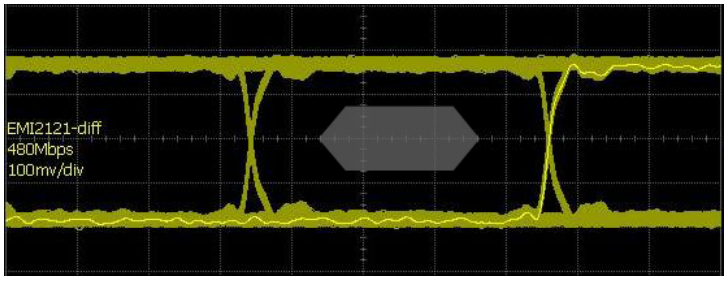
Features

- 0.5 - 0.8 pF
- Integrated EMI suppression with ESD protection
- Industry leading low clamping voltage

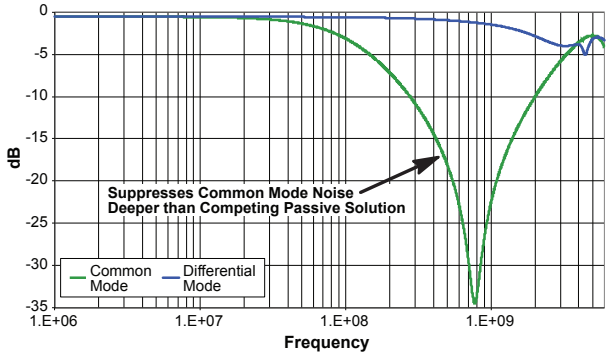




Device	Pairs	Capacitance @ 2.5 V (pF)	CM Attenuation @ 800 MHz (-dB)	DM Bandwidth F3dB (GHz)	Package	Size (mm)
EMI2121	1	0.9	-25	2.5	WQFN	2.2 x 2.0 x 0.75



USB 2.0 @ 480 Mb/s



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Thunderbolt

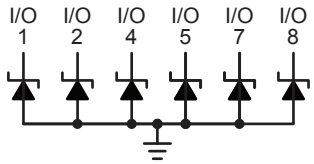
Four High Speed Pairs, up to Six Additional Lines, Low Capacitance ESD

Key Requirement

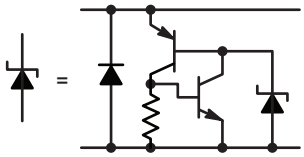
- Capacitance < 0.4 pF

Features

- Capacitance of 0.35 pF or lower
- Integrated solution in 2.0 x 1.2 mm package
- Grounds between pairs to reduce cross-talk
- Flow-through routing
- Industry leading clamping voltage

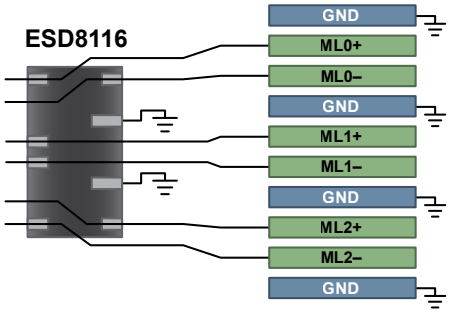


Common GND = Pins 2, 3

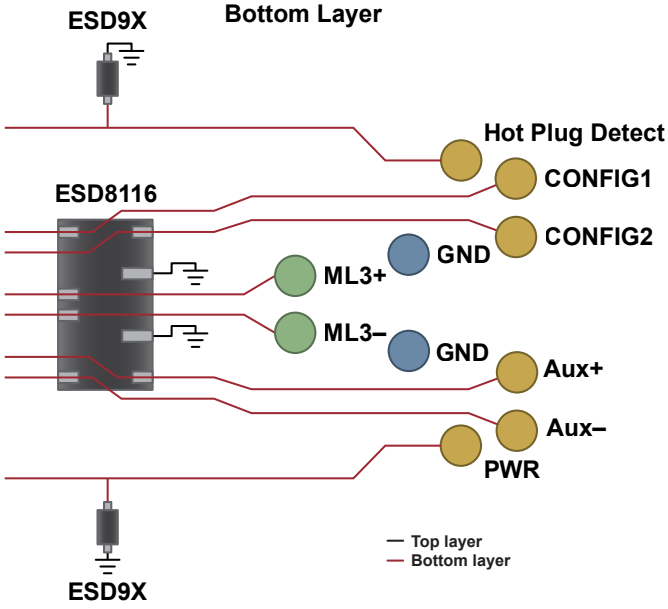


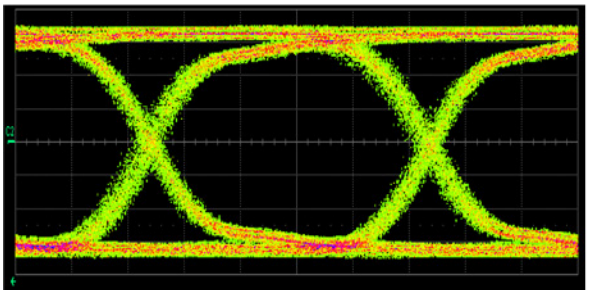
Device	Data Lines	Capacitance (pF)	Package	Size (mm)
ESD8006	3 Pair	0.25	UDFN-8	3.3 x 1.0
ESD8116	3 Pair	0.30	UDFN-8	2.0 x 1.2
ESD8011	Single Line	0.10	X3DFN-2	0.62 x 0.32
ESD8101	Single Line	0.20	DSN-2	0.43 x 0.23

Thunderbolt Connetctor
Top Layer

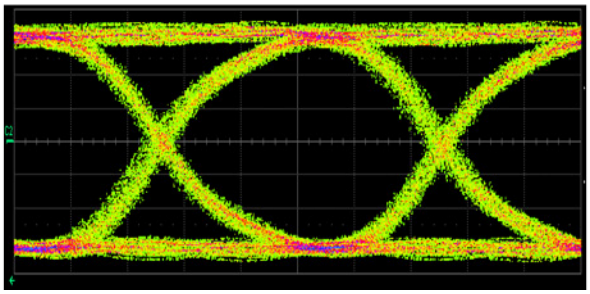


Thunderbolt Connetctor
Bottom Layer





Without ESD8116



With ESD8116

Thunderbolt @ 10 Gb/s

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HDMI, Display Port

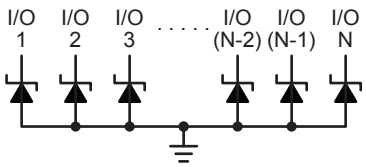
Four High Speed Pairs, Up to Six Additional Interface Lines, Low Capacitance ESD

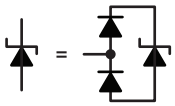
Key Requirement

- Cap < 0.5 pF

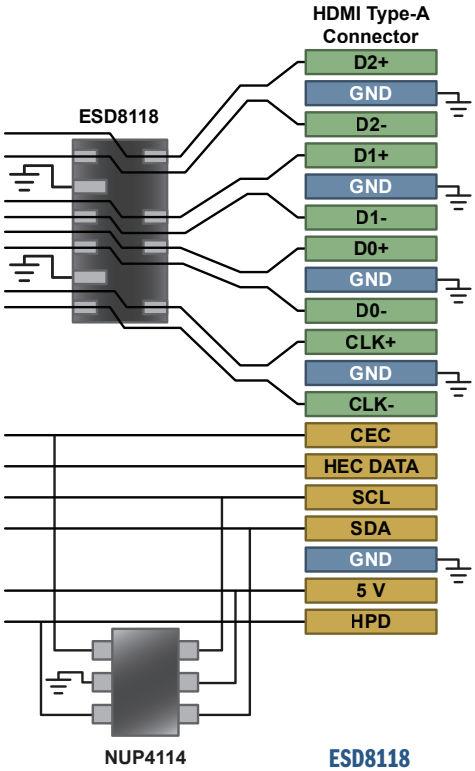
Features

- 0.3 pF ESD protection
- Flow through routing in high speed lines
- Industry leading low clamping voltage

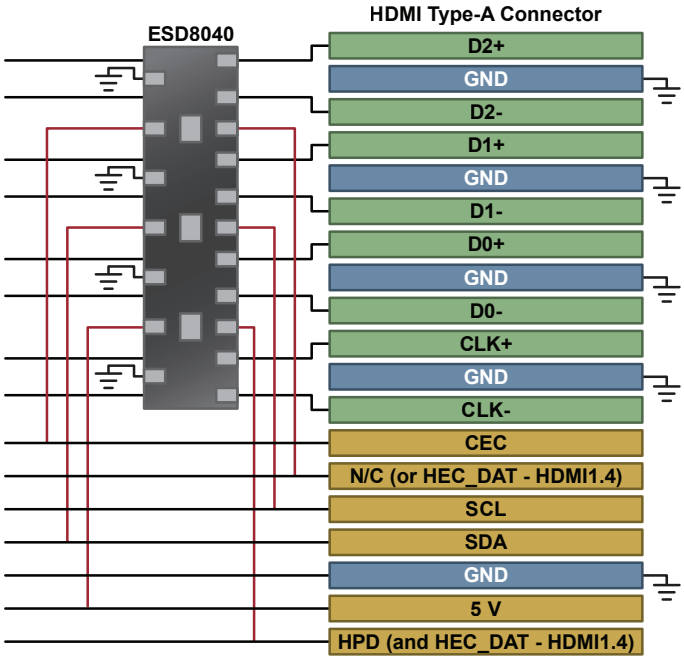




Device	Data Lines	Capacitance (pF)	Package	Size (mm)
ESD8104	4 (TMDS)	0.3	UDFN-10	2.5 x 1.0
ESD8118	8 (TMDS)	0.3	UDFN-10	3.2 x 1.2
ESD8040	14 (TMDS + Low Speed + Power)	0.3	UDFN-18	5.5 x 1.5
NUP4114UPX	5 (4 Low Speed + Power)	0.5	SOT-563	1.6 x 1.6
NUP4114UCL	5 (4 Low Speed + Power)	0.5	SC-88	2.0 x 2.1
NUP4114H	5 (4 Low Speed + Power)	0.5	TSOP-6	3.0 x 2.75

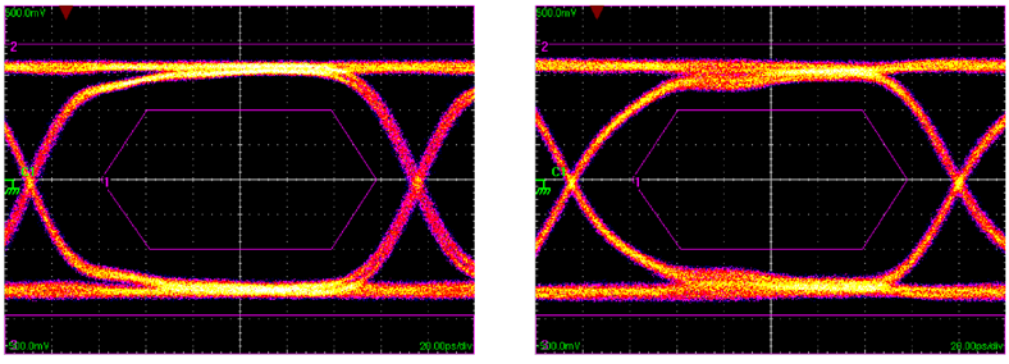


ESD8118



- MediaGuard fully integrated solution
- Includes ethernet protection (HDMI1.4)
- Backdrive current protection

ESD8040



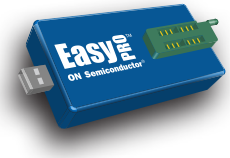
Without ESD **With ESD**

HDMI 2.0 Eye Diagram with and without ESD8104. 6 Gb/s

Serial EEPROMs

Features

- Broad density range: 1 kb to 2 Mb
- Wide operating Vcc range: 1.8/1.7 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^2C, SPI, Microwire)

EEPROMs

Data Transmission Standard	Device	Density	Organization*	Vcc Min (V)	Vcc Max (V)	fCLK Max (MHz)	Package(s)
I^2C	CAT24M01	1 Mb	128k x 8	1.8	5.5	1	SOIC-8, TSSOP-8, UDFN-8
	CAT24C512	512 kb	64k x 8	1.8	5.5	1	SOIC-8, TSSOP-8, UDFN-8
	CAT24C256	256 kb	32k x 8	1.8	5.5	1	SOIC-8, TSSOP-8, UDFN-8
	CAT24C128	128 kb	16k x 8	1.8	5.5	1	SOIC-8, TSSOP-8, UDFN-8
	CAT24C64	64 kb	8k x 8	1.7	5.5	1	SOIC-8, TSSOP-8, UDFN-8, WLCSP-4
	CAT24C32	32 kb	4k x 8	1.7	5.5	1	SOIC-8, TSSOP-8, UDFN-8, WLCSP-4, WLCSP-5
	CAT24C16	16 kb	2k x 8	1.7	5.5	0.4	SOIC-8, TSSOP-8, UDFN-8, TSOT23-5, WLCSP-4, WLCSP-5
	CAT24C08	8 kb	1k x 8	1.7	5.5	0.4	SOIC-8, TSSOP-8, UDFN-8, TSOT23-5, WLCSP-4, WLCSP-5
	CAT24C04	4 kb	512 x 8	1.7	5.5	0.4	SOIC-8, TSSOP-8, UDFN-8, TSOT23-5, WLCSP-4, WLCSP-5
	CAT24C02	2 kb	256 x 8	1.7	5.5	0.4	SOIC-8, TSSOP-8, UDFN-8, TSOT23-5, WLCSP-4, WLCSP-5
SPI	CAT25M02	2 Mb	256k x 8	1.7	5.5	10	SOIC-8
	CAT25M01	1 Mb	128k x 8	1.8	5.5	10	SOIC-8, TSSOP-8
	CAT25512	512 kb	64k x 8	1.8	5.5	20	SOIC-8, TSSOP-8, UDFN-8
	CAT25256	256 kb	32k x 8	1.8	5.5	20	SOIC-8, TSSOP-8, UDFN-8
	CAT25128	128 kb	16k x 8	1.8	5.5	20	SOIC-8, TSSOP-8, UDFN-8
	CAT25640	64 kb	8k x 8	1.8	5.5	20	SOIC-8, TSSOP-8, UDFN-8
	CAT25320	32 kb	4k x 8	1.8	5.5	20	SOIC-8, TSSOP-8, UDFN-8
	CAT25160	16 kb	2k x 8	1.8	5.5	20	SOIC-8, TSSOP-8, UDFN-8
	CAT25080	8 kb	1k x 8	1.8	5.5	20	SOIC-8, TSSOP-8, UDFN-8
	CAT25040	4 kb	512 x 8	1.8	5.5	20	SOIC-8, TSSOP-8, UDFN-8
	CAT25020	2 kb	256 x 8	1.8	5.5	20	SOIC-8, TSSOP-8, UDFN-8
	CAT25010	1 kb	128 x 8	1.8	5.5	20	SOIC-8, TSSOP-8, UDFN-8
Microwire	CAT93C86	16 kb	2k x 8 / 1k x 16	1.8	5.5	3	SOIC-8
	CAT93C86B	16 kb	2k x 8 / 1k x 16	1.8 / 1.65	5.5	4	SOIC-8, TSSOP-8, UDFN-8
	CAT93C76	8 kb	1k x 8 / 512 x 16	1.8	5.5	3	SOIC-8, TSSOP-8
	CAT93C76B	8 kb	1k x 8 / 512 x 16	1.8 / 1.65	5.5	4	SOIC-8, TSSOP-8, UDFN-8
	CAT93C66	4 kb	512 x 8 / 256 x 16	1.8	5.5	2	SOIC-8, TSSOP-8
	CAT93C56	2 kb	256 x 8 / 128 x 16	1.8	5.5	2	SOIC-8, TSSOP-8
	CAT93C46	1 kb	128 x 8 / 64 x 16	1.8	5.5	2	SOIC-8, TSSOP-8
	CAT93C46B	1 kb	128 x 8 / 64 x 16	1.8 / 1.65	5.5	4	SOIC-8, TSSOP-8, UDFN-8

* Organization for Microwire devices is selectable.

Application Specific EEPROMs

Data Transmission Standard	Device	Density	Organization	Vcc Min (V)	Vcc Max (V)	fCLK Max (MHz)	Package(s)	Notes
I^2C	CAT24C208	8 kb	1024 x 8	2.5	5.5	0.4	SOIC-8	VESA™ dual-port serial EEPROM
I^2C	CAT34C04*	4 kb	512 x 8	1.7	5.5	1	UDFN-8	Serial Presence Detect (SPD) I2C EEPROM for DDR4 DIMM
I^2C/SMBus	CAT34TS04	4 kb	512 x 8	2.2	5.5	1	TDFN-8, UDFN-8	4 kb SPD EEPROM w/ Temperature Sensor for DDR4 DIMM
I^2C	CAT34C02	2 kb	256 x 8	1.7	5.5	0.4	UDFN-8, TDFN-8, TSSOP-8	Serial Presence Detect (SPD) I2C EEPROM for DDR3 DIMM
I^2C/SMBus	CAT34TS02	2 kb	256 x 8	3.0	3.6	0.4	TDFN-8, UDFN-8	2 kb SPD EEPROM w/ Temperature Sensor for DDR3 DIMM

* Pending 1H16.

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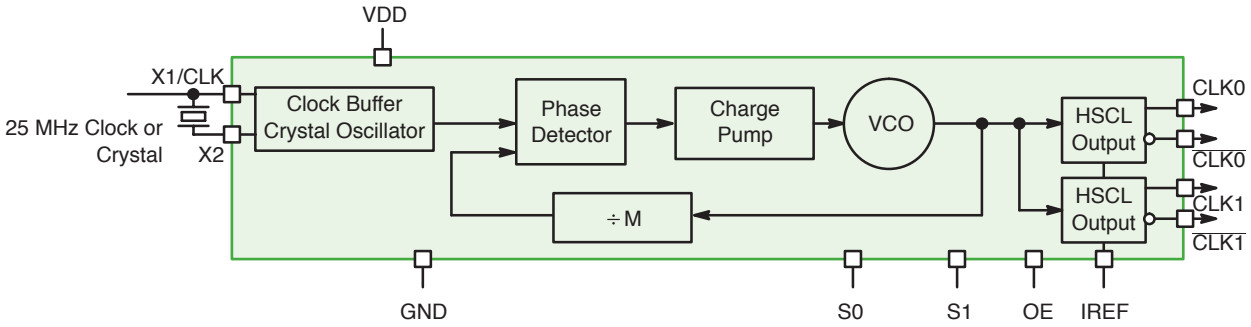
Clock Synthesizers for High Performance Computing

Features

- Uses 25 MHz fundamental mode parallel resonant crystal
- PCI-e Gen 1,2 & 3 jitter complaint HCSL differential outputs
- NB3N50134 features configurable spread spectrum outputs
- NB3N51044 features individual OE control signal for each output, PLL bypass mode and an Input multiplexer
- NB3N51054 features I2C interface for OE control and configurable spread spectrum outputs
- 3.3 V supply



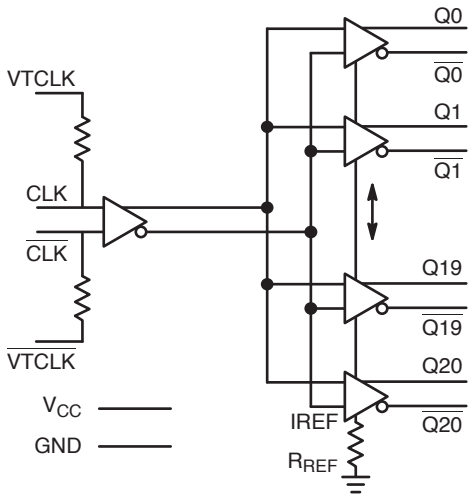
NB3N5573 Simplified Logic Diagram

Device	Number of Inputs	Input Type	f_{in} Typ (MHz)	Number of Outputs	Output Type	f_{out} Typ (MHz)	Spread Spectrum Outputs	Package
NB3N3002	1	Crystal; LVCMOS; LVTTL	25	1	HCSL	25; 100; 125; 200	No	TSSOP-16
NB3N5573	1	Crystal; LVCMOS; LVTTL	25	2	HCSL	25; 100; 125; 200	No	TSSOP-16
NB3N51032	1	Crystal; LVCMOS; LVTTL	25	2	HCSL	25; 100; 125; 200	Yes	TSSOP-16
NB3N51034	1	Crystal; LVCMOS; LVTTL	25	4	HCSL	100: 200	Yes	TSSOP-20
NB3N51044	2	Crystal; LVCMOS; LVTTL	25	4	HCSL	100: 125	No	TSSOP-28
NB3N51054	1	Crystal; LVCMOS; LVTTL	25	4	HCSL	100	Yes	TSSOP-24

Fanout Buffers for High Performance Computing

Features

- DC up to 400 MHz
- Accepts LVPECL, LVDS, HCSL, and single-ended inputs
- Typical input clock frequencies: 100, 133, 156.25, 166, 322.26, or 400 MHz
- Typical propagation delay: 800 ps
- HCSL differential outputs
- Integrated 50 Ω input termination resistors
- IREF pin enables setting of output drive
- Additive phase jitter 0.1 ps typical @ 100 MHz; PCI-e Gen 3 jitter complaint
- Additive phase jitter 80 fs maximum @ 156.25 MHz with NB3L208K, NB3L204K, NB3L202K; DB800H, DB400H, DB200H compliant



NB3N121K Logic Diagram

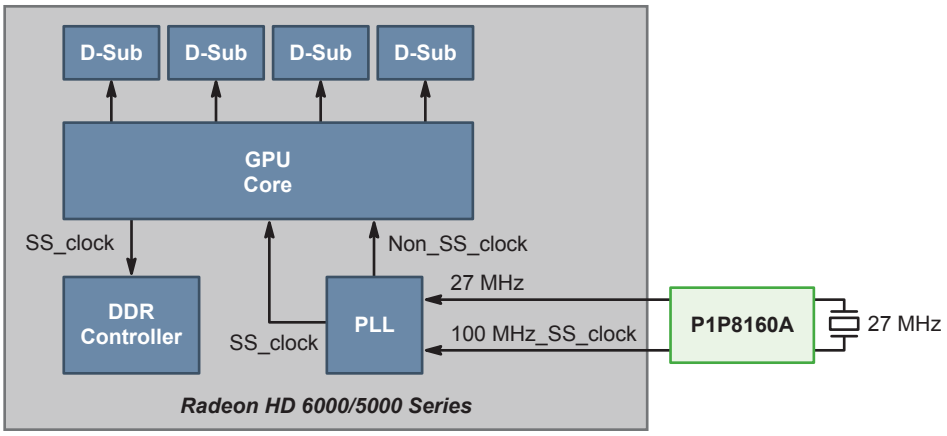
Device	Ratio	Additive $t_{Jitter(RMS)}$ Typ (ps)	$t_{skew(o-o)}$ Max (ps)	t_{pd} Typ (ns)	t_R & t_F Max (ps)	$f_{maxClock}$ Typ (MHz)	Package
NB3L202K*	1:2	0.046	30	1	125	350	QFN-16
NB3L204K*	1:4	0.046	30	1	125	350	QFN-24
NB3N106K	1:6	0.1	100	0.8	400	400	QFN-24
NB3L208K	1:8	0.046	30	1	125	350	QFN-32
NB3N108K	1:8	0.1	100	0.8	400	400	QFN-32
NB3N111K	1:10	0.1	100	0.8	400	400	QFN-32
NB4N111K	1:10	<1	100	0.8	700	400	QFN-32
NB3N121K	1:21	0.1	100	0.8	700	400	QFN-52
NB4N121K	1:21	<1	50	0.8	700	200	QFN-52

* Pending 1H16.

Computing Clock for Graphics

P1P8160A Features

- Provides reference clock to the GPU & reduces EMI in the GDDR interface
- Input frequency 27 MHz; crystal or reference clock
- Output frequency 100 MHz spread spectrum clock; 27 MHz RefOUT
- Two tri-level logic pins for selecting eight frequency deviations along with SSOFF
- Modulation rate at 100 MHz: 32 kHz
- Low cycle-cycle & long term jitter
- Supply voltage: 3.3 V ±10%
- WDFN-10 package

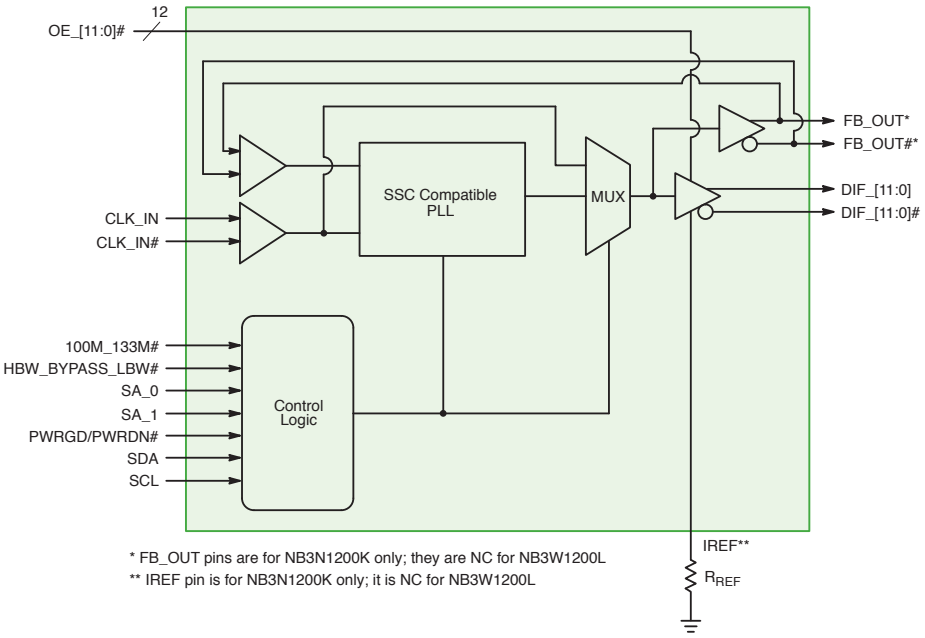


P1P8160A for AMD Graphics Card Application

Zero Delay Buffers Compliant with DB Specifications

Features

- Differential SRC clock support
- NB3N1900K, NB3N1200K: DB1900Z and DB1200Z compliant with 19 and 12 output pairs respectively
- NB3W1200L, NB3W800L: DB1200ZL and DB800ZL compliant with 12 and 8 low power NMOS push-pull output pairs respectively
- NB3W1900L: 19 low power NMOS push-pull output pairs
- Optimized for 100 MHz and 133 MHz to meet PCIe* Gen 2/Gen 3 and Intel QPI 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 power down mode, PLL BW modes, PLL/Bypass mode & frequency selection



NB3N1200K Simplified Block Diagram

Device	Ratio	Output	$t_{Jitter(Cy-Cy)}$ Typ (ps)	$t_{skew(I-o)}$ Max (ps)	$t_{skew(o-o)}$ Max (ps)	Edge Rate Max (V/ns)	Package
NB3W800L	1:8	Low power NMOS push-pull	34	±100	50	4	QFN-48
NB3N1200K	1:12	HCSL	50	±100	50	4	QFN-64
NB3W1200L	1:12	Low power NMOS push-pull	50	±100	50	4	QFN-64
NB3N1900K	1:19	HCSL	50	±100	65	4	QFN-72
NB3W1900L	1:19	HCSL	50	±100	85	4	QFN-72

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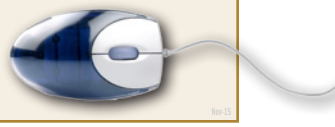

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