

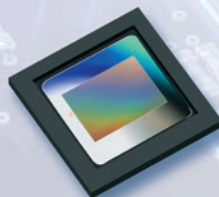


Industrial Solutions

Connectivity, control, sensing, timing, power, and protection solutions for industrial applications from ON Semiconductor.

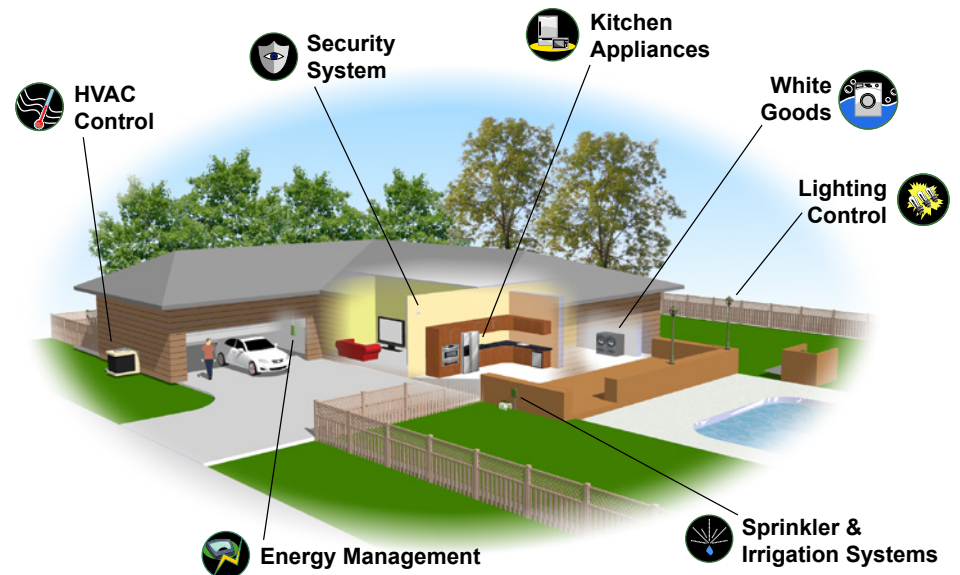
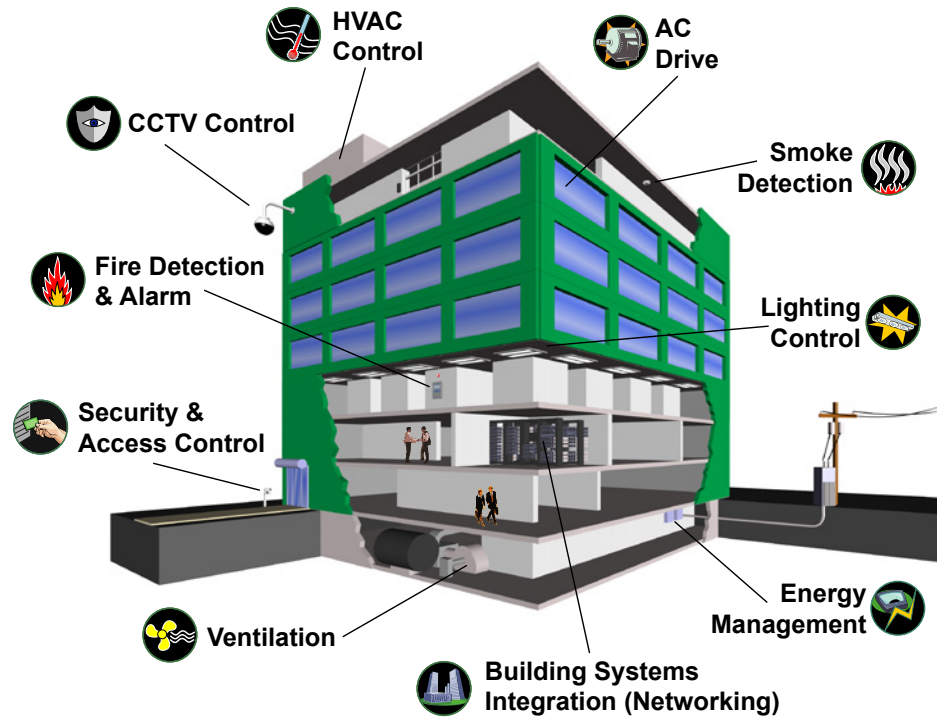


www.onsemi.com



ON Semiconductor has a complete portfolio of rugged, reliable products that meet the needs of industrial grade applications.

- Power Management
- Temperature Monitoring & Control
- Motion & Speed Control
- Electro-Mechanical Break Control
- Switching & Valve Control
- Communications & Connectivity
- Sensing & Sensor Interface
- Electrical Protection
- Oscillator Startup
- Capacitance Discharge



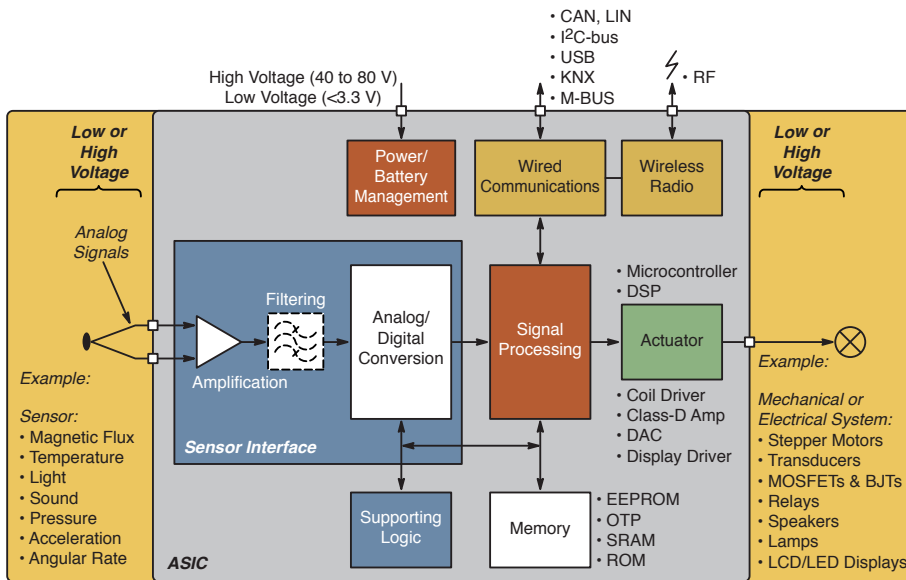
Mixed-Signal ASIC Development Services

Value Proposition

- Experienced resources and assets to bring customers' design objectives successfully to market
- Ability to integrate customers' IP into single-chip solution, thereby protecting the IP
- Flexible cost models to reduce customers' total cost

Design Engineering

- Approximately 200 expert mixed-signal designers with extensive SoC and SiP experience
- Robust custom development process
- Dedicated project managers track & report development progress
- Flexible customer development engagement, from full turnkey to subcontractor production services
- Design expertise in:
 - » Sensor interface
 - » Wireless systems
 - » Energy management
 - » Building & home control

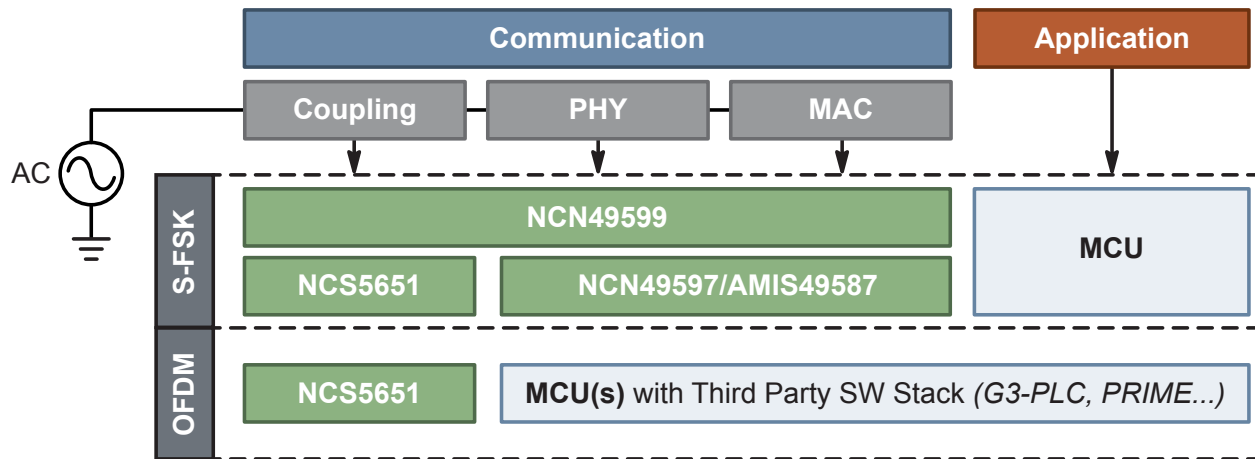


IP & Fab Processes

- ≥ 55 nm, analog-focused CMOS/BCDMOS process technologies utilizing internal fabs and external foundry partners
- Low, medium, high voltages – ≤ 1 V to 90 V
- Low current optimization – active & standby
- Low noise design – “count the electrons”
- High temperature – $\leq 200^\circ\text{C}$ (profile, for selected technologies)
- Integrated low power wireless
- Non-Volatile Memory (EEPROM, OTP), RAM & ROM
- Embedded digital IP
- Robust ESD protection
- Extensive building block ‘starting points’ consisting of amplifiers, references, DACs, ADCs, linear & switching regulators, power management, etc.

Category	Mixed Signal Intellectual Property (IP)
Serial Interfaces	USB 3.0/2.0/1.1, HDMI, MIPI, I2C, SPI, CAN, UART
Microprocessors	ARM, RCore DSP, R8051, AMBA/AHB/APB Peripherals
Memory	SRAM, DPRAM, ROM, EEPROM, OTP, FLASH
Clocking	Oscillators, PLLs, DLLs
Communication	Wireless (Proprietary & Standards), Wired (KNX, PLC and others)
Encryption	ECC, AES, 3-DES, DES, RSA
Data Converters	DAC, ADC (8 - 20 bits, 1 KSPS - 120 MSPS)
Wireless IP	PGA, LNA, PLLs, Correlators, DSP
Power Management	Efficient Switching Regulators, LDOs, Charge Pumps, Thermal Protection
References	Precision Bandgaps, Current References, Temperature Sensors
Analog and High Voltage Interfaces	High-Voltage Drivers, Display and LCD Drivers, Class D Amplifiers
Signal Conditioning	PGA, Instrumentation Amps, Digital and Analog Filters

PLC Modems/Power Line Driver



G3-PLC Alliance



G3-PLC™ Reference Board



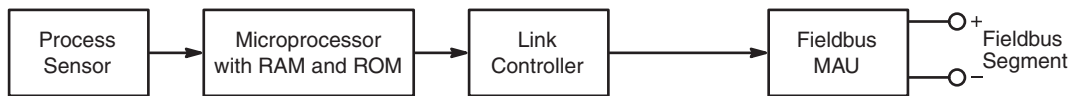
	Device	Function	Features	Package(s)	
Smart Grid Modem	NCN49599	PLC S-FSK Modem; A - D Band	<ul style="list-style-type: none"> ARM Cortex M0 Baud rate: 4800 Bauds S-FSK modulation 	<ul style="list-style-type: none"> Hardware embedded MAC + PHY Embedded 1.2 A, 2-stage power amplifier with current limitation and thermal protection 	QFN-56
	NCN49597	PLC S-FSK Modem; A - D Band	<ul style="list-style-type: none"> ARM Cortex M0 Baud rate: 4800 Bauds 	<ul style="list-style-type: none"> S-FSK modulation Hardware embedded MAC + PHY 	QFN-52
Smart Metering Modem	AMIS49587	PLC S-FSK Modem; A & B Band	<ul style="list-style-type: none"> ARM7TDMI, 24 MHz core Baud rate: 2400 Bauds 	<ul style="list-style-type: none"> S-FSK modulation Hardware embedded MAC + PHY 	QFN-52
Power Amplifier	NCS5651	Power Line Driver; Class AB	<ul style="list-style-type: none"> Low distortion power line driver with optimized interface for PLC modems Capability to drive 2.0 A peak into reactive loads 	<ul style="list-style-type: none"> Current shutdown minimizes power consumption during power down state Rail-to-Rail Drop of Only ±1 V with Iout = 1.5 A 	QFN-20 EP

Modems



AMIS-49200 & AMIS-49250 Fieldbus Physical Layer Medium Access Units

- Compatible to both FOUNDATION Fieldbus H1 (Type 111 and Type 112 per FF-816) and PROFIBUS PA standards
- Enables Fieldbus to completely power field devices using the integrated power supply block
- Data rate: 31.25 kbps voltage mode
- Low current consumption 500 μ A typ
- LQFP-44 and NQFP-44 packages

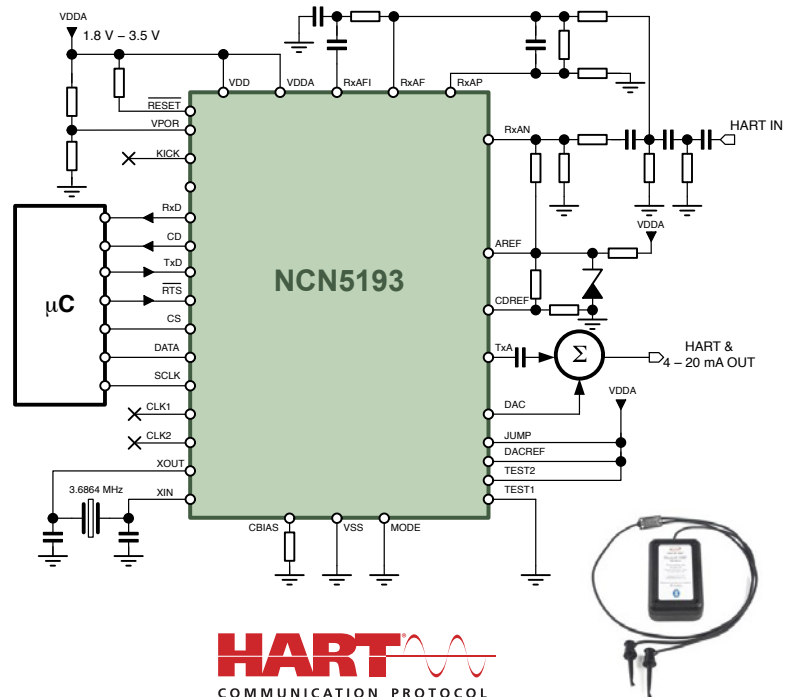


Industrial HART Protocol Modems

- Single-chip, half-duplex 1200 bps FSK modem
- Bell 202 shift frequencies of 1200 Hz and 2200 Hz
- Transmit-signal wave shaping
- Receive band-pass filter

HART Modems

Device	Input Frequency	DAC	Temp Range (°C)	Package
NCN5193	460.8 kHz, 920 kHz, or 1.8 MHz	Integrated 16-bit Sigma-Delta	-40 to +85	QFN-32
NCN5192	460.8 kHz, 920 kHz, or 1.8 MHz	Integrated 16-bit Sigma-Delta	-40 to +85	QFN-32
A5191HRT	460.8 kHz	External	-40 to +85	QFN-32, LQFP-32, PLCC-28

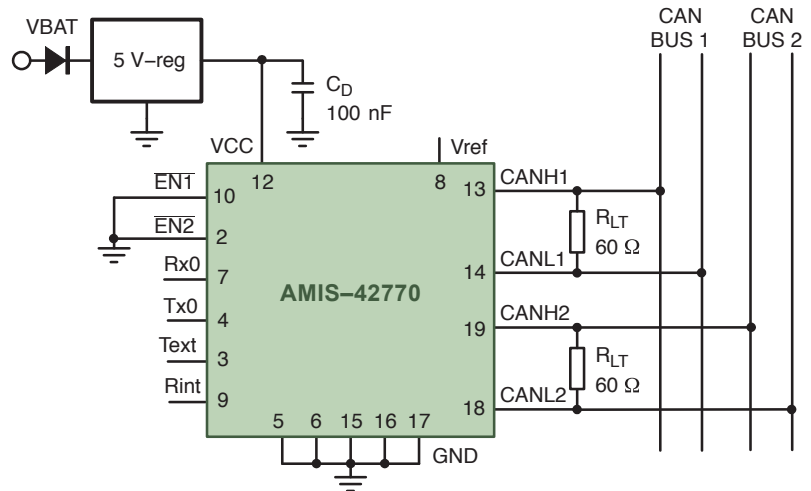
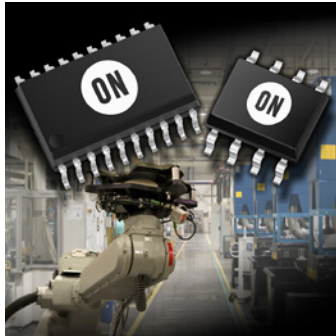


HART
COMMUNICATION PROTOCOL



CONNECTIVITY

CAN Transceivers for Long Networks, >500 m



Features

- ISO 11898-2 compliant
- Up to 1 Mb/s communication speed
- Delivers low transmit data rate in networks exceeding 1 km
- Functional in 12 V and 24 V systems

CAN Transceivers



Device	Type	Description	Package
AMIS42770	Dual	High-Speed CAN Repeater	SOIC-20
AMIS42670	Single	High-Speed CAN Transceiver for Long Networks	SOIC-8
AMIS42671	Single	High-Speed CAN Transceiver for Long Networks	SOIC-8
AMIS42673	Single	High-Speed CAN Transceiver for Long Networks	SOIC-8
AMIS42675	Single	High-Speed CAN Transceiver for Long Networks	SOIC-8

KNX Transceivers

KNX is a standardized (EN 50090, ISO/IEC 14543), OSI-based network communications protocol for intelligent buildings. KNX is the successor to, and convergence of, three previous standards:

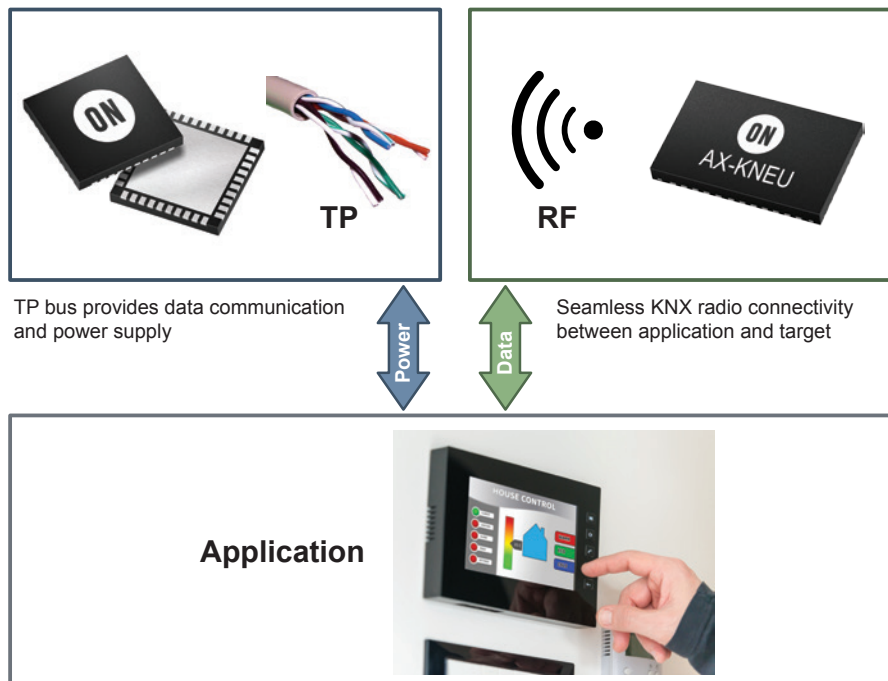
the European Home Systems Protocol (EHS), BatiBUS, and the European Installation Bus (EIB or Instabus).

KNX Open Standards

- EN 50090: European Standard
- ISO/IEC 14543-3: International Standard
- GB/Z 20965: Chinese Standard
- ANSI/ASHRAE 135: US Standard

Applications

- Connects appliances and sensors, especially for climate and light control - wired or wireless - to the 9600 Baud KNX twisted pair (TP) bus inside a building



RF	AX8052F143
Multi/Ready	✓
High Sensitivity	✓
Ultra Low Receive and Standby Current	✓
PHY + MAC	✓

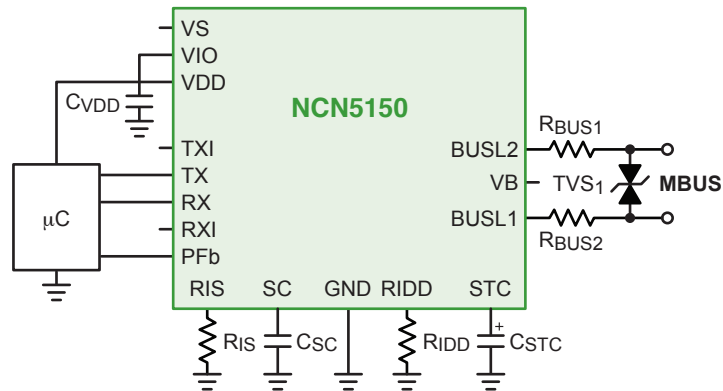
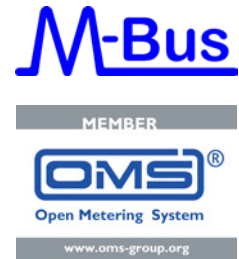


Twisted Pair	NCN5120	NCN5121	NCN5110	NCN5130
Efficiency Increase		✓	✓	✓
10/20 mA Bus Current Consumption	✓	✓		
5 to 40 mA Bus Current Consumption			✓	✓
KNX Bus Current Limitation		✓	✓	✓
PHY + MAC Layer (TPUART Compatible)	✓	✓		✓
PHY Layer (Analog Only)			✓	
3.3 V Fixed DC/DC	✓	✓	✓	✓
Adjustable DC/DC	✓	✓	✓	✓
20 V LDO	✓	✓	✓	✓
Analog Monitor Output		✓		✓

Wired M-BUS Transceiver

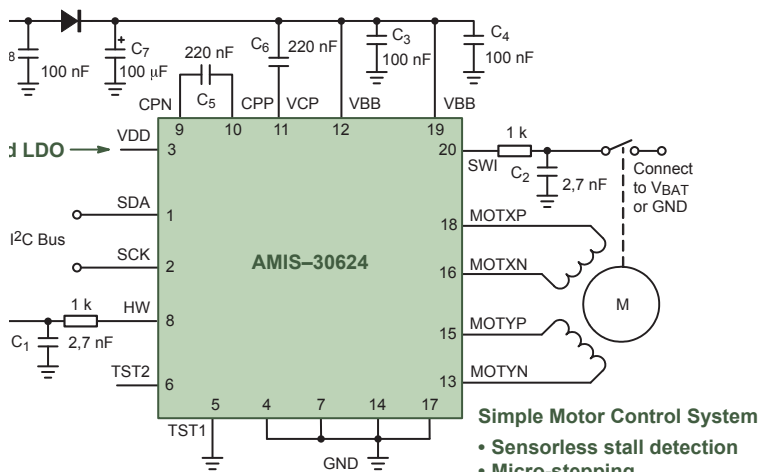
Features

- Satisfies physical requirements for M-BUS, described in EN 13757-2 and EN 1434-3
- UART communication speeds up to 38400 baud
- Integrated 3.3 V VDD LDO regulator (extended peak current of 15 mA)
- Supports powering slave device from the bus or from external power supply
- SOIC-16 and QFN-20 packages



General Application Diagram

Stepper Motor Drivers for Motion Control

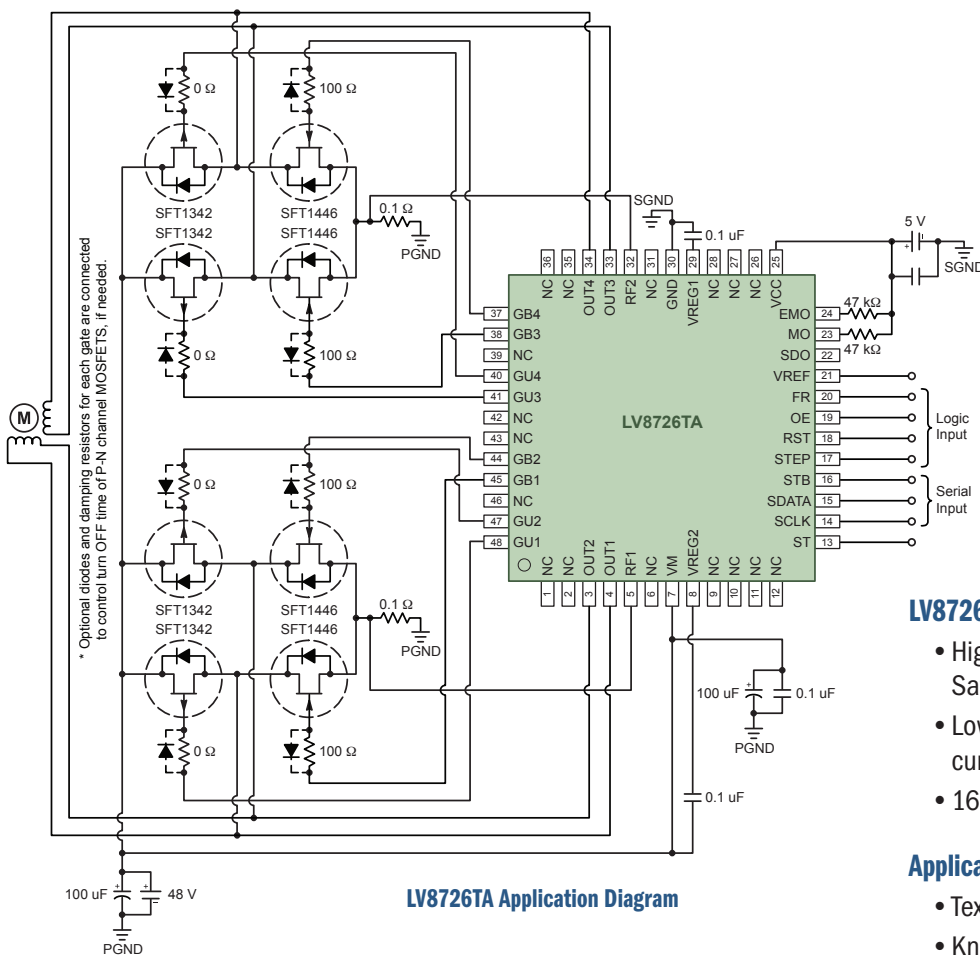


Simple Motor Control System

- Sensorless stall detection
- Micro-stepping
- Position controller
- Programmable velocity and acceleration



AMIS-30624 Application Diagram



LV8726TA Features

- High operating voltage ($V_{mmax} = 60\text{ V}$) for Safe design and high tolerance
- Low standby current and low operation current for low power consumption
- 16 selectable step modes

Applications

- Textile machine
- Knitting machine
- Sewing machine
- Packing machine
- Engraving machine
- Large printer

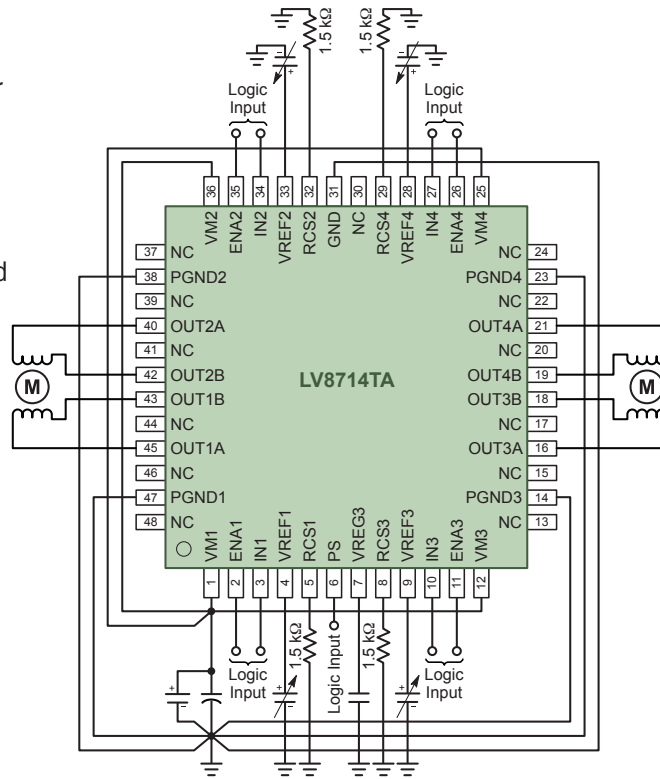
Stepper Motor Drivers for Motion Control

Features

- Free microstep drive (full, half, 1/4, ... 1/256, over 1/256) enabled by controlling VREF voltage; low vibration and high convenience
- Constant current control without RF high power resistor results in simpler design and lower cost
- No charge pump results in fewer external parts and small package

Applications

- Security camera
- CCTV
- Network camera
- Scanner
- Point-of-sale printer
- Thermal printer



LV8714TA Application Diagram

Device	Type	V _M Max (V)	V _{CC} Max (V)	I _O Max (A)	I _O Peak Max (A)	Max Step Resolution	Control Type	Features	Package
AMIS-30422	Stepper	30	40	Note1	Note1	1/128	Clock	Note 3, 4, 5	NQFP-48
AMIS-30543	Stepper	30	40	3.2	6	1/128	Clock	Note 3, 4, 5	NQFP-32
AMIS-30624	Stepper	30	40	0.8	0.8	1/128	I2C	Note 3, 4, 5	NQFP-32, SOIC-20W
LV8726TA	Stepper	60	6	Note1	Note1	1/128	Clock; SPI	Note 3, OCP	TQFP-48EP
LV8727	Stepper	55	Note 2	4	4.6	1/128	Clock	Note 3, OCP	HZIP-25
LV8728MR	Stepper	36	Note 2	2	2.5	1/128	Clock	Note 3, OCP	MFP-30KR
LV8702V	Stepper	36	Note 2	2.5	3	1/4	Clock	Note 3, 5, OCP	SSOP-44J
LV8774Q	Stepper/2x Brush DC	36	Note 2	2	2.5	1/16	Clock; Parallel	Note 3, OCP	VQFN-44L
LV8740V	Stepper/2x Brush DC	38	Note 2	2.5	3	1/4	Clock; Parallel	Note 3, OCP	SSOP-44J
LV8732V	Stepper/2x Brush DC	36	Note 2	2	2.5	1/8	Clock; Parallel	Note 3, OCP	SSOP-44K
LV8734V	Stepper/2x Brush DC	36	Note 2	1.5	1.75	1/8	Clock; Parallel	Note 3, OCP	SSOP-44K
LV8736V	Stepper/2x Brush DC	36	Note 2	1	1.5	1/8	Clock; Parallel	Note 3, OCP	SSOP-44K
LV8711T	Stepper/2x Brush DC	18	6	0.8	1	1/2	Parallel	Note 3, OCP	TSSOP-24
LV8716QA	Stepper/2x Brush DC	12.6	Note 2	1	1.5	1/2	Parallel	Note 3, 6	QFN-16
LV8712T	Stepper	18	6	0.8	1	1/8	Clock	Note 3	TSSOP-24
LV8713T	Stepper	18	6	0.8	1	1/32	Clock	Note 3	TSSOP-24
LV8714TA	2x Stepper/4x Brush DC	18	6	1.5	1.75	Over 1/256	Parallel	Note 3, 6, OCP	TQFP-48EP
LV8414CS	2x Stepper	6	6	0.4	0.6	1/64	Clock; I2C	Note 3	WLP-32K
LV8760T	Brush DC	38	6	3	4	-	Parallel	Note 3, OCP	TSSOP-20J
LV8762T	Brush DC	36	Note 2	1	1.5	-	Parallel	Note 3, OCP	TSSOP-24

NOTE 1: Function of external MOSFETS

NOTE 2: Single power supply (only VM pin)

NOTE 3: Integrated active flyback, under-voltage, over temperature

NOTE 4: Integrated under temperature, safe position upon loss of communication

NOTE 5: Integrated BEMF output for stall or step loss detection

NOTE 6: Integrated constant-current control without high power resistor

Stepper Motor Drivers for Motion Control

Key Features

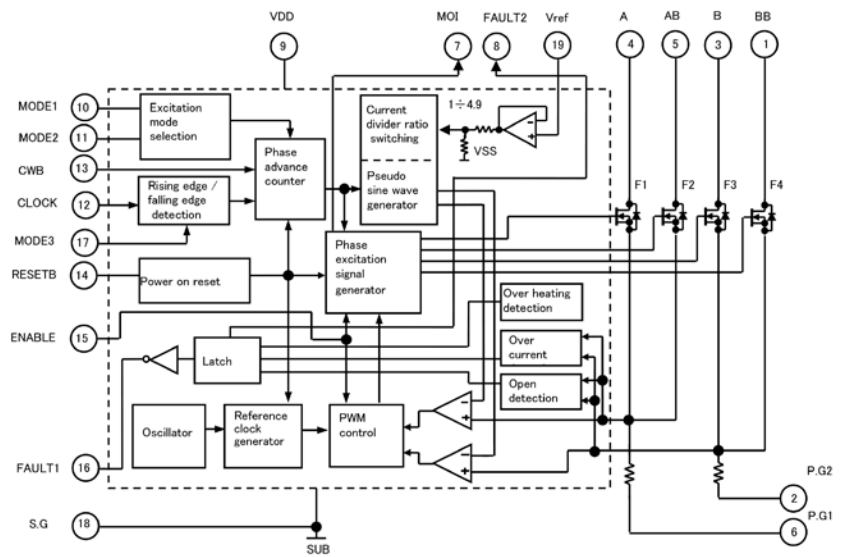
- For Unipolar Stepper Motor Drive by IPM (Intelligent Power Module)
- Current Sense, Fault Detections are Fully integrated
- Pin-compatible line up



SIP-19



SIP-19S



Block Diagram for STK672-440BN-E

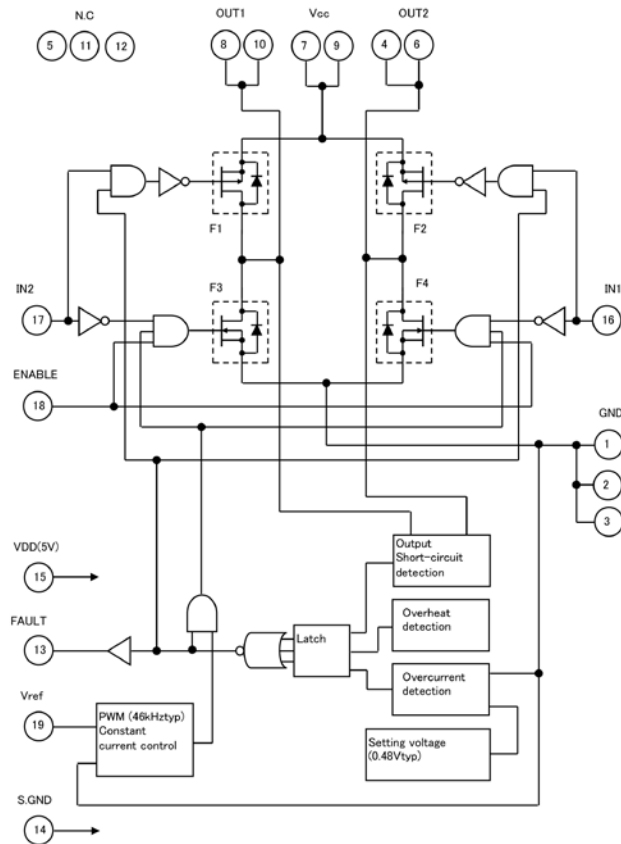
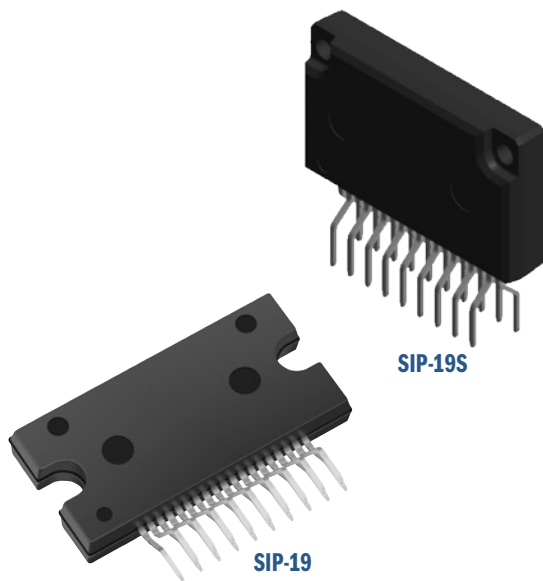
CONTROL & DRIVE

Device	Type	V _M Max (V)	V _{CC} Max (V)	I _O Max (A)	I _O Peak Max (A)	Step Resolution	Control Type	Current Sense	Fault Detection			Package
									Overcurrent	Thermal	UVLO	
STK672-430AN-E	Stepper	52	5.25	2.5	10	1/16	Clock	Fully Integrated	Yes	Yes	Yes	SIP-19
STK672-432AN-E	Stepper	52	5.25	2.5	10	1/16	Clock	Fully Integrated	Yes	Yes	Yes	SIP-19S
STK672-432BN-E	Stepper	52	5.25	2.5	10	1/16	Clock	Fully Integrated	Yes	Yes	Yes	SIP-19S
STK672-440AN-E	Stepper	52	5.25	3.5	20	1/16	Clock	Fully Integrated	Yes	Yes	Yes	SIP-19
STK672-440BN-E	Stepper	50	5.25	3.5	20	1/16	Clock	Fully Integrated	Yes	Yes	Yes	SIP-19
STK672-442AN-E	Stepper	52	5.25	3.5	20	1/16	Clock	Fully Integrated	Yes	Yes	Yes	SIP-19S
STK672-442BN-E	Stepper	50	5.25	3.5	20	1/16	Clock	Fully Integrated	Yes	Yes	Yes	SIP-19S
STK672-630AN-E	Stepper	52	5.25	2.65	10	1/2	Clock	Fully Integrated	Yes	Yes	Yes	SIP-19
STK672-632AN-E	Stepper	52	5.25	2.65	10	1/2	Clock	Fully Integrated	Yes	Yes	Yes	SIP-19S
STK672-640AN-E	Stepper	52	5.25	4	20	1/2	Clock	Fully Integrated	Yes	Yes	Yes	SIP-19
STK672-642AN-E	Stepper	52	5.25	4	20	1/2	Clock	Fully Integrated	Yes	Yes	Yes	SIP-19S
STK672-732AN-E	Stepper	52	5.25	2.65	10	1/2	Parallel	Fully Integrated	Yes	Yes	Yes	SIP-19S
STK672-740AN-E	Stepper	52	5.25	4	20	1/2	Parallel	Fully Integrated	Yes	Yes	Yes	SIP-19

Brush DC Motor Control

Key Features

- No need for dead time design
- Built-in Sensing resistor
STK681-360
- Built-in Protective Functions
STK681-332
- PWM operation
STK681-332/-360

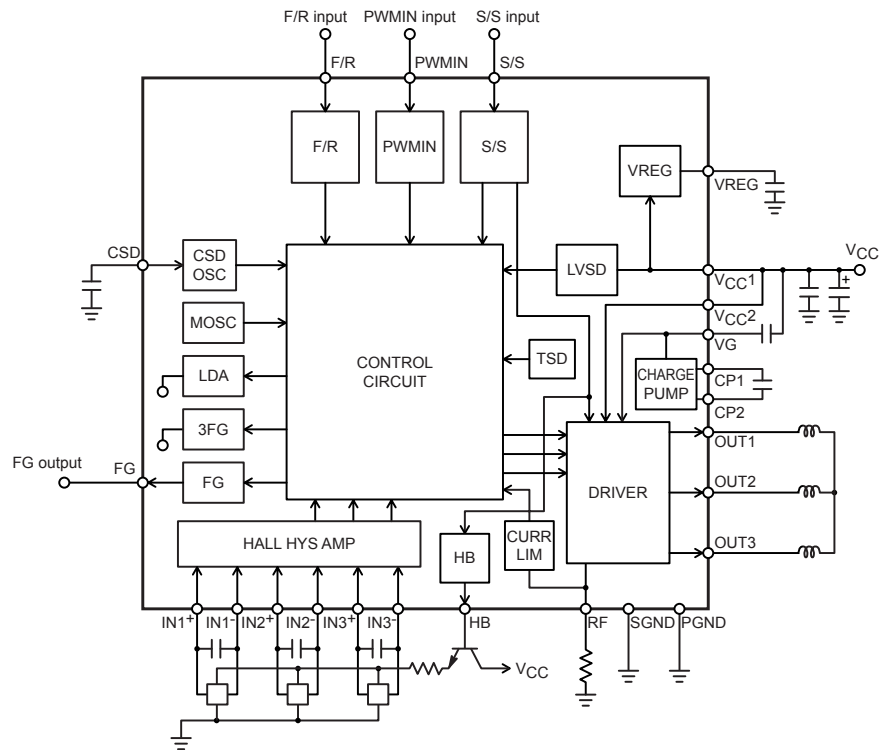


Device	Type	V _M Max (V)	V _{CC} Max (V)	I _O Max (A)	I _O Peak Max (A)	Control Type	Current Sense	Fault Detection			Package
								Overcurrent	Thermal	UVLO	
STK681-332-E	Brush DC	52	5.25	8.5	12	Parallel PWM	External Resistor	Yes	Yes	Yes	SIP-19S
STK681-360-E	Brush DC	52	5.25	5.8	8	Parallel PWM	Fully Integrated	Yes	Yes	No	SIP-19

Brushless DC Motor Control

LV8827LFQA Features

- VCC max = 36 V, IO max = 1.5 A (built-in output transistor)
- Speed control and synchronous rectification using direct PWM input
- 1-Hall FG output
- Latch type constraint protection circuit (the latch is released by S/S and F/R)
- Forward/reverse switching circuit, Hall bias pin
- Power save circuit (power save in stop mode)
- Integrated current limit, low-voltage protection, thermal shutdown circuit
- Charge pump circuit; 5 V regulator output
- Start/stop circuit (short brake when motor is to be stopped)



LV8827LFQA 3-Phase Brushless DC Motor Driver

CONTROL & DRIVE

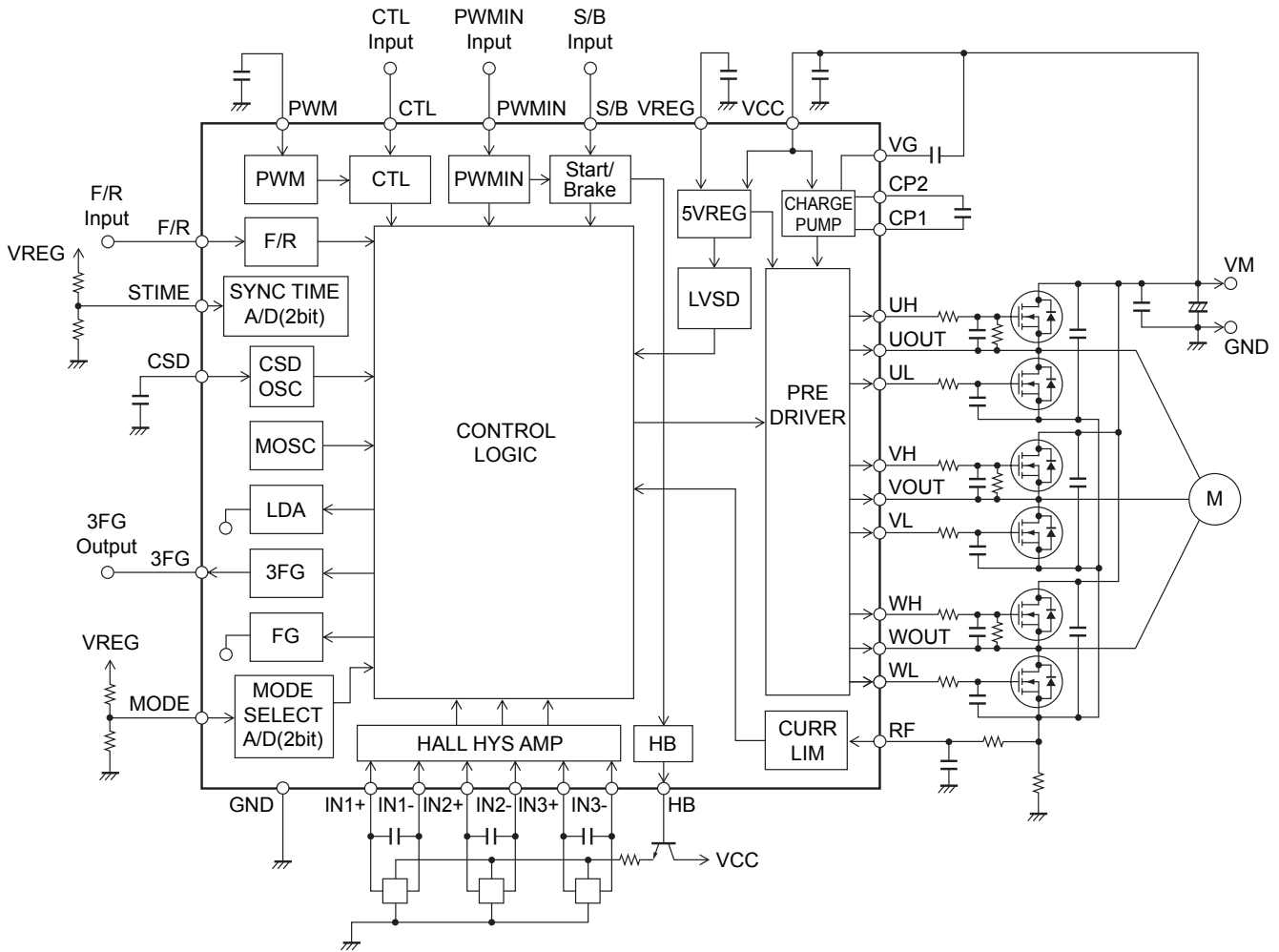
Device	Description	Vcc Min (V)	Vcc Max (V)	Po Max (W)	Io Max (mA)	Package
LV8121V	Brushless DC 3-Phase Motor Driver	8	36	1.7	3500	SSOP-44K
LV8824QA	Brushless DC 3-Phase Motor Controller	7	34	1.45	50	VQFN-32U
LB11696V	Brushless DC 3-Phase Motor Controller	4.5	18	1.05	30	SSOP-30
LV8827LFQA	Brushless DC 3-Phase Motor Driver	8	36	1.35	1500	VQFN-24N
LV8127T	Brushless DC 3-Phase Motor Controller	12 ¹	23 ²	1.1	50	TSSOP-36
MC33033	Brushless DC 3-Phase Motor Controller	10	30	0.619 - 0.867*	100	SOIC-20, PDIP-20
MC33035	Brushless DC 3-Phase Motor Controller	10	30	0.650 - 0.867*	100	SOIC-24, PDIP-24
MC33039	Closed-Loop Brushless Motor Adapter	5.5	9	0.650 - 0.867*	20	SOIC-8, PDIP-8

* Dependent upon package. 1. VM Min = 18 V. 2. VM Max = 190 V.

Brushless DC Motor Control

LV8824QA Features

- Speed control and synchronous rectification using direct PWM input and DC voltage
- 3-Hall FG output
- Latch type constraint protection
- Forward/reverse switching circuit, Hall bias pin
- Power save circuit
- Integrated current limit; low-voltage protection; thermal shutdown circuit
- Charge pump circuit(external N-Channel/N-Channel), 5 V regulator output
- Start/stop circuit (short brake when motor is to be stopped)



Application Diagram for LV8824QA

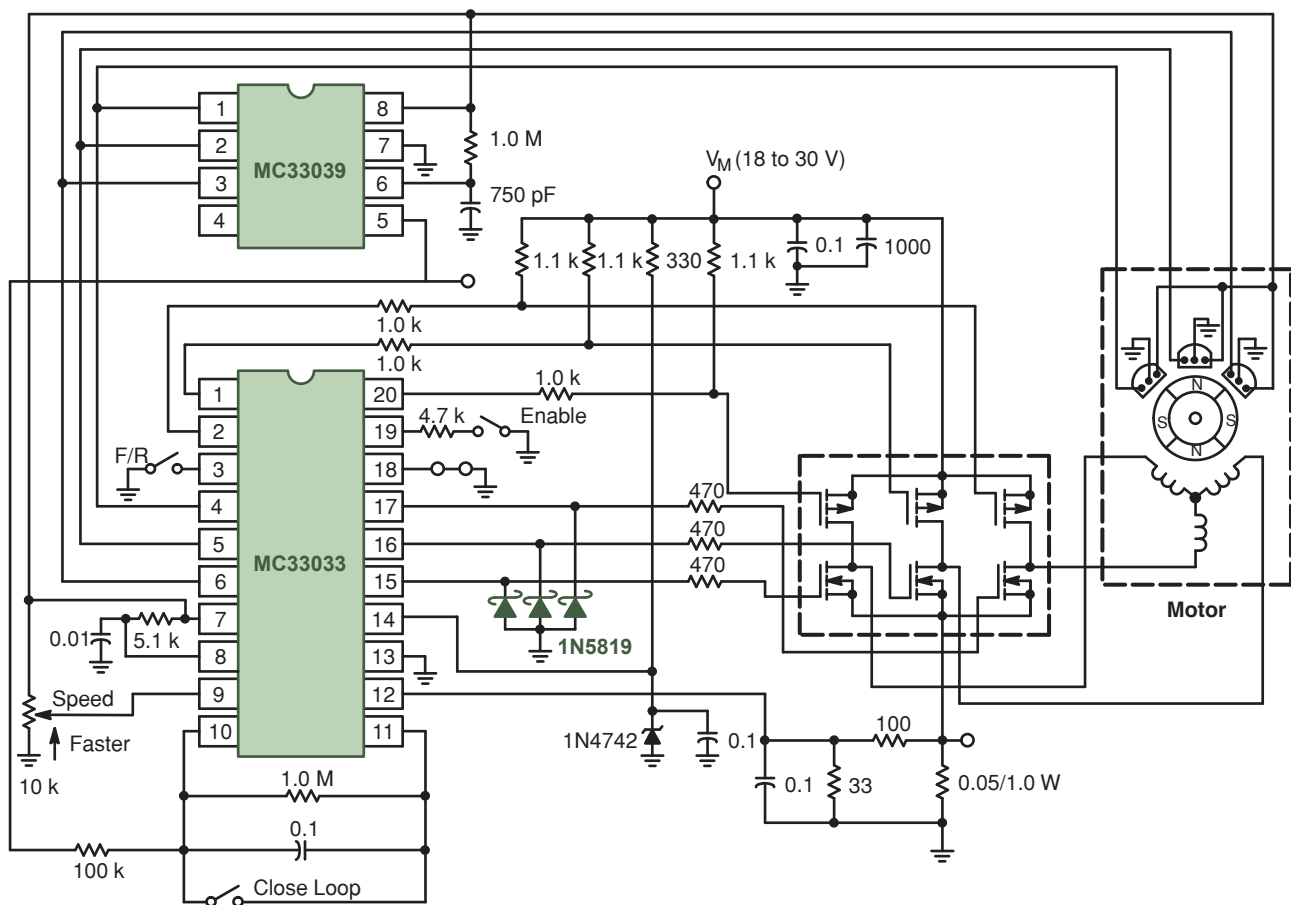
Brushless DC Motor Control

MC33033/5 Features

- Rotor position decoder for proper commutation sequencing
- Temperature compensated reference capable of supplying sensor power
- Frequency programmable sawtooth oscillator
- Three open collector top drivers
- Three high current totem pole bottom drivers

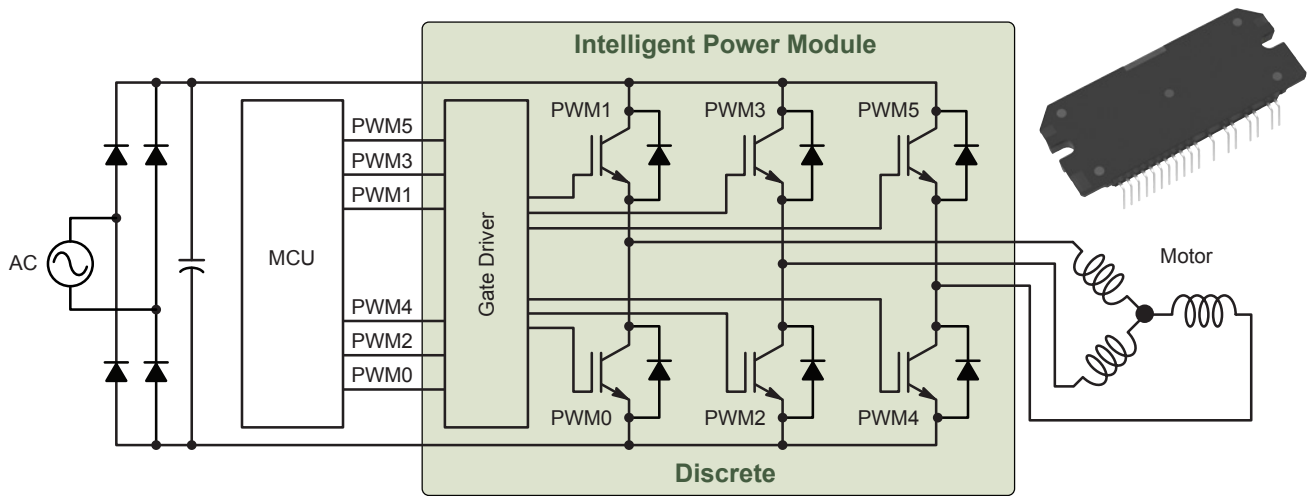
MC33039 Features

- Digital detection of each input transition for improved low speed motor operation
- Operation down to 5.5 V for direct powering from MC33035 reference
- Internal shunt regulator allows operation from a non-regulated voltage source
- Inverter output for easy conversion between 60°/300° and 120°/240° sensor phasing conventions



Application Diagram for MC33033 and MC33039

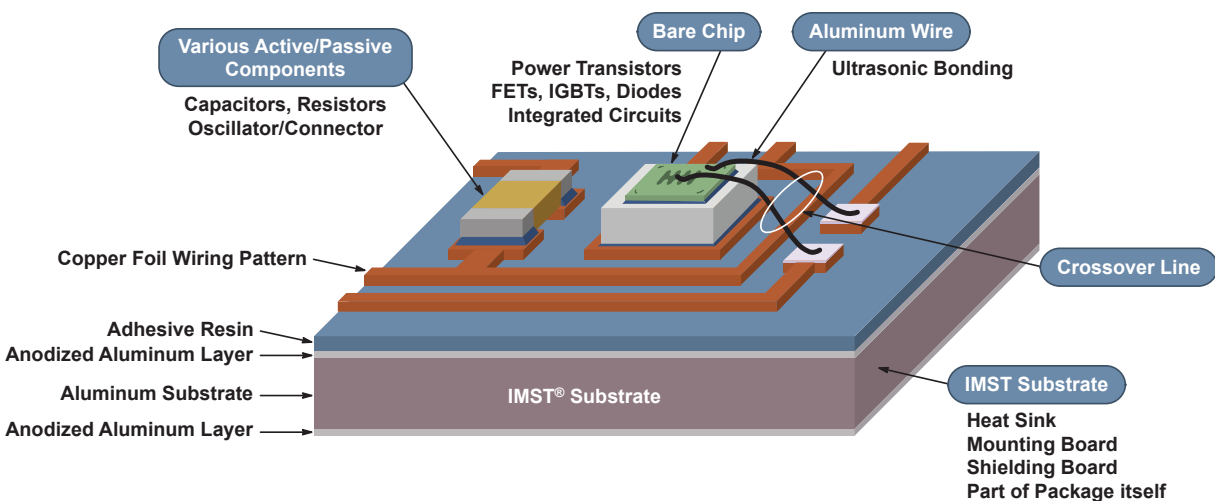
Inverter Drive – Discrete and Module Designs



Intelligent Power Modules (IPM) for Inverter Designs

Insulated Metal Substrate Technology (IMST®) forms electronic circuits on plates of aluminum (metal substrates). IMST-based hybrid devices use the high thermal conductivity plates of aluminum for their base substrates.

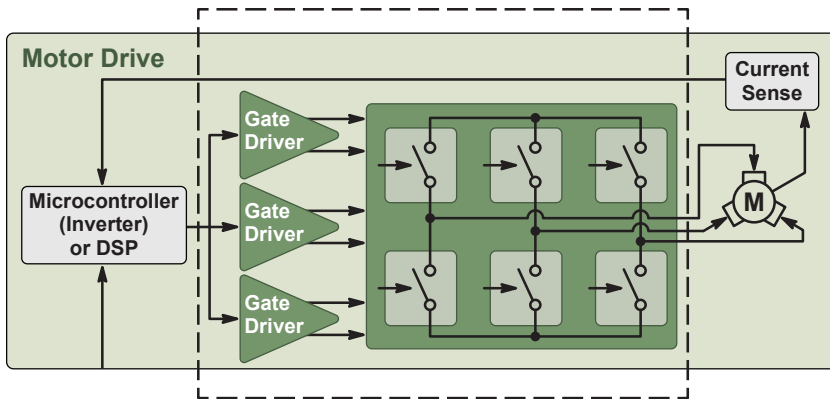
Hybrid devices from ON Semiconductor enable power output circuits, control circuits, and peripheral circuits to be mounted on the same substrate. IMST succeeds in turning bare chip mounting into an element technology, and will continue to evolve as an outstanding mounting technology capable of delivery high density, high performance, and high reliability.



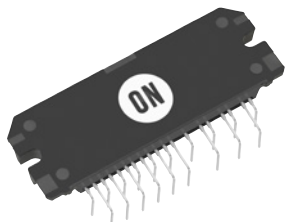
Insulated Metal Substrate Technology

IMST enables assembly of discrete passive components (resistors, capacitors); discrete active components (diodes, transistors); and more complex devices (gate drivers, DSPs, logic) into highly integrated modules.

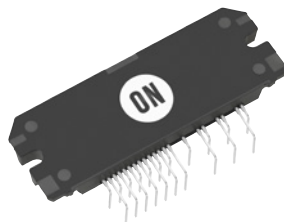
Intelligent Power Modules (IPM) for Inverter Designs



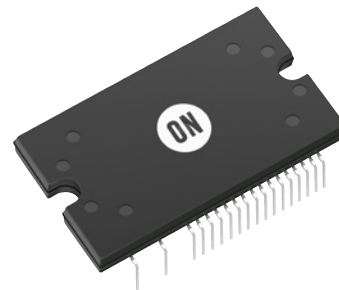
- Intelligent power module (IPM) is a 3-phase inverter with gate drivers, UVLO, thermal and current sense
- Optimized layout for EMI & thermal performance
- Insulated Metal Substrate Technology (IMST)
- Available with integrated PFC



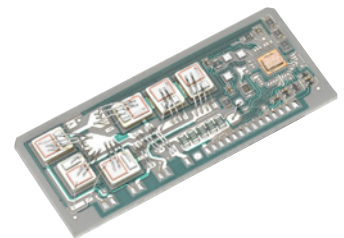
SIP1 Package



SIP1A Package



DIP4 Package



SPL Interhal Board

CONTROL & DRIVE

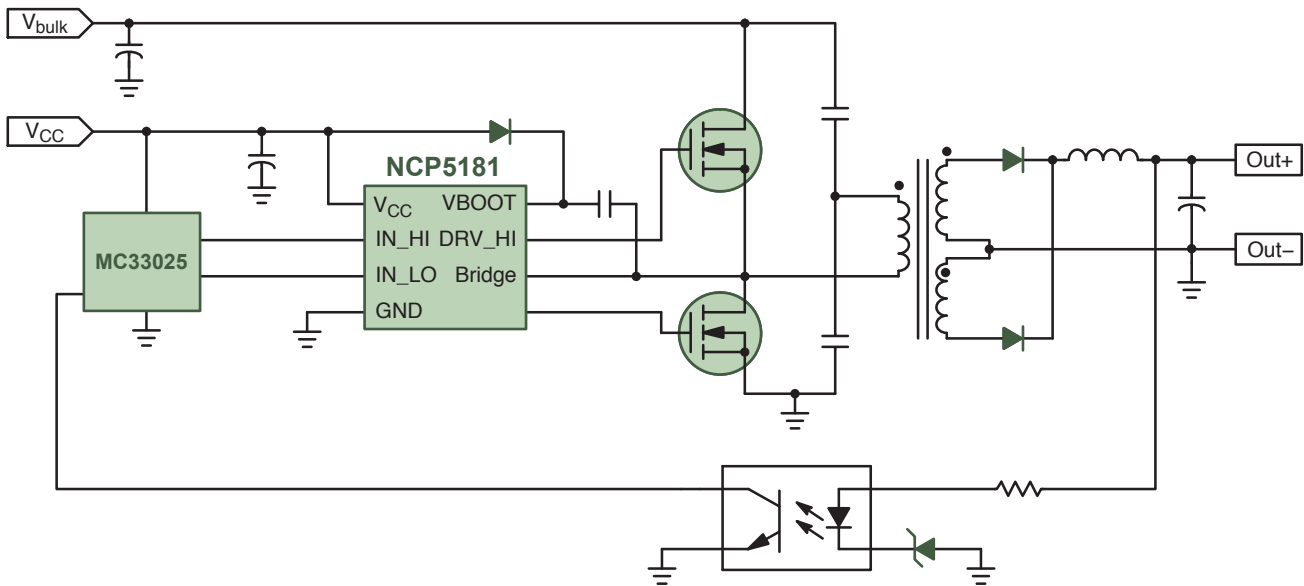
Power Modules

Device	Type	V _{DS} Max (V)	I _{op} Peak Current (A)	Package
STK551U362A-E	Module 1 Shunt resistor	600	10	SIP1A
STK554U362A-E	Module 3 Shunt resistor	600	10	SIP1A
STK554U362C-E	Module 3 Shunt resistor	600	10	SIP1A
STK544UC62K-E	Module 3 Shunt resistor	600	10	SIP1
STK551U392A-E	Module 1 Shunt resistor	600	15	SIP1A
STK554U392A-E	Module 3 Shunt resistor	600	15	SIP1A
STK551U3A2A-E	Module 1 Shunt resistor	600	20	SIP1A
STK5F1U3C2D-E	Module 1 Shunt resistor	600	30	DIP4
STK5F4U3C2D-E	Module 3 Shunt resistor	600	30	DIP4
STK5F1U3E2D-E	Module 1 Shunt resistor	600	50	DIP4
STK5F4U3E2D-E	Module 3 Shunt resistor	600	50	DIP4

Up to 600 V MOSFET/IGBT Gate Drivers

Device	Description	Number of Drivers	V _{CC} Max (V)	Drive Source/Sink Typ (mA)	Rise Time (ns)	Fall Time (ns)	t _p Max (ns)	Package
NCP5104	Single Input High and Low Side Power MOSFET Driver	2	20	250 / 500	85	35	170	SOIC-8; PDIP-8
NCP5106	Dual Input High Voltage High and Low Side MOSFET or IGBT Drivers	2	23	250 / 500	85	35	170	SOIC-8; PDIP-8
NCP5304	Dual Input High Voltage High and Low Side MOSFET or IGBT Drivers	2	23	250 / 500	85	35	170	SOIC-8; PDIP-8
NCP5111	Single Input Half-Bridge Power MOSFET or IGBT Driver	2	23	250 / 500	85	35	170	SOIC-8; PDIP-8
NCP5181	Dual Input High Voltage High and Low-Side MOSFET or IGBT Drivers	2	20	1400 / 2200	20; 40	20; 40	170	SOIC-8; PDIP-8

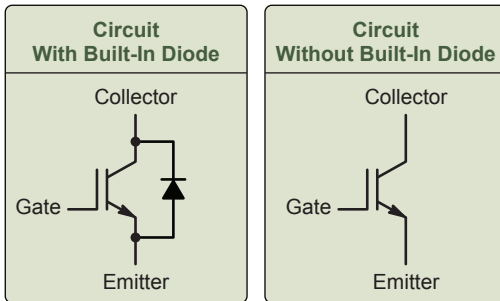
CONTROL & DRIVE



NCP5181 Application Diagram

IGBTs for Inverters, UPS, Solar, and Welding

IGBTs

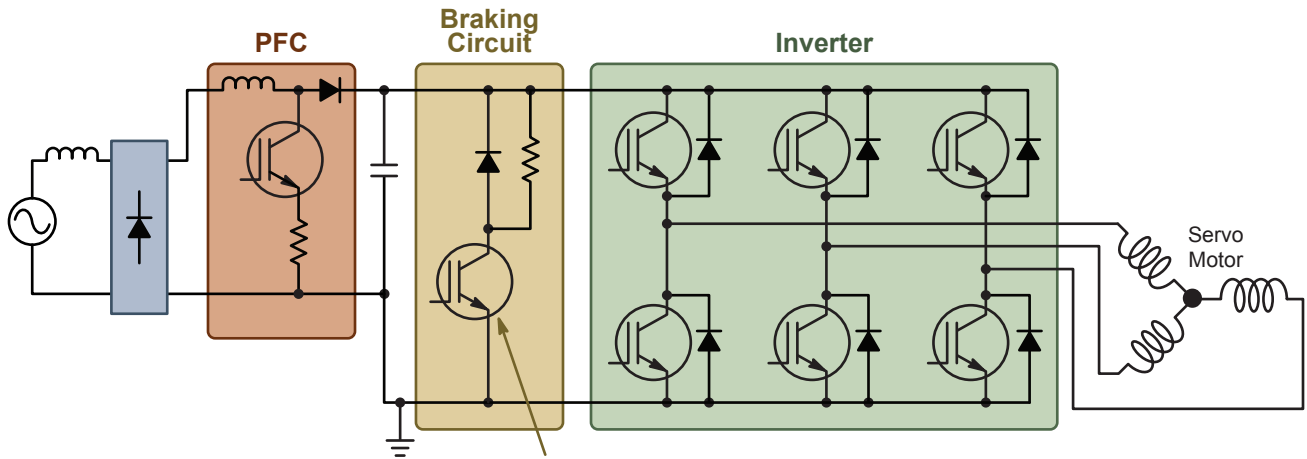


IGBT Features

- Low saturation voltage using trench technology
- Low switching loss
- Rugged short circuit withstand capability
- Soft Fast Reverse Recovery Diode

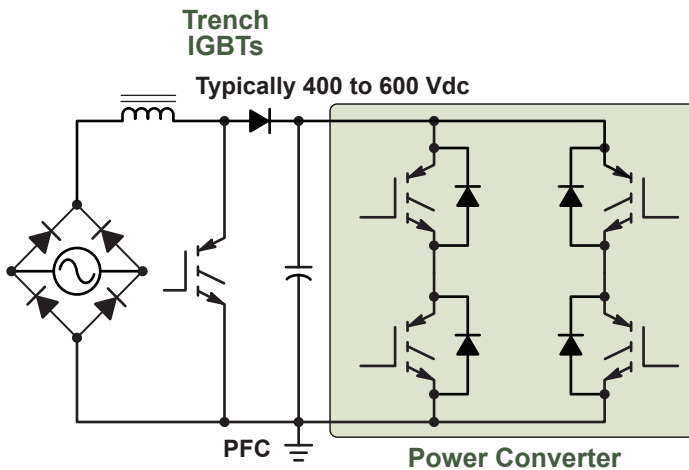
Device	Voltage (V)	Current @ 100°C (A)	V _{CE(sat)} (V)	E _{off} (mJ)	T _{sc} (ms)	Co-Packaged Diode	Package
NGTB03N60R2DT4G	600	4.5	1.7	0.027	–	Yes	DPAK
NGTB05N60R2DT4G	600	8	1.65	0.06	–	Yes	DPAK
NGTB10N60FG	600	10	1.5	–	5	Yes	TO-220F-3FS
NGTB30N60L2WG	600	30	1.4	0.31	5	Yes	TO-247
NGTB35N60FL2	600	35	1.7	0.28	5	Yes	TO-247
NGTB40N60FL2	600	40	1.7	0.44	5	Yes	TO-247
NGTB40N60L2	600	40	2	0.28	5	Yes	TO-247
NGTB50N60L2	600	50	1.5	0.6	5	Yes	TO-247
NGTB50N60FL2	600	50	1.8	0.46	5	Yes	TO-247
NGTB50N60S1	600	50	1.8	0.46	5	Yes	TO-247
NGTB75N60FL2	600	75	1.7	1	5	Yes	TO-247
NGTB35N65FL2	650	35	1.7	0.28	5	Yes	TO-247
NGTG35N65FL2	650	35	1.7	0.28	5	No	TO-247
NGTB40N65FL2	650	40	1.7	0.44	5	Yes	TO-247
NGTB50N65FL2	650	50	1.8	0.46	5	Yes	TO-247
NGTB75N65FL2	650	75	1.7	1	5	Yes	TO-247
NGTB15N120FL2	1200	15	2	0.37	10	Yes	TO-247
NGTG15N120FL2	1200	15	2	0.37	10	No	TO-247
NGTB25N120FL3	1200	25	1.7	0.7	0	No	TO-247
NGTB25N120FL2	1200	25	2	0.6	10	Yes	TO-247
NGTG25N120FL2	1200	25	2	0.6	10	No	TO-247
NGTB30N120L2	1200	30	1.7	1.4	10	Yes	TO-247
NGTB30N120FL2	1200	30	2	0.7	10	Yes	TO-247
NGTB40N120FL3	1200	40	1.7	1.1	0	No	TO-247
NGTB40N120L3	1200	40	1.55	1.5	0	No	TO-247
NGTB40N120FL2	1200	40	2	1.1	10	Yes	TO-247
NGTG40N120FL2	1200	40	2	1.1	10	No	TO-247
NGTB50N120FL2	1200	50	2.2	1.4	10	Yes	TO-247

Motor Drive Braking



Device	Voltage (V)	Current @ 100°C (A)	Package
NGTG20N60L2TF1G	600	20	TO-3PF-3L
NGTG15N60R2FG	600	14	TO-220F-3FS
NGTG12N60TF1G	600	12	TO-3PF-3L
NGTG10N60R2DT4G	600	10	DPAK

Motor Drive Power Factor Correction



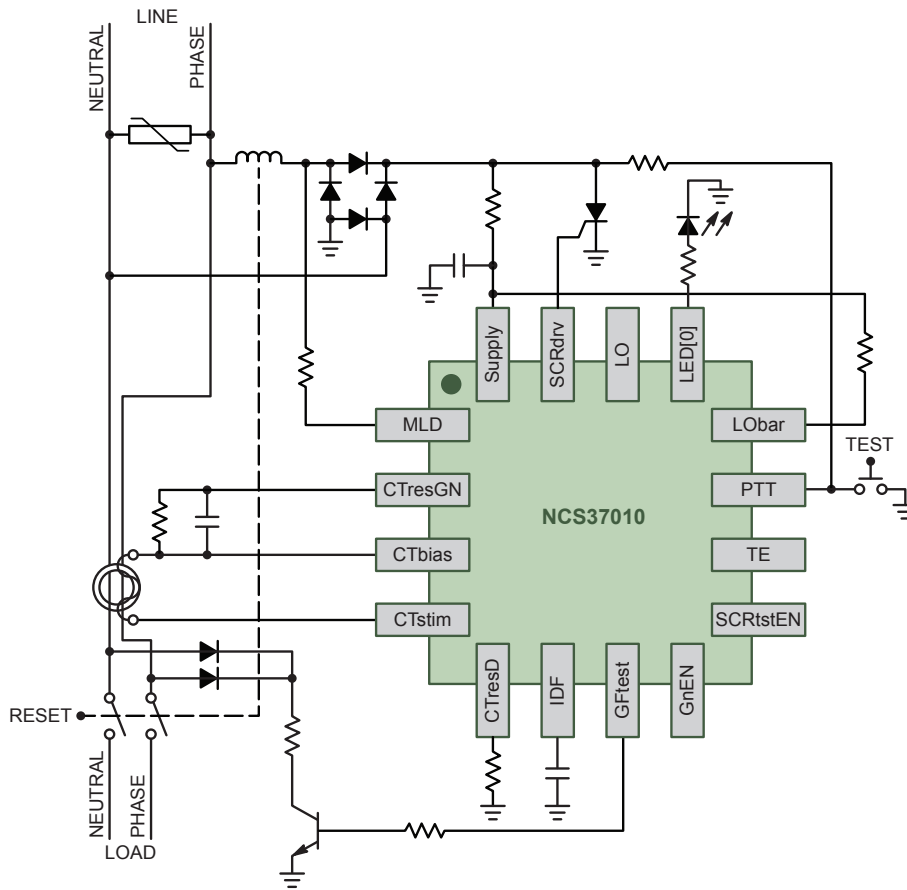
Trench IGBTs

Device	Voltage (V)	Current (A)	Package
NGTG50N60F	600	50	TO-247
NGTG30N60F	600	30	TO-247
NGTG20N60L2TF1G	600	20	TO-3PF-3L
NGTG12N60TF1G	600	12	TO-3PF-3L

UL943 Compliant GFCI Controllers

Features

- Detect all required fault types with 1 single current transformer (v. industry standard 2)
- Proprietary impedance measurement circuitry
- Fault current density weighted response time provides superior noise immunity
- Best in class power consumption
- Trip indicator/load monitoring
- LED and buzzer options for external indicator
- Optimized solenoid deployment
- Synchronized to AC for higher reliability load separation from the mains
- Highly integrated solution (including self-test) reduces BOM
- Smart power control works with virtually all supply topologies

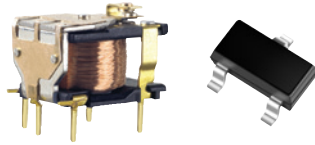


NCS37010 Application Diagram

Device	Differential Fault	Grounded-Neutral Fault	Mechanical Lockout	Electronic Lockout	LED Status Indication	External Differential Self Test	Trip Circuit Self Test	V _{CC} Min (V)	V _{CC} Max (V)	I _T Max (mA)	V _I Typ (V)	T _A Min (°C)	T _A Max (°C)	Package
NCS37010	✓	✓		✓	✓	✓	✓	6	12	2.2	1.8	-40	85	QFN-16, TSSOP-20
NCS37012	✓	✓	✓		✓	✓		6	12	1	12	-40	85	QFN-16, TSSOP-20

Integrated, Reliable Drive Circuits for Motors and Electro-mechanical Relays

Most relays mounted to a PCB require a relay driver circuit!



Features

- Integrates diodes, resistors and capacitors into one circuit
- Delivers additional current to the relay coil and protects against ESD
- Meets IEC61000-4-4 Electrical Fast Transient (EFT) test standards

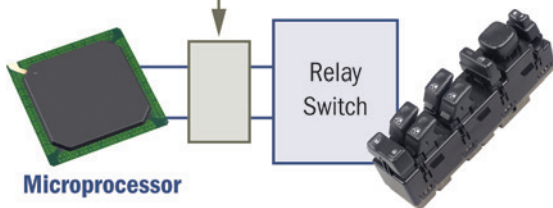
Relay Drivers

Device	Configuration	Circuit Type *	Voltage (V)	Current (mA)	Package
MDC3105	Single	Bipolar-Clamp	5	500	SOT-23
MDC3105D	Dual	Bipolar-Clamp	5	500	SC-74
NUD3105	Single	MOSFET	5	500	SOT-23
NUD3105D	Dual	MOSFET	5	500	SC-74
NUD3112	Single	MOSFET	12	500	SOT-23
NUD3112D	Dual	MOSFET	12	500	SC-74
NUD3124	Single	MOSFET	24	150	SOT-23
NUD3124D	Dual	MOSFET	24	150	SC-74
NUD3160	Single	MOSFET	60	150	SOT-23
NUD3160D	Dual	MOSFET	60	150	SC-74

* **Bipolar:** the driver circuit consists of a transistor combined with resistors and diodes.
MOSFET: the driver circuit consists of a MOSFET combined with resistors and diodes.

24 V Relay Driver Socket

MOSFET Relay Driver Socket - NUD3124



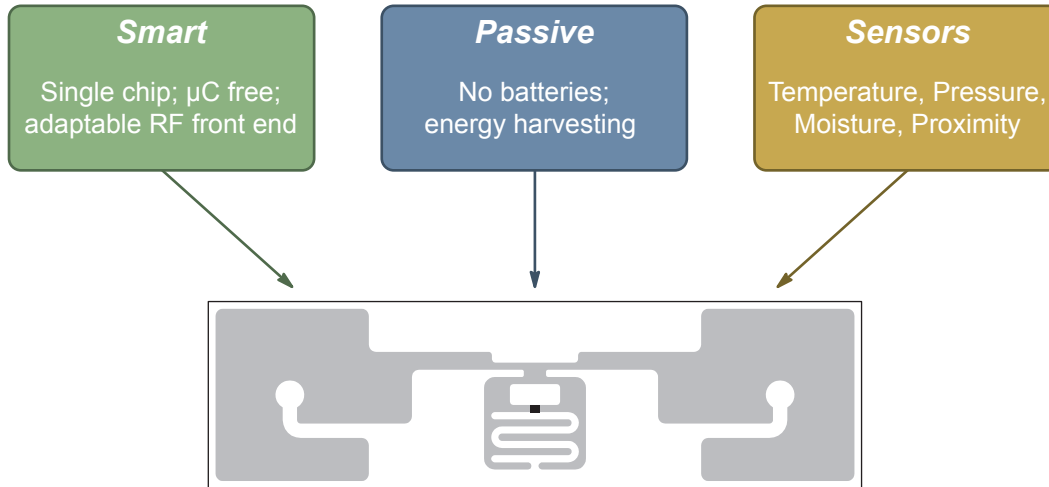
Low Noise Operational Amplifiers for I/O Buffering and Signal Conditioning

Low Noise Operational Amplifiers

Device	Channels	V _S Min (V)	V _S Max (V)	I _Q /Ch (mA)	GBW (MHz)	V _{OS} Max (mV)	V _{OS} Drift (μV/°C)	I _B (nA)	CMRR (dB)	e _n (nV/√Hz)	Rail-to-Rail	Package
MC33171/2/4	1, 2, 4	3	44	180	1.8	4.5	10	20	90	32	-	PDIP-8, SO-8, PDIP-14, SOIC-14, TSSOP-14
LM7301	1	1.8	32	0.6	4	6	2	65	88	30	I/O	SOT-23-5
MC33071/2/4	1, 2, 4	3	44	1.6	4.5	3	10	100	97	32	-	PDIP-8, SOIC-8, WQFN-10, PDIP-14, SOIC-14, TSSOP-14
MC33178/9	2, 4	4	36	0.4	5	3	2	100	110	7.5	-	PDIP-8, SOIC-8, Micro8, PDIP-14, SOIC-14, TSSOP-14
NCS2005	1	1.8	32	1.4	8	5	2	50	120	53	I/O	SOT-23-5
LM833	2	10	36	2	15	5	2	300	100	4.5	-	PDIP-8, SOIC-8
MC33078/9	2, 4	5	18	2.1	16	2	2	300	100	4.5	-	PDIP-8, SOIC-8, PDIP-14, SOIC-14
MC33272/4	2, 4	3	36	2.2	24	1	2	300	100	18	-	PDIP-8, SOIC-8, PDIP-14, SOIC-14, TSSOP-14
MC33077	2	2.5	18	1.75	37	1	2	280	107	4.4	-	PDIP-8, SOIC-8
NCS20074	4	2.7	36	0.41	3	3	2	0.005	111	20	Output	SOIC-14, TSSOP14
NCS325	1	1.8	5.5	0.02	0.35	0.05	0.02	0.05	110	100	I/O	SOT-23-5

Battery-Free Wireless Sensors

**Introducing the World's First Battery-Free, μ C-Free Sensor Tag
Breakthrough Sensor Technology Implemented on RFID**



Features	Benefits
• Battery-free and wireless	→ Ideal for locations with limited access • underground, within walls, intrusive to body, within boxes, toxic or dangerous locations
• Ultra-thin	→ Ideal for space-constrained applications • Within doorways, within RFID tags, peel and stick, bandages
• Low cost to scale	→ Effective where multiple sensors are required • Disposable products, multiple data points, increasing needs over time

Device	Sensing Functions	Sensor Reading Sensitivity	Surface Placement
SPS1M001	Moisture + Proximity	Low Sensitivity	Metal
SPS1M002	Moisture + Proximity	Low Sensitivity	Non-Metal
SPS1M003	Moisture + Proximity	High Sensitivity	Non-Metal
SPS1T001	Temperature + Proximity	0 to +50°C ($\pm 0.3^\circ\text{C}$) or -40 to +85°C ($\pm 1^\circ\text{C}$)	Non-Metal

SENSING

Mainstream CMOS Image Sensors

Device	Sensor/ SOC	Resolution (MP)	Optical Format	Frame Rate	Pixel Size (μm)	Shutter Type ¹	CFA	Operating Temp ($^{\circ}\text{C}$)
MT9V115	SOC	VGA	1/13"	30 fps	1.8	ERS	Color	-30 to +70
MT9V124	SOC	VGA	1/13"	30 fps	1.8	ERS	Color	-30 to +70
ASX350AT	SOC	VGA	1/5"	60 fps digital, 30 fps analog	3.8	ERS	Color	-40 to +105
ASX340AT	SOC	VGA	1/4"	60 fps digital, 30 fps analog	5.6	ERS	Color	-40 to +105
ASX340CS	SOC	VGA	1/4"	60 fps	5.6	ERS	Color	-30 to +70
MT9V111	SOC	VGA	1/4"	30 fps	5.6	ERS	Color	-20 to +60
MT9V128	SOC	VGA	1/3"	60 fps	6.0	ERS	Color	-40 to +105
MT9V024	Sensor	WVGA	1/3"	60 fps	6.0	GS	Color, Mono, RCCC	-40 to +105
MT9V034	Sensor	WVGA	1/3"	60 fps	6.0	GS	Color, Mono	-30 to +70
ARX550AT	Sensor	0.5	1/5"	66 fps	3.8	ERS	Color, RCCC	-40 to +105
AR0140CS	Sensor	1.2	1/4"	1.2 45 fps, 720p60	3.0	ERS	Color	-30 to +85
AR0140AT	Sensor	1.0	1/4"	60 fps	3.0	ERS	Color	-40 to +105
AR0141CS	Sensor	1.0	1/4"	1.2 45 fps, 720p60	3.0	ERS	Color, Mono, RGB-IR	-30 to +85
AR0130CS	Sensor	1.2	1/3"	1.2 45 fps, 720p60	3.8	ERS	Color, Mono	-30 to +70
AR0132AT	Sensor	1.2	1/3"	1.2 45 fps, 720p 60 fps	3.8	ERS	Color, Mono, RCCC	-40 to +105
AR0134CS	Sensor	1.2	1/3"	1.2 54 fps, 720p60	3.8	GS	Color, Mono	-30 to +70
MT9M021/31	Sensor	1.2	1/3"	1.2 45 fps, 720p60	3.8	GS	Mono	-30 to +70
MT9M024/34	Sensor	1.2	1/3"	1.2 45 fps, 720p60	3.8	ERS	Color, Mono	-30 to +70
MT9M114	SOC	1.3	1/6"	1.3 30 fps, VGA 75 fps	1.9	ERS	Color	-30 to +70
MT9M131	SOC	1.3	1/3"	1.3 15 fps, VGA 30 fps	3.6	ERS	Color	-30 to +70
MT9M001	Sensor	1.3	1/2"	30 fps	5.2	ERS	Mono	0 to +70
MT9D131	SOC	1.9	1/3.2"	1.9 15 fps, SVGA 30 fps	2.8	ERS	Color	-30 to +70
AR023Z	Sensor	2.1	1/2.7"	1080p 60 fps	3.0	ERS, GRR	RGB Bayer	-30 to +85
AR0230	Sensor	2.1	1/2.7"	1080p60	3.0	ERS	Color	-30 to +85
AR0237	Sensor	2.1	1/2.7"	1080p60	3.0	ERS	Color	-30 to +85
AR0261	Sensor	2.1	1/6"	1080p60	1.4	ERS	Color	-30 to +70
AS0260	SOC	2.1	1/6"	30 fps	1.4	ERS	Color	-30 to +70
AR0231AT	Sensor	2.3	1/2.7"	40 fps	3.0	ERS	RGB	-40 to +105
AR0331	Sensor	3.1	1/3"	1080p60	2.2	ERS, GRR	Color	-30 to +85
AR0333	Sensor	3.1	1/3"	1080p30	2.2	ERS	Color	-30 to +85
AR0330	Sensor	3.5	1/3"	1080p60	2.2	ERS, GRR	Color	-30 to +70
AR0543	Sensor	5.0	1/4"	5 15 fps, 1080P 30fps	1.4	ERS	Color	-30 to +70
MT9P006	Sensor	5.0	1/2.5"	5 15 fps, 720p60	2.2	ERS, GRR	Color	-30 to +70
MT9P031	Sensor	5.0	1/2.5"	5 15 fps, 720p60	2.2	ERS, GRR	Color, Mono	-30 to +70
AR0833	Sensor	8.0	1/3.2"	8 30 fps, 1080P 30fps	1.4	ERS, GRR	Color	-30 to +70
AR0835	Sensor	8.0	1/3.2"	8 42 fps, 1080P 60fps	1.4	ERS, GRR	Color	-30 to +70
MT9J003	Sensor	10	1/2.3"	10 15 fps, 1080p60	1.7	ERS, GRR	Color, Mono	-30 to +70
AR1011HS	Sensor	10	1"	60 fps	3.4	ERS	Color	-30 to +70
AR1335	Sensor	13	1/3.2"	13 30 FPS, 1080p 60 fps	1.1	ERS	Color	-30 to +70
MT9F002	Sensor	14	1/2.3"	14 13 fps	1.4	ERS, GRR	Color	-30 to +70
AR1820HS	Sensor	18	1/2.3"	18 24 fps, 1080p 120 fps	1.3	ERS, GRR	Color	-30 to +70

1. ERS = Electronic Rolling Shutter, GRR = Global Reset Release, GS = Global Shutter

Co-Processors for Mainstream CMOS Image Sensors

Available Features

- HDR with ALTM
- Dewarp, up to 165 degrees
- Spatial Transform Engine Software Add-on
- Overlays
- GPIOs, up to 5
- Color Pipe
 - Demosaic
 - Gamma correction
 - Auto white balance
 - Defect correction
 - Noise reduction
 - Auto exposure
 - Flicker detection

Device	Resolution (MP)	Frame Rate (fps)	Video	Output Format	Package
AP0100AT	1	45	720p/60 fps, NTSC/PAL	YUV	VFBGA-100
AP0100CS	1	45	1.2 MP/45 fps; 720p/60 fps	NTSC/PAL; YUV	VFBGA-100
AP0101AT	1	45	1.2 MP/45 fps; 720p/60 fps	SMPTE 296M; YUV	VFBGA-81
AP0101CS	1	45	1.2 MP/45 fps; 720p/60 fps	SMPTE 296M; YUV	VFBGA-81
AP0102AT	1	–	1.2 MP/45 fps; 720p/60 fps; 1080p/30 fps	RGB; YUV	VFBGA-100
AP0200AT	2	30	1.2 MP/45 fps; 720p/60 fps; 1080p/30 fps	H.264; MJPEG	VFBGA-100
AP0201AT	2	30	1.2 MP/45 fps; 720p/60 fps; 1080p/30 fps	H.264; MJPEG	VFBGA-100
AP0202AT	2	30	1.2 MP/45 fps; 720p/60 fps; 1080p/30 fps	RGB565; RGB888; YUV	VFBGA-100
AP1302	13	30	13 MP/30 fps; 1080p/120 fps	JPEG; RAW; RGB565; RGB888; YUV	VFBGA-120

PYTHON Global Shutter CMOS Image Sensors

With resolutions from VGA to 25 megapixels, the PYTHON family of image sensors addresses the needs of general purpose industrial imaging applications such as machine vision inspection and motion monitoring, security, surveillance, and intelligent transportation systems (ITS). Combining flexibility in configuration and resolution with high speed and high sensitivity, these devices capture fast moving scenes without distortion by combining low read noise and high sensitivity with frame rates up to 815 fps.

Features

- CDS global shutter technology with low noise performance
- True HW scalable family concept
- High configurability and fast adaptability
- Quadratic speed increase with ROI windowing
- Multiple regions of interest
- High dynamic range
- Color, Monochrome, and Enhanced NIR configurations
- Standard and protective tape configurations
- Low power, cost efficient configurations



Device	Resolution (MPix)	Pixel Count (H x V)	Pixel (µm)	Diagonal (mm)	Lens	CFA ¹	FPS Max	Evaluation Kit
PYTHON 300	0.3	640 x 480	4.8	3.8	1/4"	C/M/NIR	815	✓
PYTHON 500	0.5	800 x 600	4.8	4.8	1/3.6"	C/M/NIR	545	✓
PYTHON 1300	1.3	1280 x 1024	4.8	7.9	1/2"	C/M/NIR	210	✓
PYTHON 2000	2.3	1920 x 1200	4.8	10.9	2/3"	C/M/NIR	225	✓
PYTHON 5000	5.3	2592 x 2048	4.8	15.9	1"	C/M/NIR	100	✓
PYTHON 10K	11.1	3840 x 2896	4.5	21.6	4/3	C/M/NIR	175	✓
PYTHON 12K	12.5	4096 x 3072	4.5	23.0	4/3	C/M/NIR	160	✓
PYTHON 16K	16.8	4096 x 4096	4.5	26.1	APS-H	C/M/NIR	120	✓
PYTHON 25K	26.2	5120 x 5120	4.5	32.6	APS-H	C/M/NIR	80	✓

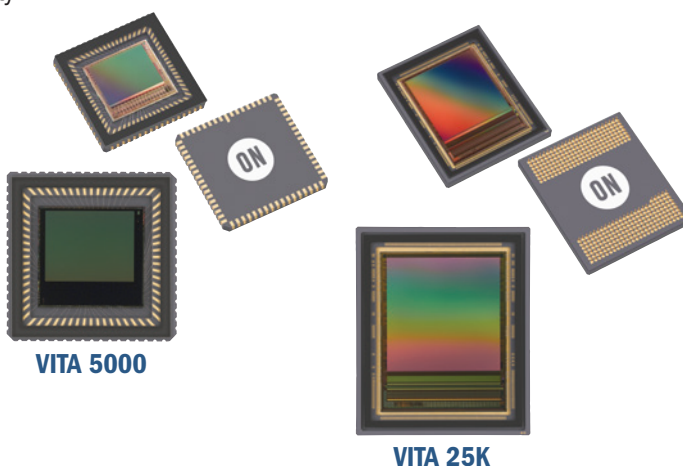
1. CFA Options - Bayer Color (C), Monochrome (M), Enhanced NIR (NIR).

Versatile CMOS Image Sensors

VITA image sensors combine flexibility in configuration and resolution with high speed and high sensitivity, addressing a wide range of customer requirements in a cost-effective family of rolling/global shutter CMOS image sensors. A flexible read-out architecture makes them well suited for machine vision, intelligent transportation systems and surveillance, and other applications that demand high functionality, while delivering excellent image quality.

Features

- 1.3 to 25 Megapixels
- Pipelined and triggered global shutter with dual readout
- Rolling shutter with CDS
- Quadratic speed increase with ROI windowing
- Multiple regions of interest



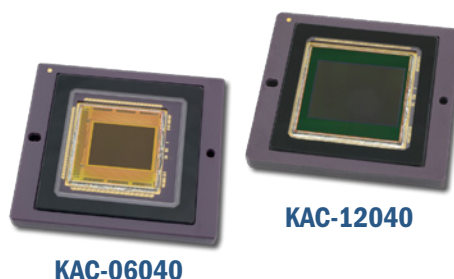
Device	Resolution (MPix)	Pixel Count (H x V)	Pixel (μm)	Diagonal (mm)	Lens	CFA ¹	FPS Max	Evaluation Kit
VITA 1300	1.3	1280 x 1024	4.8	7.9	1/2"	C/M	150	✓
VITA 2000	2.3	1920 x 1200	4.8	10.9	2/3"	C/M	90	✓
VITA 5000	5.3	2592 x 2048	4.8	15.9	1"	C/M	75	✓
VITA 12K	12.6	4096 x 3072	4.5	23.0	4/3"	C/M	160	✓
VITA 16K	16.8	4096 x 4096	4.5	26.1	APS-H	C/M	125	✓
VITA 25K	26.2	5120 x 5120	4.5	32.6	APS-H	C/M	80	✓

1. CFA Options - Bayer Color (C), Monochrome (M).

KAC image sensors provide both global shutter and low noise rolling shutter modes, combined with programmable bit depth (8 to 14 bit) with a flexible readout architecture that supports interspersed video streams. These features enable the use of multiple regions of interest that can simultaneously monitor both wide areas and local regions, making these devices ideal for machine vision, surveillance, ITS, and analytical microscopy.

Features

- Global shutter, low noise rolling shutter
- Programmable bit depth
- Interspersed video streams
- Multiple regions of interest
- High frame rates
- High NIR sensitivity



Device	Resolution (MPix)	Pixel Count (H x V)	Pixel (μm)	Diagonal (mm)	Lens	CFA ¹	FPS Max	Evaluation Kit
KAC-06040	6	2832 x 2128	4.7	16.7	1"	C/M	160	✓
KAC-12040	12	4000 x 3000	4.7	23.5	4/3"	C/M	70	✓

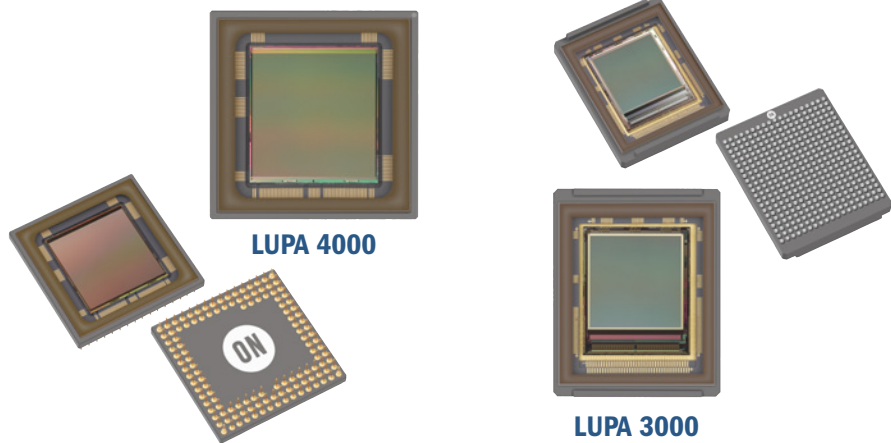
1. CFA Options - Bayer Color (C), Monochrome (M).

High Speed CMOS Image Sensors

LUPA devices offer resolution as high as 2048 x 2048 and frame rates up to 500 fps. These features, combined with a power consumption as low as 150 mW with absolutely no blooming or lag, create a perfect foundation for highly reliable, high sensitivity image sensors.

Features

- Frame rates up to 500 fps at several megapixel resolutions
- Unprecedented sensitivity
- Pipelined global shutter
- Low power dissipation
- High resolution
- No blooming or image lag
- Mono and color variants



Device	Resolution (MPix)	Pixel Count (H x V)	Pixel (µm)	Diagonal (mm)	Lens	CFA ¹	FPS Max	Evaluation Kit
LUPA 300	0.3	640 x 480	9.9	7.9	1/2"	C/M	250	✓
LUPA 1300-2	1.3	1280 x 1024	14	22.9	1"	C/M	500	✓
LUPA 3000	3	1696 x 1710	8	19.3	1"	C/M	485	✓
LUPA 4000	4	2048 x 2048	12	34.8	35 mm	C/M	15	✓

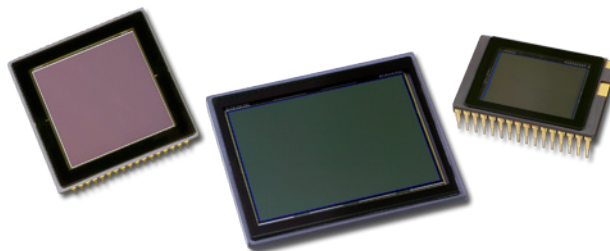
1. CFA Options - Bayer Color (C), Monochrome (M).

Full Frame CCD Image Sensors

From the intricacies of microscopy to the far reaches of astrophotography, Full Frame CCD image sensors deliver high performance results. With high quantum efficiency across the entire visible spectrum, these sensors are ideal for demanding imaging applications that can accommodate a mechanical shutter or strobe illumination, such as electronic still photography, medical X-ray, and inspection.

Features

- High resolution
- Support for large sensor formats
- Simple, two-phase clocking
- Very low dark current for long exposures
- Vertical and horizontal binning



Full Frame CCD Image Sensors

Device	Resolution (MPix)	Pixel Count	Pixel (µm)	Diagonal (mm)	Lens	CFA ¹	FPS Max	Evaluation Kit
KAF-0261	VGA	512 x 512	20.0	14.5	1"	M	15.0	✓
KAF-0402	WVGA	768 x 512	9.0	8.3	1/2"	M	20.0	✓
KAF-1001	1.0	1024 x 1024	24.0	34.8	APS-H	M	3.0	✓
KAF-1603	1.6	1536 x 1024	9.0	16.6	1"	M	2.2	✓
KAF-3200	3.3	2184 x 1510	6.8	18.0	4/3"	M	2.5	✓
KAF-4320	4.3	2084 x 2084	24.0	70.7	645	M	2.0	✓
KAF-6303	6.3	3088 x 2056	9.0	33.4	APS-H	M	0.6	✓
KAF-8300	8.3	3326 x 2504	5.4	22.5	4/3"	M	2.9	✓
KAF-09000	9.3	3056 x 3056	12.0	51.9	645 1.3x	M	0.4	
KAF-16200	16.2	4500 x 3600	6.0	34.6	APS-H	C/M	1.5	
KAF-16801	16.8	4096 x 4096	9.0	52.1	645 1.3x	M	0.4	✓
KAF-16803	16.8	4096 x 4096	9.0	52.1	645 1.3x	M	0.2	
KAF-40000	40.0	7304 x 5478	6.0	54.8	645 1.3x	C	1.3	
KAF-50100	50.1	8176 x 6132	6.0	61.3	645 1.1x	M	1.0	

1. CFA Options - Bayer Color (C), Monochrome (M).

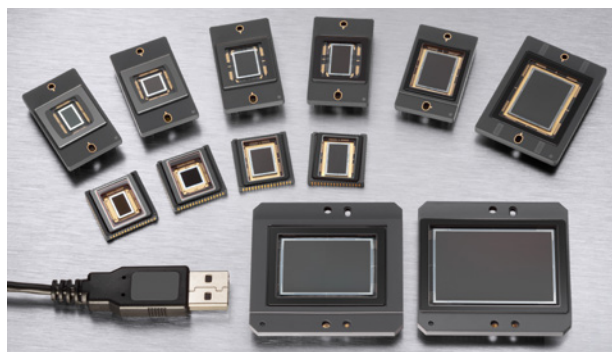


Interline Transfer CCD Image Sensors

With an integrated electronic shutter, Interline Transfer CCD image sensors provide real time imaging in applications where a mechanical shutter or strobe illumination is either not required or desired. With progressive scan readouts, they are particularly well suited for machine vision, microscopy, fluoroscopy, and other applications that demand the highest imaging performance. Most 5.5 μm and 7.4 μm devices share common pin-out and electrical connections, allowing a single camera design to support a full family of products.

Features

- Progressive scan with electronic shutter and anti-blooming support
- High resolution
- High sensitivity
- Low image lag and smear



5.5 μm Interline Transfer CCD Image Sensors

Device	Resolution (MPix)	Pixel Count	Pixel (μm)	Diagonal (mm)	Lens	CFA ¹	FPS Max	Evaluation Kit
KAI-0330	VGA	648 x 484	9	7.3	1/2"	C/M	120	✓
KAI-0340	VGA	640 x 480	7.4	5.9	1/3"	C/M	210	✓
KAI-0373	WVGA	768 x 484	11.6 x 13.6	11.1	2/3"	M	30	
KAI-01150 ²	0.9	1280 x 720	5.5	8.1	1/2"	C/M/S	138	✓
KAI-1003	1	1024 x 1024	12.8	18.5	4/3"	M	30	✓
KAI-1010	1	1008 x 1018	9	12.9	1"	M	30	
KAI-1020	1	1000 x 1000	7.4	10.5	2/3"	C/M	50	✓
KAI-01050 ²	1	1024 x 1024	5.5	8	1/2"	C/M	120	✓
KAI-2020	1.9	1600 x 1200	7.4	14.8	1"	C/M	30	✓
KAI-02050 ²	1.9	1600 x 1200	5.5	11.1	2/3"	C/M	68	✓
KAI-02170 ²	2.1	1920 x 1080	7.4	16.3	1"	C/M/S	60	✓
KAI-02150 ²	2.1	1920 x 1080	5.5	12.1	2/3"	C/M/S	64	✓
KAI-04070 ²	4.2	2048 x 2048	7.4	21.4	4/3"	C/M/S	28	✓
KAI-04050 ²	4.1	2336 x 1752	5.5	16.1	1"	C/M/S	32	✓
KAI-08051 ²	8.1	3296 x 2472	5.5	22.7	4/3"	C/M/S	16	✓
KAI-08052 ^{2*}	8.1	3296 x 2472	5.5	22.7	4/3"	C/M/S	16	✓
KAI-08670	8.6	3600 x 2400	7.4	32.0	APS-H	C/M/S	12	✓
KAI-11002	10.7	4008 x 2672	9	43.4	35 mm	C/M	5	✓
KAI-16000	15.8	4872 x 3248	7.4	43.3	35 mm	C/M	3	
KAI-16050 ²	16	4896 x 3264	5.5	32.4	APS-H	C/M/S	8	✓
KAI-16070 ²	15.7	4864 x 3232	7.4	43.2	35 mm	C/M/S	8	✓
KAI-29050 ²	28.8	6576 x 4384	5.5	43.5	35 mm	C/M/S	4	✓
KAI-47051	46.8	8856 x 5280	5.5	56.7	645 1.1x	C/M/S	7	✓

1. CFA Options - Bayer Color (C), Monochrome (M), and Sparse CFA (S). 2. Pin and Electrically Compatible. * Pending 3Q16.

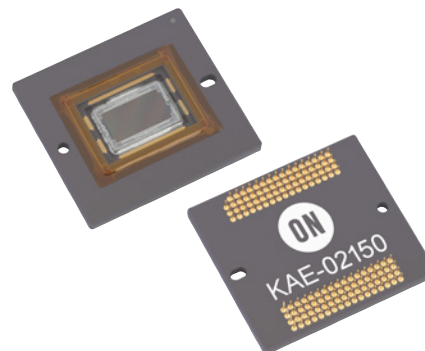
Interline Transfer EMCCD Image Sensors

Combining the high sensitivity of an electron-multiplied output register with the pixel uniformity and resolution scalability available from Interline Transfer CCDs, KAE devices enable the capture of scenes with widely varying lighting conditions – from sunlight to starlight – in a single image and from a single camera. This flexibility makes them ideal for light starved applications such as surveillance, scientific imaging, medical imaging, and intelligent transportation systems.

US export controls currently apply to all shipments of KAE devices designated for destinations outside of the US and Canada, requiring ON Semiconductor to obtain an export license from the US Department of Commerce before image sensors or evaluation kits can be exported.

Features

- 86 dB dynamic range with 1 electron read noise
- Progressive scan readout
- High sensitivity, low noise architecture
- Excellent smear performance



KAE-02150 Image Sensor

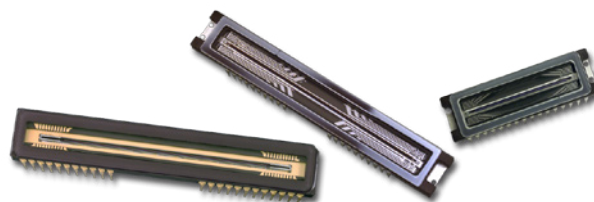
Device	Resolution (MPix)	Pixel Count	Pixel (μm)	Diagonal (mm)	Lens	CFA	FPS Max	Evaluation Kit
KAE-02150	2.1	1920 x 1080	5.5	12.1	2/3"	C/M	30	✓

Linear CCD Image Sensors

Linear CCD image sensors combine high resolution with high dynamic range, making them ideal for use in applications such as flatbed scanners, high-speed document scanners and copiers, machine vision cameras, and satellite imaging.

Features

- High dynamic range
- Pinned photodiodes for low lag and low dark current
- Channel independent electronic exposure control
- Single output per color, including multi-readout register architectures
- High data rates



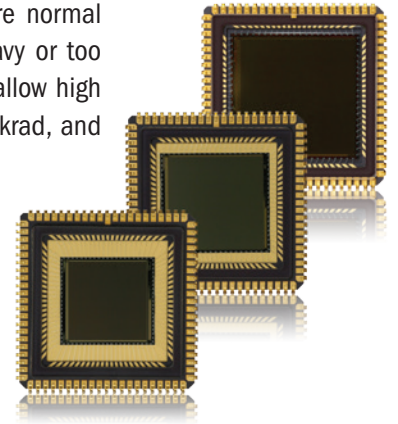
Linear CCD Image Sensors

Device	Pixel Count	Pixel (μm)	Diagonal (mm)	CFA ¹	Evaluation Kit
KLI-2104	4196 x 1, 2098 x 3	7.0, 14.0	29.4	Luma+C	
KLI-2113	2098 x 3	14	29.4	C/M	✓
KLI-4104	8160 x 1, 4080 x 3	5.0, 10.0	40.8	Luma+C/M	✓
KLI-8023	8002 x 3	9	72	C/M	✓

1. CFA Options – Bayer Color (C), Monochrome (M).

Radiation Tolerant Image Sensors

Radiation hardened CMOS images play an important role in high-radiation environments where normal CMOS or CCD imagers cannot survive, and where CRT image tubes are too expensive, too heavy or too large. STAR and HAS image sensors are designed using radiation-tolerant design techniques to allow high tolerance against total dose effects. All devices feature qualified radiation tolerance up to 300 krad, and include on-chip Fixed Pattern Noise (FPN) correction and a programmable gain amplifier.



Applications

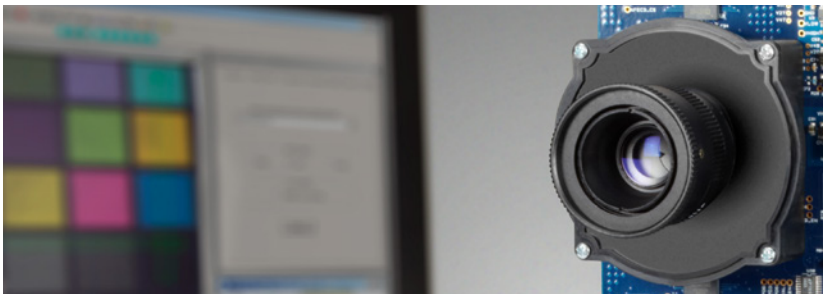
- GNC guidance, navigation, and control applications
- AOCS attitude and orbit control systems
- Nuclear inspection

Device	Resolution (Mpix)	Pixel Count	Pixel (μm)	Diagonal (mm)	ADC	CFA	FPS Max
STAR250	0.3	512 x 512	25	18.1	10-bit	M	30
STAR1000	1.0	1024 x 1024	15	21.7	10-bit	M	11
HAS2	1.0	1024 x 1024	18	26.1	12-bit	M	10



Evaluation Support

ON Semiconductor provides supporting hardware and software to qualified engineering teams to accelerate product development. These kits contain everything necessary to build a working prototype with test functionality.

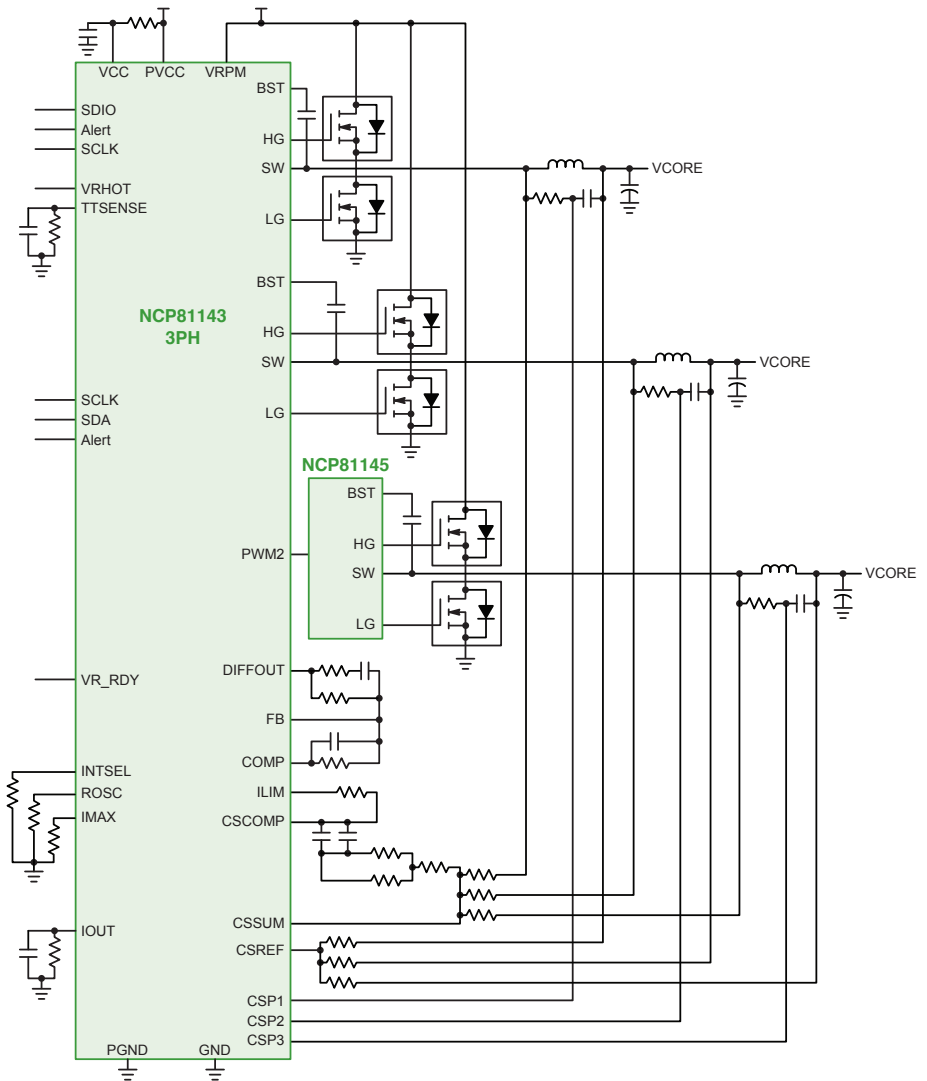


SENSING

VR12.5/6 Multiphase Controllers for Embedded Applications

Features

- Dual-edge pulse width modulation
- Fastest initial response to dynamic load events
- True differential voltage sensing
- Differential inductor DCR current sensing
- Input voltage feed forward
- Adaptive voltage positioning
- Pin-programmable controller configuration
- Integrated OVP, UVP, OCP
- Operating temperature range: -40°C to +125°C

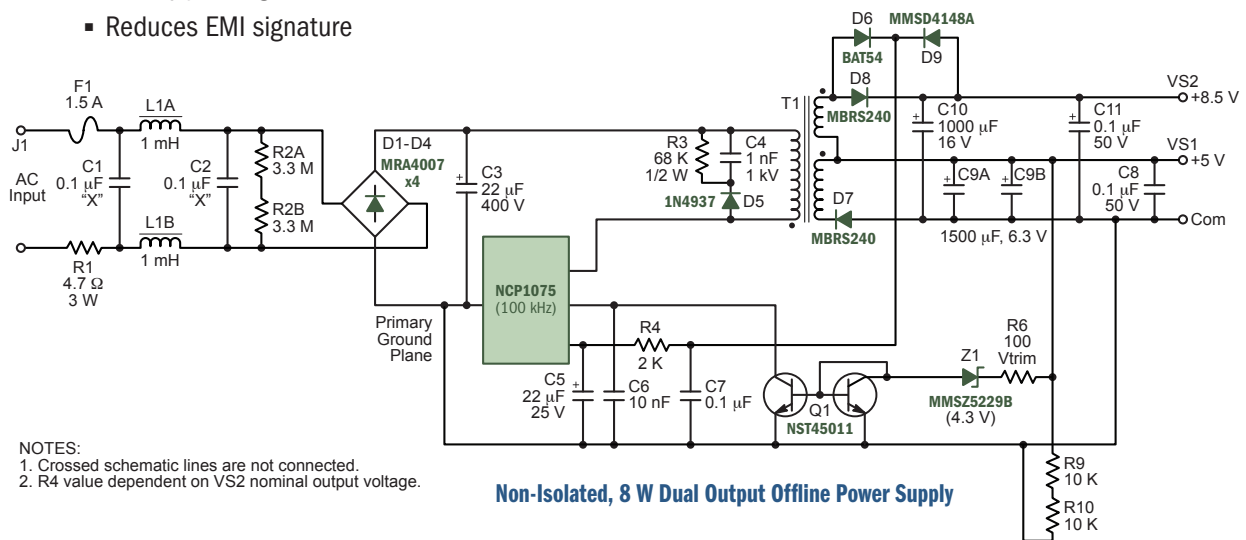


Device	Description	Driver / MOSFETs	Package
NCP81140	4-Phase Controller	—	QFN-32
NCP81141	1-Phase VR12.6 Controller	Integrated 5 V Driver	QFN-28
NCP81142	4-Phase VR12.5 Controller	—	QFN-32
NCP81143	3-Phase VR12.5 Controller	2x Integrated 5 V Drivers	QFN-36
NCP81145	5 V Driver	—	DFN-8
NCP81146	12 V Driver	—	DFN-8
NCP81147	1-Phase Buck 0.8 V / 3.3 V	—	QFN-16
NCP81148	Dual Buck with LDOs	—	QFN-28
NCP81149	1-Phase VR12.6 Controller	Integrated MOSFETs	—

Compact Power Delivery with Switching Regulators

Features

- Highly integrated solution
 - Reduces system size and cost
- Thermistor input can be configured as
 - Second remote diode temp; two analog inputs
- Dynamic Self Supply (DSS) capability
 - No need for an auxiliary transformer winding
- On-chip 700 V power switch circuit
 - Compact and easy system design
- Frequency jittering
 - Reduces EMI signature
- Skip-cycle operation
 - No acoustic noise
- Low power consumption and frequency foldback
 - Allows energy ECO regulations compliance
- Output overload and open loop protection
 - Protects your application
- Over-power and brown-out protection
- Ramp Compensation



NOTES:
 1. Crossed schematic lines are not connected.
 2. R4 value dependent on VS2 nominal output voltage.

Current Mode Switching Regulators

Device	Max Output Power ¹ (W)	Power Switch Voltage (V)	Peak Current Limit (mA)	Typ ² RDS(on) (Ω)	Min HV Startup	Frequency Options (kHz)	Dynamic Self Supply	Freq Jittering	Freq Foldback	Brown-in/-out	Soft-Start	Enable	Over Power Compensation	Package(s)
NCP1060	4	700	Adj	34	21	60, 100	✓	✓	✓	✓	✓	✓	✓	PDIP-7, SOIC-10
NCP1070	4	700	250	22	30	65, 100, 130	✓	✓	✓	✓	✓	✓	✓	PDIP-7, SOT-223
NCP1071	5	700	350	22	30	65, 100, 130	✓	✓	✓	✓	✓	✓	✓	PDIP-7, SOT-223
NCP1063	11	700	Adj	11	21	60, 100	✓	✓	✓	✓	✓	✓	✓	PDIP-7, SOIC-16
NCP1072	11	700	350	11	30	65, 100	✓	✓	✓	✓	✓	✓	✓	PDIP-7, SOT-223
NCP1075	15	700	450	11	30	65, 100, 130	✓	✓	✓	✓	✓	✓	✓	PDIP-7, SOT-223
NCP1076	20	700	650	4.7	30	65, 100, 130	✓	✓	✓	✓	✓	✓	✓	PDIP-7, SOT-223
NCP1077	20	700	800	4.7	30	65, 100, 130	✓	✓	✓	✓	✓	✓	✓	PDIP-7, SOT-223

1. Maximum Power Output with DSS. 2. Typical at 25°C.

Rugged Linear Voltage Regulators

Linear Voltage Regulators

Device	I _o Typ	Dropout Typ (V)	V _{in} Max (V)	V _{out} (V)	Package
LM317M	500 mA	2.2	40	Adj.	TO-220, DPAK, SOT-223
MC78Mxx/A	500 mA	2.0	40	5, 6, 8, 9, 12, 15, 18, 20, 24	TO-220, DPAK
MC79Mxx/A	500 mA	1.1	-35	-5, -8, -12, -15	TO-220, DPAK
NCP78xx	1.0 A	2.0	35	5, 12, 15	TO-220
MC78xx/A/AE	1.0 A	2.0	40	5, 6, 8, 9, 12, 15, 18, 24	TO-220, DPAK, D2PAK
MC79xx/A	1.0 A	1.3	-40	-5, -5.2, -6, -8, -12, -15, -18, -24	TO-220, D2PAK
LM317	1.5 A	2.25	40	Adj.	TO-220, D2PAK
LM337	1.5 A	2.4	-40	Adj.	TO-220, D2PAK

* Visit www.onsemi.com for additional linear voltage regulators at lower output currents and voltages

Low Dropout Regulators

Device	I _o Typ	Dropout (mV)	V _{in} Max (V)	V _{out} (V)	Package
NCP785A	10 mA	—	450	3.3, 5.0, 12, 15	SOT-89
NCP786A*	10 mA	—	450	3.3, 5.0, 12, 15	SOT-223
NCP702	200 mA	140 (max)	6	0.8, 1.8, 2.8, 3.0, 3.3	SOT-23-5, XDFN-6
NCP703	300 mA	180 (max)	6	0.8, 1.8, 2.8, 3.0, 3.3	SOT-23-5, XDFN-6
NCP705	500 mA	250 (typ)	6	Adj, 0.8, 1.8, 2.8, 3.0, 3.3	SOT-223-6, WDFN-6
NCP3335A	500 mA	340 (max)	16	Adj, 1.5, 1.8, 2.5, 2.8, 2.85, 3.0, 3.3, 5.0	Micro8, DFN-10
NCP3337	500 mA	340 (max)	16	Adj, 1.8, 2.5, 3.3, 5.0	DFN-10
NCP186	1.0 A	130 (max)	6	Adj, 1.2 - 3.9	XDFN-8
NCP59748	1.5 A	165 (max)	6	Adj	QFN-20, DFN-10
NCP59150/1/2	1.5 A	175 (typ)	18	1.8, 2.5, 2.8, 3.0, 3.3, 5.0	D2PAK-5, DFN-8
NCP59744	3.0 A	195 (max)	505	Adj	QFN-20
NCP59749	3.0 A	280 (max)	9	Adj	QFN-20
NCP59300/1/2	3.0 A	300 (typ)	18	1.8, 2.5, 2.8, 3.0, 3.3, 5.0	D2PAK-5
NCP4632	3.0 A	510 (typ)	6	0.8, 1.5, 2.8, 3.3	DPAK-5

* Pending 3Q16

Energy Efficient TRIACs for High & Low Power Switching & AC Control

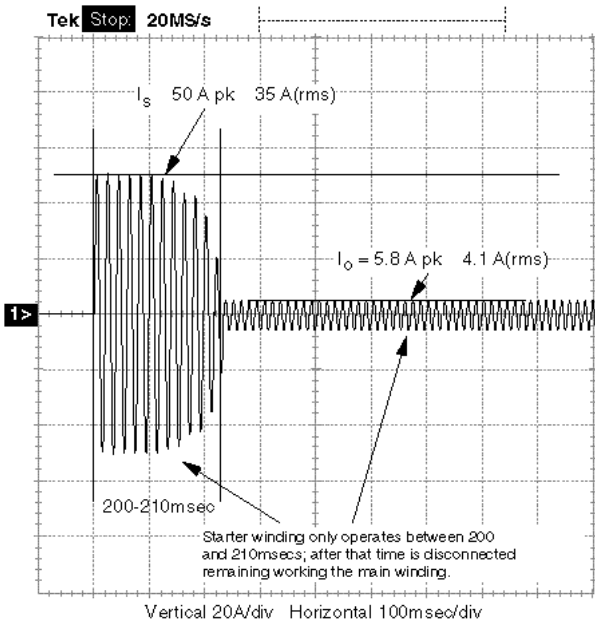
TRIACs – High Current

Device	$I_T(\text{rms})$ (A)	V_{drm} (V)	I_{gt} (mA)	dV/dt (V/ μs)	Package
BTB Series, Standard	8 - 16	600 - 800	25 - 50	25 - 400	T0-220 AB
BTB Series, Logic Level	8 - 16	600 - 800	5 - 10	15 - 50	T0-220 AB
BTB Series, Snubberless	8 - 30	600 - 800	35 - 50	500 - 2000	T0-220 AB
BTB Series, High Tj	8 - 16	600	35 - 50	1000	T0-220 AB
BTA Series, Standard	8 - 16	600 - 800	25 - 50	25 - 400	T0-220 II ¹
BTA Series, Logic Level	8 - 16	600 - 800	5 - 10	15 - 50	T0-220 II ¹
BTA Series, Snubberless	8 - 30	600 - 800	35 - 50	500 - 2000	T0-220 II ¹
BTA Series, High Tj	8 - 16	600	35 - 50	1000	T0-220 II ¹
MAC Series	8 - 16	200 - 800	5 - 50	25 - 750	T0-220 AB
MAC15 Series	15	400 - 800	50	5 - 250	T0-220 AB
2N63 Series	8 - 12	600 - 800	50	5 - 250	T0-220 AB

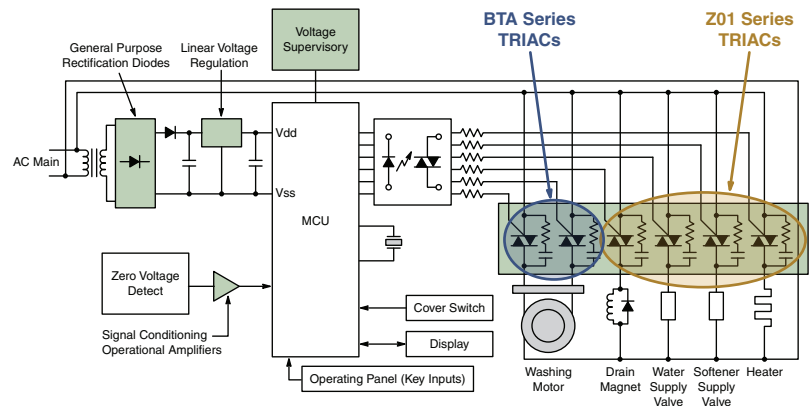
1. Internally Isolated T0-220

BTA/BTB Series Key Features

- Blocking voltage to 800 V
- On-state current ratings to 30 A RMS @ 25°C
- Greater noise immunity achieved with higher dV/dt up to 2,000 V/ μs minimum @ 125°C
- Standard and snubberless
- Logic level
- Uniform gate trigger current in 3 & 4 quadrants
- Highest industry standard isolation voltage of 2,500 V_{rms}
- Internal ceramic pad provides voltage insulated tab



Current during compressor startup (<200 ms) is too high; >200 ms, current drops to nominal value. Thyristor must be selected to sustain startup current without overheating. See AND8007/D for details.



Typical Application Using High and Low Current TRIACs

TRIACs – Low Current

Device	$I_T(\text{rms})$ (A)	V_{drm} (V)	I_{gt} (mA)	dV/dt (V/ μs)	Package
Z01 Series	0.8 - 1	600 - 800	3 - 10	25 - 400	SOT-223
MAC08 Series	0.8	600 - 800	10	10	SOT-223
MAC4D Series	4	600 - 800	3 - 35	10	DPAK

High & Low Current SCRs for Half-Wave AC

Z01 & NYC Series Key Features

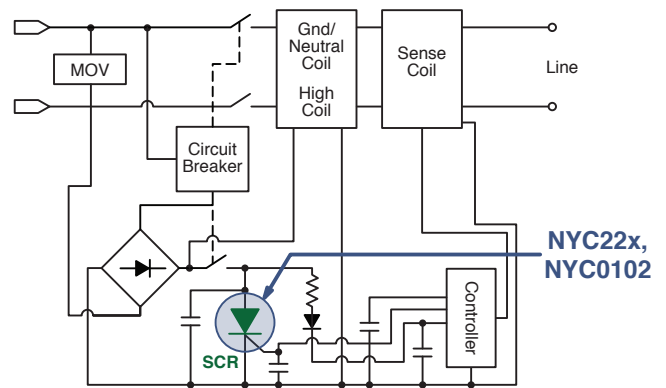
- $I_{T(rms)}$ = 1.5 A, 1.0 A and 0.25 A
- I_{gt} = 200 μ A to 10 mA
- Off-state voltage of 600 V
- dV/dt up to 200 V/ μ s minimum, depending on I_{gt} level
- Sensitive gate triggering in four trigger modes; low I_{gt} levels in quadrants 1, 2 & 3 for good interface with MPU
- Improved noise immunity
- Peak non-repetitive surge current up to 15 A

SCRs – Low Current

Device	$I_{T(rms)}$ (A)	V_{drm} (V)	I_{gt} (mA)	dV/dt (V/ μ s)	Package
NYC0102	0.25	200	0.2	200	SOT-23
MCR08	0.8	200 - 600	0.2	10	SOT-223
NYC222	1	50 - 600	0.2	25	SOT-223
MCR703	4	100 - 600	0.1	10	DPAK
MCR718	4	400 - 600	0.1	10	DPAK

SCRs – High Current

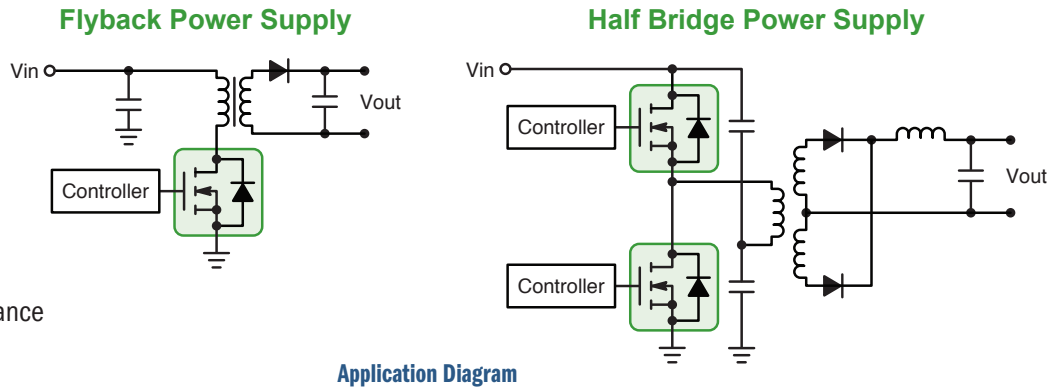
Device	$I_{T(rms)}$ (A)	V_{drm} (V)	I_{gt} (mA)	dV/dt (V/ μ s)	Package
MCR8D Series	8	600 - 800	0.2 - 15	10 - 200	DPAK
MCR8 Series	8	400 - 800	0.2 - 15	15 - 250	TO-220 AB
MCR72 Series	8	100 - 600	0.2	10	TO-220 AB
MCR218 Series	8	50 - 400	25	100	TO-220 AB
MCR12D Series	12	600 - 800	0.2 - 20	10 - 50	DPAK
MCR12 Series	12	400 - 800	8 - 20	100 - 250	TO-220 AB
2N6394 Series	12	50 - 800	30	50	TO-220 AB
MCR16 Series	16	800	20	300	TO-220 AB
2N6400 Series	16	50 - 800	30	50	TO-220 AB
MCR25 Series	25	400 - 800	30	250	TO-220 AB
2N6504 Series	25	50 - 800	30	50	TO-220 AB
MCR69 Series	25	50 - 100	30	10	TO-220 AB



GFCI - Ground Fault Circuit Interrupter

NYC22x,
NYC0102

Power MOSFETs for AC Drive



Features

- High reliability
- Low power dissipation
- High avalanche resistance
- High-speed switching

Source Voltage	Device	V_{DSS} (V)	I_D (A)	$R_{DS(on)}$ @ 10 V		C_{iss} (pF)	Q_g (nC)	G-S Protect Diode	Package
				Typ (Ω)	Max (Ω)				
~240 Vac	BFL4004	800	6.5	1.9	2.5	710	36	—	TO-220F
	BFL4026	900	5	2.8	3.6	650	33	—	TO-220F
	BFL4001	900	6.5	2.1	2.7	850	44	—	TO-220F
380 to 480 Vac	2SK4177	1500	2	10	13	380	37.5	Built in	TO-263(D2PAK)
	2SK3748	1500	4	5	7	790	80	Built in	TO-3PF
	NDFPD1N150C	1500	0.1	100	150	80	4.2	—	TO-220F
	NDFP03N150C	1500	2.5	8	10.5	650	34	—	TO-220F
	NDTL03N150C	1500	2.5	8	10.5	650	34	—	TO-3P
	NDUL03N150C	1500	2.5	8	10.5	650	34	—	TO-3PF
	NDUL09N150C	1500	9	2.2	3.0	2025	114	—	TO-3PF
590 to 690 Vac	WPH4003	1700	3	8.2	10.5	850	48	—	TO-3PF

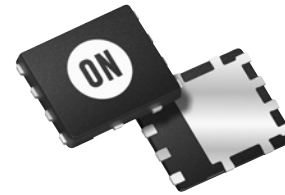
MOSFETs for Energy Storage Systems

Device	Channel	V_{DSS} (V)	I_D (A)	$R_{DS(on)}$ @ 10 V Max (m Ω)	$Q_G(TOT)$ (nC)	Package
BMS3004	P	-75	-68	8.5	300	TO-220F-3SG (SC-67)
SMP3003	P	-75	-100	8.0	280	TO-263
NDPL070N10B	N	100	70	12.8	26	TO-220-3L
NDBA100N10B	N	100	100	8.2	35	TO-263
NDPL100N10B	N	100	100	8.7	35	TO-220-3L
NDBA180N10B	N	100	180	3.3	95	TO-263
NDPL180N10B	N	100	180	3.5	95	TO-220-3L

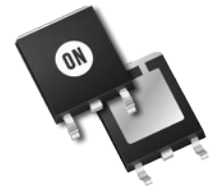
Power MOSFETs for Motor Control

Features

- Low $R_{DS(on)}$ to minimize conduction losses
- Low capacitance to minimize driver losses
- Low gate charge to minimize switching losses
- High avalanche resistance
- High current capability



SO-8 Flat Lead Package

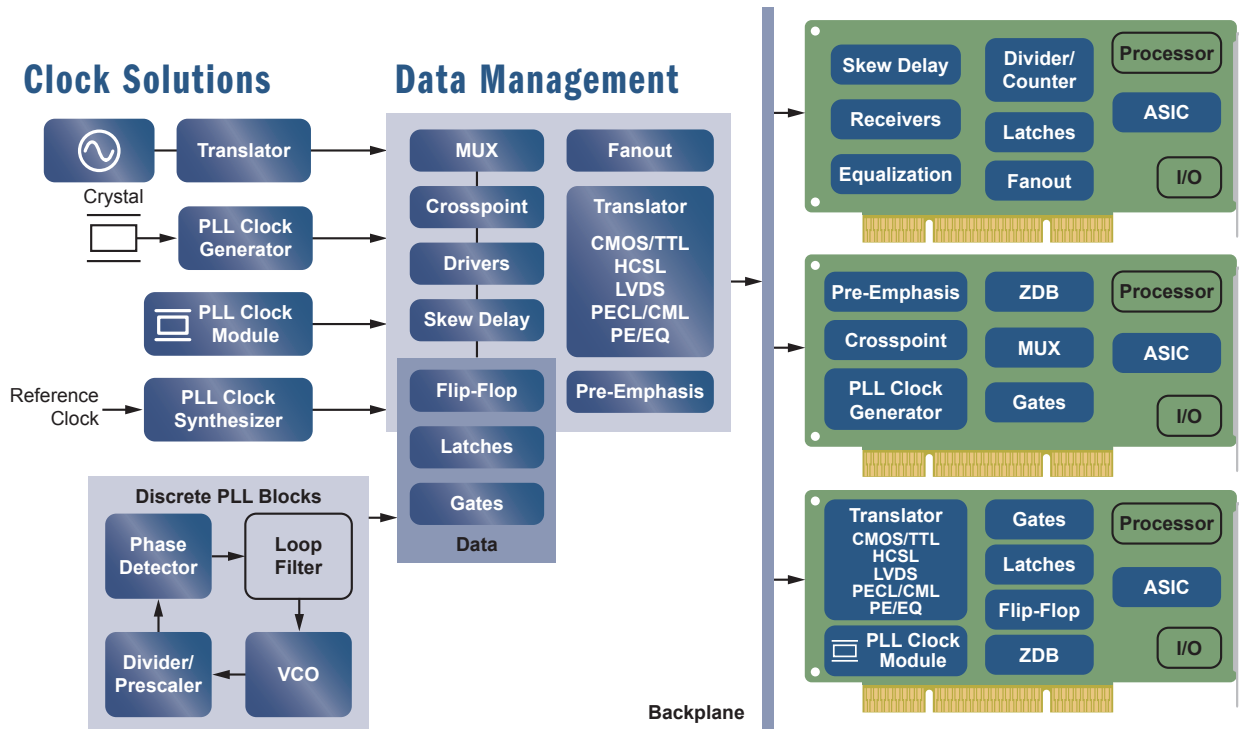


ATPAK

Power MOSFETs

Device	Channel	V _{DS} (V)	I _D (A)	R _{DS(ON)} (mΩ)	Q _{G(TOT)} (nC)	Package
BMS3004	P	-75	-68	8.5	300	TO-220F-3SG (SC-67)
BMS3003	P	-60	-78	6.5	285	TO-220F-3SG (SC-67)
NTTFS5116PL	P	-60	-20	52	25	u8FL
BXL4004	N	40	100	3.9	140	TO-220-3L (SC-46)
NTD5802N	N	40	101	4.4	75	DPAK, IPAK
NTD5805N	N	40	51	9.5	33	DPAK, IPAK
NTP5404N	N	40	167	4.5	125	D2PAK, TO-220
NTMFS5C404NLT	N	40	352	0.75	81	SO-8FL (DFN-5)
NTMFS5C410NLT	N	40	315	0.9	66	SO-8FL (DFN-5)
NTMFS5C430NL	N	40	200	1.5	30	SO-8FL (DFN-5)
NTMFS5C423NL	N	40	150	2	23	SO-8FL (DFN-5)
NTMFS5C442NLT	N	40	126	2.8	22	SO-8FL (DFN-5)
NTMFS5C450NL	N	40	110	3	16	SO-8FL (DFN-5)
NTMFS5C456NL	N	40	78	4.4	12	SO-8FL (DFN-5)
NTMFS5C460NL	N	40	70	5	10	SO-8FL (DFN-5)
NTMFS5C468NL	N	40	50	11	4.4	SO-8FL (DFN-5)
NTMFS5H400NL	N	40	330	0.8	54	SO-8FL (DFN-5)
NTMFS5H409NL	N	40	270	1.1	41	SO-8FL (DFN-5)
NTTFS5C453NL	N	40	107	3	16	u8FL
NTTFS5C454NL	N	40	85	3.8	8.2	u8FL
2SK3703	N	60	30	26	40	TO-220F-3SG (SC-67)
2SK3816	N	60	40	26	40	TO-262-3L (I2PAK)
2SK4066	N	60	100	4.7	220	TO-262-3L (I2PAK)
2SK4094	N	60	100	5	220	TO-220-3L (SC-46)
ATP401	N	60	100	3.7	300	ATPAK
ATP404	N	60	95	7.2	120	ATPAK
BBL4001	N	60	74	6.1	135	TO-220F-3SG (SC-67)
NTMFS5C604NL	N	60	287	1.2	52	SO-8FL (DFN-5)
NTMFS5C612NL	N	60	235	1.5	41	SO-8FL (DFN-5)
NTMFS5C628NL	N	60	140	2.9	22	SO-8FL (DFN-5)
NTMFS5C646NL	N	60	93	4.7	15.7	SO-8FL (DFN-5)
NTMFS5C670NL	N	60	71	6.1	9	SO-8FL (DFN-5)
NTMFS5C673NL	N	60	49	10	6	SO-8FL (DFN-5)
NTMFS5844NL	N	60	60	12	30	SO-8FL (DFN-5)
NTP5864N	N	60	63	12.4	31	TO-220
NTTFS5C670NL	N	60	70	6.5	9	u8FL
NTTFS5C673NL	N	60	50	9.3	4.5	u8FL
BMS4007	N	75	60	7.8	160	TO-220F-3SG (SC-67)
ATP405	N	100	40	33	68	ATPAK
NTD6416ANL	N	100	19	80	25	DPAK, IPAK

Timing and Data Distribution Subsystem

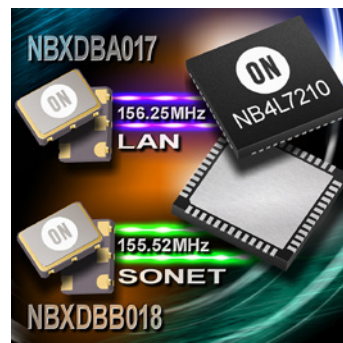


ON Semiconductor provides a complete portfolio of timing and data management solutions for all aspects of the clock tree. System designers can optimize their clock circuits with industry leading clock distribution devices, demonstrating the industry's lowest jitter and skew. A broad product portfolio, 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. For further details by device, function, or parametrics, refer to our website at www.onsemi.com.

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, HSTL, HCSSL, LVTTTL/LVCMOS outputs for flexible interfacing
- Maximum clock rates >10 GHz
- Maximum data rates >12 Gbps
- Typical jitter as low as 30 fs
- Integrated termination resistors for simplified circuit design
- Edge rates as low as 28 ps
- Low phase noise floor ≤ -174 dBc/Hz
- Low skew

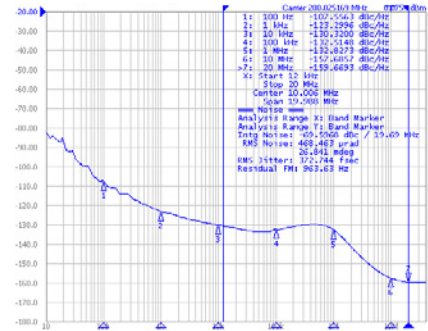


PLL Clock Synthesizers/Generators



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



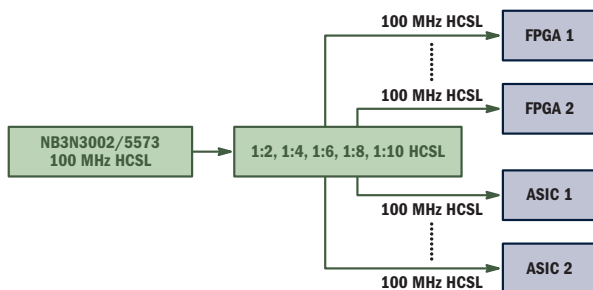
NB3N5573 Typical Phase Noise at Fc = 200 MHz

CLOCK DISTRIBUTION

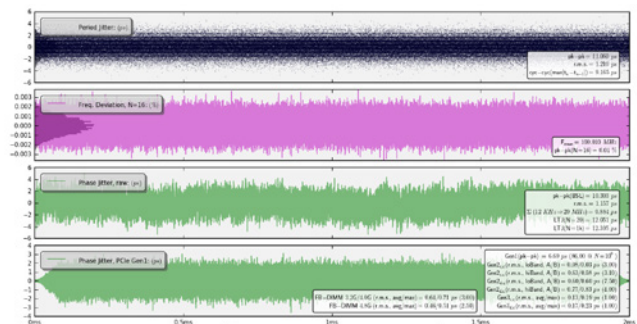
Device	Input (MHz)	Output (MHz)	Application	Input Level					Output Level	Vcc Typ (V)	Package(s)
				XTAL	CML	CMOS	LVPECL	TTL			
NB3N3002	25	25/125/200	CPU/DIMM, PCIe Gen 1,2,3	✓		✓		✓	HCSL	3.3	TSSOP-16
NB3N5573	25	25/100/125/200	CPU/DIMM, PCIe Gen 1,2,3	✓		✓		✓	HCSL	3.3	TSSOP-16
NB3N3020	5 to 27	5 to 210	Network GigE	✓	✓	✓	✓		ECL, LVTTTL	3.3	TSSOP-16
NB3N501	2 to 50	13 to 160	Networking, Consumer, STB	✓					CMOS	3.3, 5	SOIC-8
NB3N502	2 to 50	14 to 120	Networking, Consumer, STB	✓		✓			LVCMOS	3.3, 5	SOIC-8
NB4N507A	5 to 52	50 to 200	Networking, Consumer, STB	✓		✓			ECL	3.3, 5	SOIC-16
NB3N508S	27	216	VCXO Set Top Box	✓		✓			LVDS	3.3	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	✓		✓			HCSL	3.3	TSSOP-20
NB3N51044	25	100/125	CPU/DIMM, PCIe Gen 1,2,3	✓		✓			HCSL	3.3	TSSOP-28
NB3N51054	25	100	CPU/DIMM, PCIe Gen 1,2,3	✓					HCSL	3.3	TSSOP-24

PCIe Timing Solutions

- PCIe clock synthesizers with single, dual, and quad outputs
- PCIe buffers with 1:2, 1:4, 1:6, 1:8, 1:10, and 1:21 fanouts
- Solutions for one, two, six, eight, ten, and twenty-one channel applications available
- Ultra low skew
- Small propagation delay variation (up to 21 output)
- Jitter compliant with PCIe Gen 1,2, 3 specification
- Direct device interface eliminates external termination components and simplifies BOM



PCIe Gen 1, 2, 3 Clock Generation and Distribution



Jitter Results After Fanout

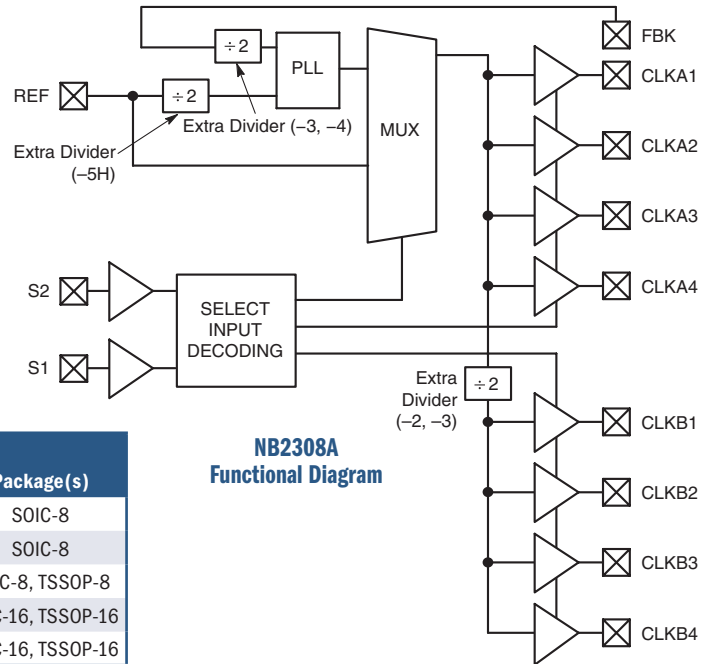
Zero Delay Buffers



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

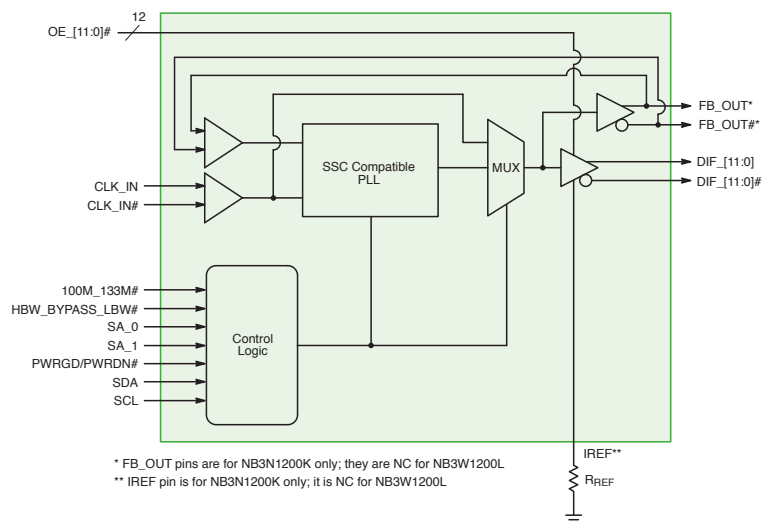
Device	Input Level	Output Level	VCC Typ (V)	f _{Max Typ} (MHz)	Channels	tSkew 0-0 Max (ps)	Package(s)
NB3N2302	CMOS	CMOS	3.3, 5	133	2	250	SOIC-8
NB2304A	CMOS	CMOS	3.3	133.3	4	200	SOIC-8
NB2305A	CMOS	CMOS	3.3	133.3	5	250	SOIC-8, TSSOP-8
NB2308A	CMOS	CMOS	3.3	133.3	8	200	SOIC-16, TSSOP-16
NB2309A	CMOS	CMOS	3.3	133.3	9	250	SOIC-16, TSSOP-16



PCIe Zero Delay Buffers

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



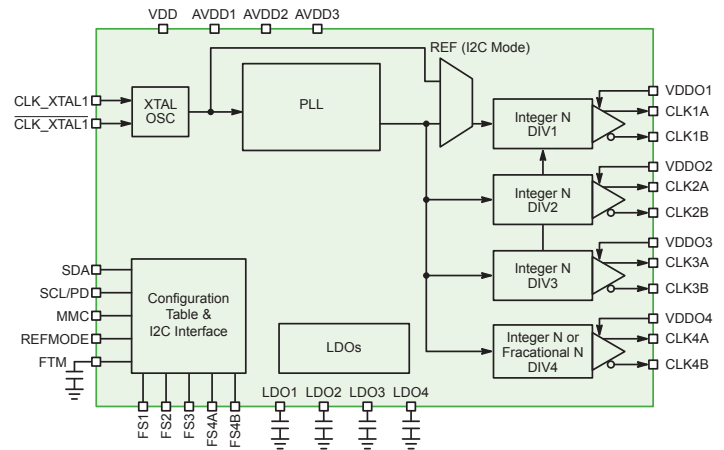
* FB_OUT pins are for NB3N1200K only; they are NC for NB3W1200L
 ** IREF pin is for NB3N1200K only; it is NC for NB3W1200L

NB3N1200K Simplified Block Diagram

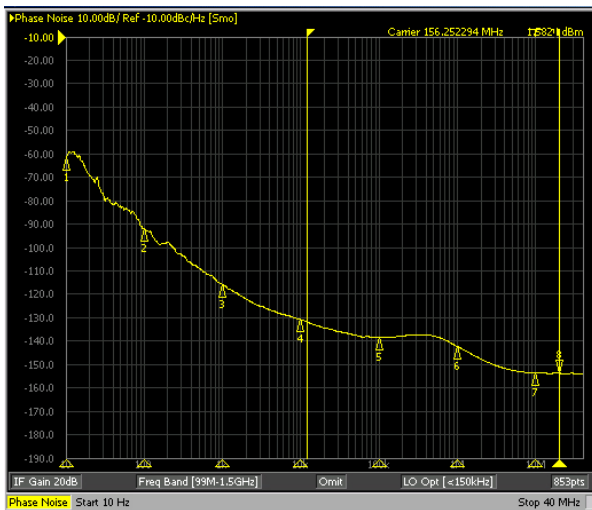
Low Noise, Programmable Multi-Rate Clock Generator

NB3H5150/1 Features

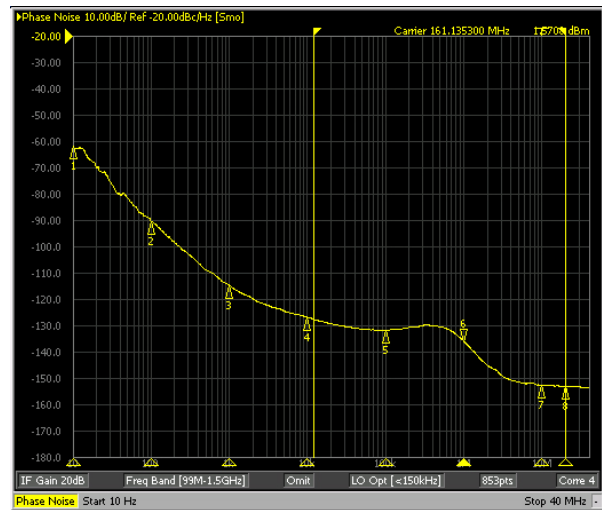
- Uses 25 MHz Crystal or reference input
- External Loop Filter is not required
- User programmable frequencies with four Independent Output Pairs:
 - CLK(1:3) are derived from Integer-N dividers, and CLK4 is derived from either an Integer-N divider or a Fractional-N divider
 - Several different output frequencies can be selected through I2C/SMBus interface or Frequency Select (FSn) pins
- Each output pair can be configured either as two LVCMOS outputs (or) a differential LVPECL pair
- Input supply voltage supports 3.3V or 2.5V operation
- Each output pair has an independent supply voltage rail (VDDOx):
 - For LVCMOS outputs, the supply voltage rail supports 1.8V, 2.5V or 3.3V operation
 - For LVPECL output pairs, the supply voltage rail supports 2.5V or 3.3V operation
- 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
- QFN-32 package
- -40°C to +85°C Ambient Operation Temp



CLOCK DISTRIBUTION



Integer-N Output RMS Phase Jitter = 233 fs !!
Integer-N Output Phase Noise (Max) = 300 fs
Integration range = 12 kHz - 20 MHz

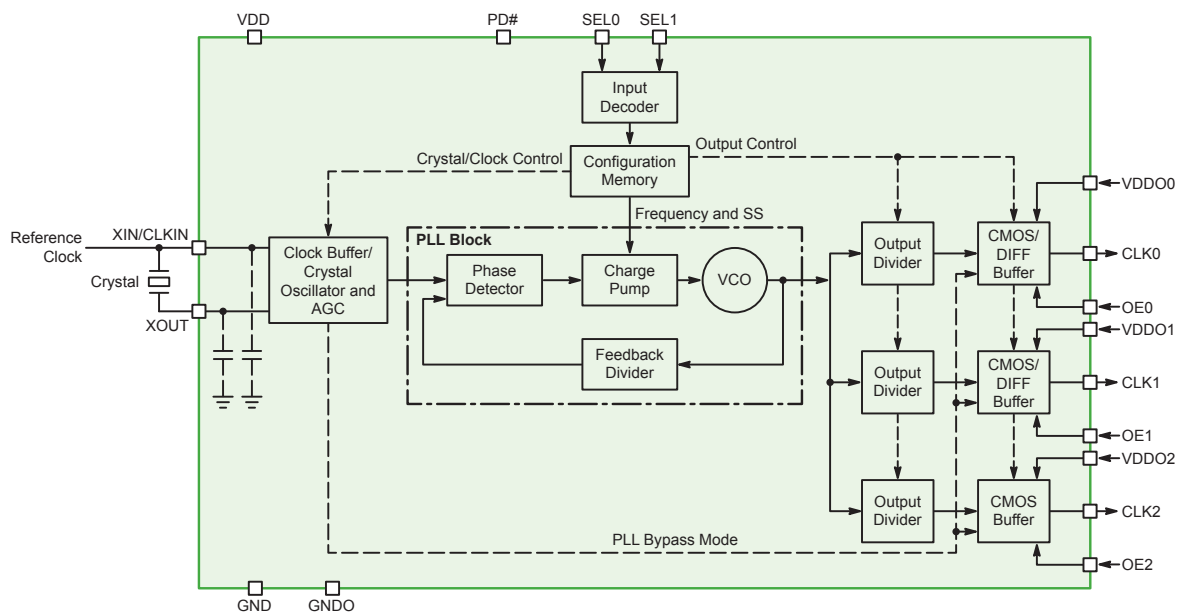


Fractional-N Output RMS Phase Jitter = 371 fs !!
Fractional-N Output Phase Noise (Max) = 1 ps
Integration range = 12 kHz - 20 MHz

Omnicklock Programmable Clock Synthesizers

Key Features

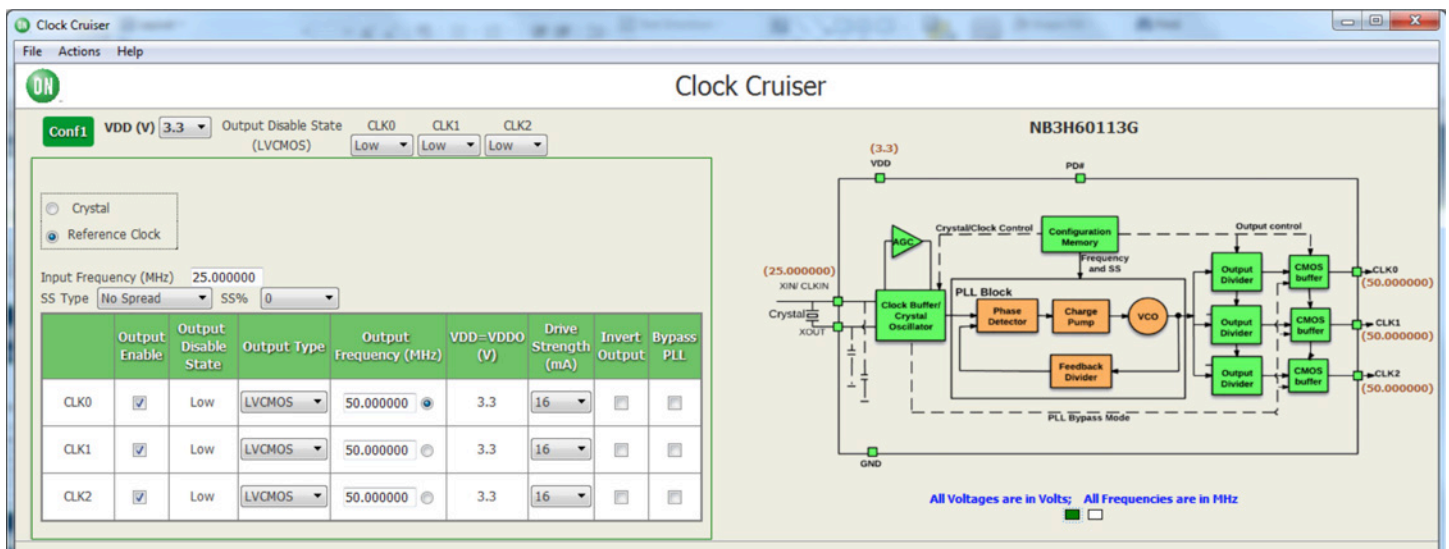
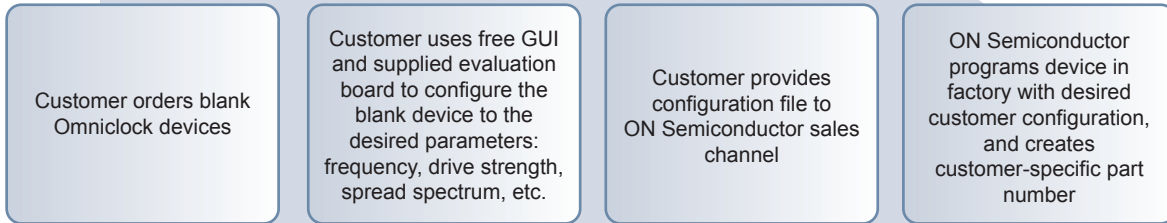
- Single PLL
- Input Frequency Range:
 - Crystal: 3 – 50 MHz (low cost ESR crystal compatible)
 - Clock: 3 – 200 MHz (single-ended only)
- Up to 3 single-ended (LVCMOS/LVTTL) outputs, or up to 1 differential (LVPECL, LVDS, HCSL or CML) output + 1 single-ended (LVCMOS/LVTTL) output
- Output Frequency Range: 8 kHz (Min), 200 MHz (Max)
- Programmable Spread Spectrum Capabilities for EMI Suppression
 - Center Spread (0.125% steps): $\pm 0.125\%$ to $\pm 3\%$
 - Down Spread (0.25% steps): -0.25% to -4%
 - Modulation Rate: 30 kHz – 130 kHz
- PLL Bypass mode
- Individual Output Enable pin for each output and Power Down Capability
- Individual Output Voltage pins per output, allowing setting of output voltage (1.8 V, 2.5 V or 3.3 V; equal to or less than VDD)
- Automatic Gain Control (Crystal Power Limiting)
- Programmable internal input crystal load capacitors
- Programmable Output Drive current
- Up to 4 independent configurations using SELx pins
- Supply Voltage: 3.3 V $\pm 10\%$; 2.5 V $\pm 10\%$; 1.8 V ± 0.1 V
- Temperature Range: -40°C to $+85^{\circ}\text{C}$
- Available in QFN-16 (3 mm x 3 mm) and WDFN-8 (2 mm x 2 mm) packages



Block Diagram

Omnicklock Programmable Clock Synthesizers

Using Omniclock in Your System



Configuration GUI

Device	Individual OE	Individual V _{ddo}	Supply Voltage (V)	Number of Configurations	Number of Outputs	Package
NB3H63143G	Yes	Yes	2.5 / 3.3	4	3	QFN-16
NB3H60113G	No	No	2.5 / 3.3	1	3	DFN-8
NB3V63143G	Yes	Yes	1.8	4	3	QFN-16
NB3V60113G	No	No	1.8	1	3	DFN-8

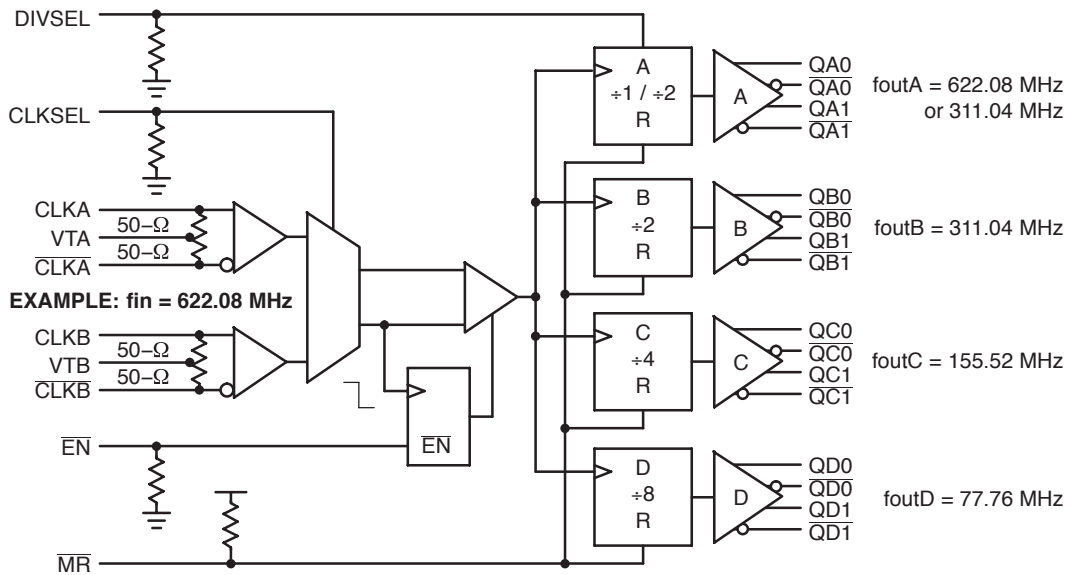
Dividers and Counters



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 _{Max} 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-16
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

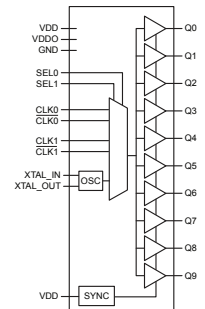


NB4L339 Functional Diagram

Clock and Data Distribution

Features

- Complete portfolio of fanout buffers, multiplexers, cross point switches
- Supporting frequencies from DC to 12 GHz/Gbps
- Device noise floor as low as -174 dBc
- Pre-Emphasis and Equalization blocks available
- Offer new direct X-tal interface capabilities
- Industry leading additive jitter as low as 30 fs typical
- Industry leading output-to-output skew as low as 3 ps minimum
- Wide offering of voltage and interface translation:
 - ECL, PECL, CML, LVPECL, LVDS, M-LVDS, HSTL, HCSSL, LVCMOS/LVTTL
- Power supply 1.5 V, 1.8 V, 2.5 V, 3.3 V, 5.0 V



NB3F8L3010C
Functional Diagram

CLOCK DISTRIBUTION

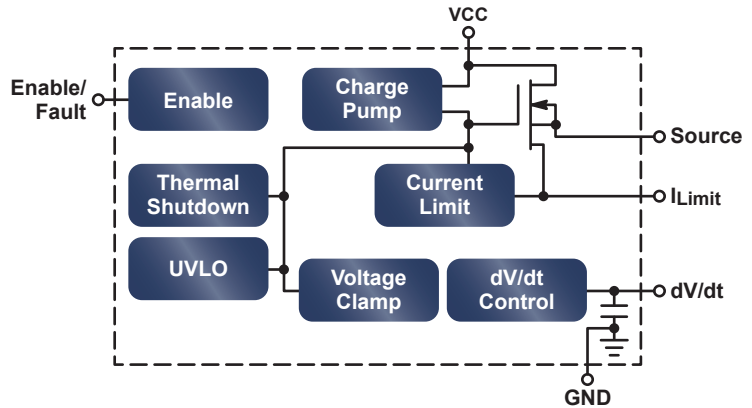
Device	Outputs per Channel	Output Level	Input Level								Vcc Typ (V)	t _{skew} 0-0 (ps)	f _{Max} Typ (GHz)	Package(s)
			CML	CMOS	LVPECL	HCSSL	HSTL	LVDS	XTAL	TTL				
NB3N106K/08K NB3N111K/21K NB3L202K/04K	2, 4, 6, 8, 10, 21	HCSSL		✓	✓	✓	✓	✓	✓	✓	3.3	100	0.4	QFN-52, QFN-32, QFN-24, QFN-16
NB3L83948C	12	CMOS		✓		✓	✓	✓		✓	2.5, 3.3	25	0.35	LQFP-32
NB3V8312C	12	CMOS		✓						✓	1.8, 2.5, 3.3	150	0.25	LQFP-32
NB3F8L3010C	10	CMOS		✓	✓	✓	✓	✓	✓	✓	1.5, 1.8, 2.5, 3.3	55	0.2	QFN-32
NB3M8T3910G	10	HCSSL, CMOS, LVDS, ECL			✓	✓		✓			2.5, 3.3	50	1.4	QFN-48
NB7L111M	10	CML	✓	✓	✓			✓		✓	2.5, 3.3	20	5.5	QFN-52
NB7L1008/M	8	ECL/CML	✓		✓			✓			2.5, 3.3	20/25	7/8	QFN-32
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	1	7.5	QFN-24
NB3F8L3005C	5	CMOS		✓	✓	✓	✓	✓	✓	✓	1.5, 1.8, 2.5, 3.3	55	0.2	QFN-32
NB3L853141	5	ECL	✓	✓	✓	✓	✓	✓	✓	✓	2.5, 3.3	30	700	TSSOP-20
NBSG14	5	ECL	✓	✓	✓			✓		✓	2.5, 3.3	15	12	QFN-16, BGA-16
NB3M8302C/04C	2, 4	CMOS, TTL		✓						✓	2.5, 3.3	45, 85	0.2	SOIC-8
NB3N853501E	4	ECL		✓							3.3	30	0.266	TSSOP-20
NB3N853531E	4	ECL		✓					✓	✓	3.3	30	0.266	TSSOP-20
NB6HQ14M	4	CML	✓	✓	✓			✓		✓	2.5	3	5	QFN-16
NB6L14/M	4	ECL/CML	✓	✓	✓			✓		✓	2.5, 3.3	20	3	QFN-16
NB6L14S/N14S	4	LVDS	✓	✓	✓		✓	✓		✓	2.5/3.3	20	2	QFN-16
NB7HQ14M	4	CML	✓		✓			✓			2.5	15	7	QFN-16
NB7L14/M	4	ECL/CML	✓	✓	✓			✓		✓	2.5, 3.3	15	7/8	QFN-16
NB4L339	2	ECL	✓		✓			✓			2.5, 3.3	60	0.7	QFN-32
NB4N11M	2	CML	✓	✓	✓			✓		✓	3.3	25	2.5	TSSOP-8
NB6L11	2	ECL	✓	✓	✓			✓		✓	2.5, 3.3	15	6	TSSOP-8, SOIC-8
NB6L11M	2	CML	✓	✓	✓			✓		✓	2.5, 3.3	15	2	QFN-16
NB6L11S	2	LVDS	✓	✓	✓		✓	✓		✓	3.3	25	2	QFN-16
NB6L611	2	ECL	✓	✓	✓			✓		✓	2.5, 3.3	15	3	QFN-16
NB7L11M	2	CML	✓	✓	✓			✓		✓	2.5, 3.3	15	8	QFN-16
NB7L72M	2	CML	✓	✓	✓			✓		✓	2.5, 3.3	10	8.5	QFN-16
NB7L572	2	CML	✓	✓	✓			✓		✓	2.5, 3.3	15	7	QFN-32
NB3L8504S	4	LVDS	✓		✓	✓	✓	✓			2.5, 3.3	50	0.7	TSSOP-16
NB3L8543S	4	LVDS	✓		✓	✓	✓	✓			2.5, 3.3	40	0.65	TSSOP-20
NB3L8533	4	LVPECL	✓		✓	✓	✓	✓			2.5, 3.3	30	0.65	TSSOP-20
NB3L208K	8	HCSSL			✓	✓		✓			2.5, 3.3	100	0.35	QFN-32
NB3U1548C	4	LVCMOS, LVTTTL		✓						✓	1.5, 1.8, 2.5, 3.3	250	0.16	TSSOP-8, SOIC-8
NB3N4666C	4	LVCMOS, LVTTTL			✓	✓		✓			3.3	50	0.2	TSSOP-16, QFN-16
NB3V1102C/3C NB3V1104C/6C	2, 3, 4, 6	LVCMOS		✓							1.8, 2.5, 3.3	50	0.25	TSSOP-14,8
NB7VQ572M	2	CML	✓		✓			✓			1.8, 2.5	15	5	QFN-32
NBSG11	2	ECL	✓	✓	✓			✓		✓	2.5, 3.3	15	12	QFN-16, BGA-16
NB6L56	1	ECL	✓		✓		✓	✓			2.5, 3.3	25	2.5	QFN-32

Electronic Fuses for Inrush Current Limiting on Power Buses

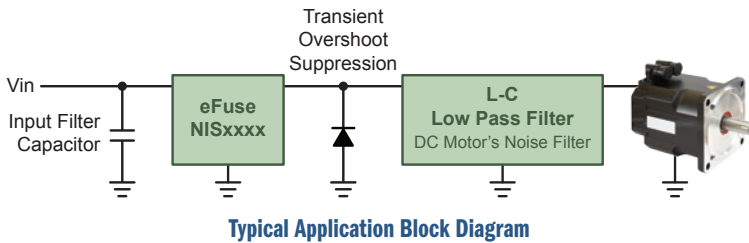
5 V and 12 V Power Bus Protection

Features

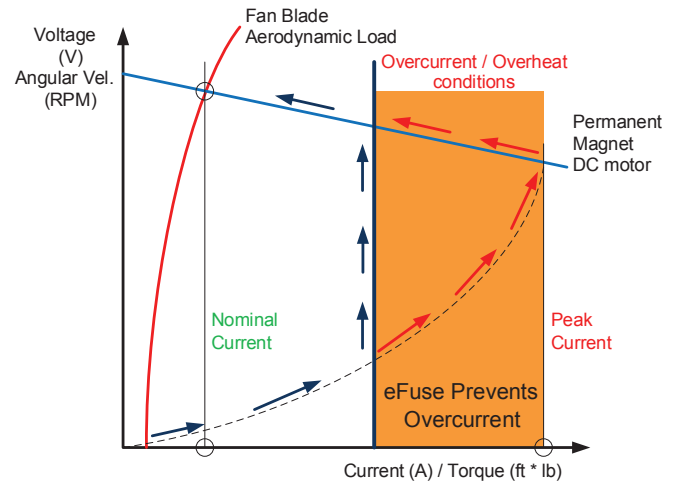
- Low $R_{DS(ON)}$, high operating and trip currents (I_{OP} , I_{TRIP})
- Overvoltage protection
- Precise I_{TRIP} control
- Slew rate control
- Thermal shut-down
- EN pin for synchronizing multiple eFuses
- Outperforms poly-fuses:
 - Tighter spec tolerances
 - Lower resistance
 - Lower trip-time
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



Typical Feature Set for eFuse



Typical Application Block Diagram



DC Motor I/V Characteristics

Device	Input Voltage (V)	Output Clamping Voltage (V)	I_{TRIP} Trip Current (A)	$R_{DS(ON)}$ ($m\Omega$)	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 3Q16

PROTECTION

ESD and Surge Protection for Industrial Networks

Transient Voltage Suppressors (TVS)

Device	P _{pk} * (W)	V _{rwm} (V)	Direction	Package
SMF Series	200	5 - 36	Unidirectional	SOD-123FL
1SMA Series	400	5 - 78	Uni-, Bidirectional	SMA
1SMB Series	600	5 - 170	Uni-, Bidirectional	SMB
P6SMB Series	600	5.8 - 171	Uni-, Bidirectional	SMB
1SMC Series	1500	5 - 78	Unidirectional	SMC
1.5SMC Series	1500	5.8 - 77.8	Unidirectional	SMC

* Peak surge power under 10/1000 μs.

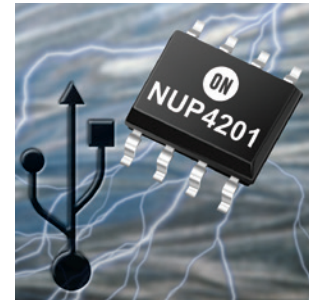
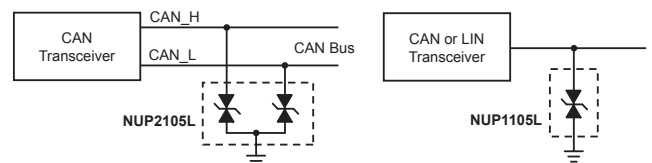
Zener Voltage Regulators

Device	Power (W)	V _Z (V)	V _Z Tolerance (%)	Package
BZX84 Series	0.225	2.4 - 75	2, 5	SOT-23
MMBZ Series	0.225	2.4 - 91	5	SOT-23
MMSZ Series	0.5	1.8 - 91	5	SOD-123
1SMA59 Series	1.5	3.3 - 68	5	SMA
1SMB59 Series	3	3.3 - 200	5	SMB
1N59 Series	3	3.3 - 200	5	Surmetic 30
1N53 Series	5	3.3 - 200	5	Surmetic 40

Network Dataline Protection

Device	Application	V _{rwm} Max (V)	Line-to-Line Capacitance (pF)	Peak Surge Current* Max (A)	Package
NUP3105L	HS CAN	32	30	8	SOT-23
NUP2125	HS CAN	24	5	3	SOT-323
NUP2115L	FlexRay	24	5	3	SOT-23
NUP2105L	HS CAN	24	15	8	SOT-23
NUP1105L	LIN, LS CAN	24	30	8	SOT-23
SM12T	RS-232	12	48	12	SOT-23
NUP4201	USB2.0 FS	5	2.5	25	SO-8
TVS4201	USB2.0 FS	5	1.5	25	TSOP-6
TVS8814/8	10/100/1000BASE-T Ethernet, Gb Ethernet	5	1.5	25	UDFN-10

* on VP pin (pin 5).



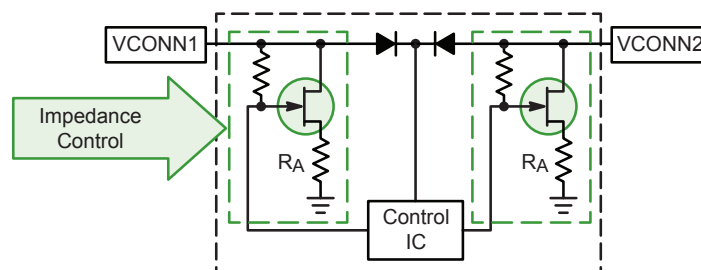
PROTECTION

USB3.1 Type-C Port Control

Features

- Current optimized for USB control
- Low capacitance enables high speed operation

Device	V _{GDS} (V)	V _{GS(off)} (V)	I _{GSS} (nA)	I _{DSS} (mA)	y _{sf} (mS)	C _{ISS} (pF)	Package
TF412S	-30	-0.18 to -1.5	1	1.2 to 3.0	5.0	4	SOT-883



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.

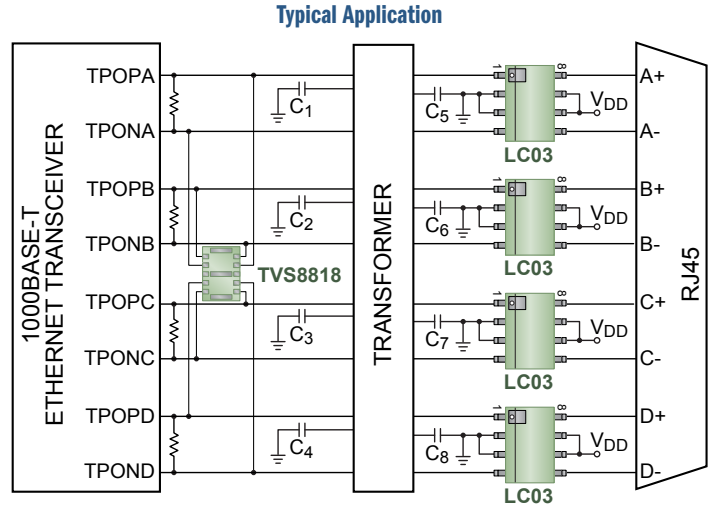
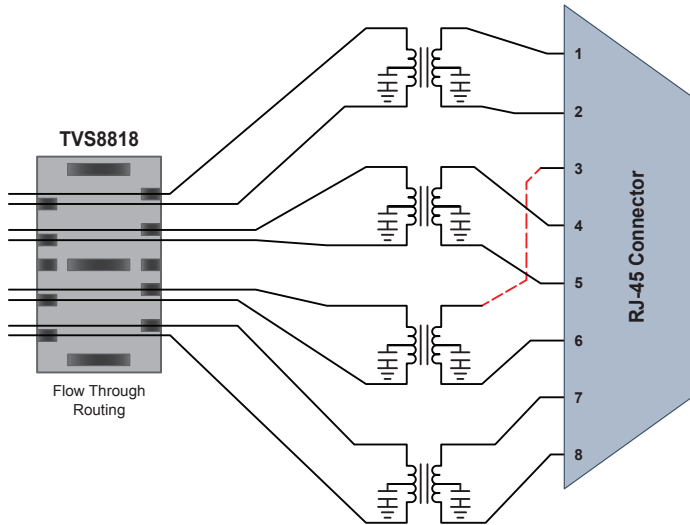
Features

- 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

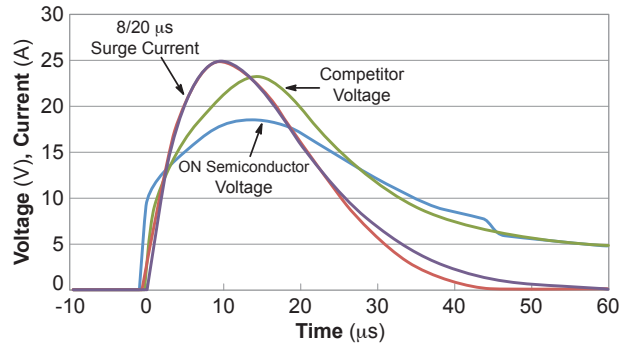
Benefits

- 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

PROTECTION



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 μ s (A)	Typical Line-Line Capacitance (pF)	ESD Contact Rating (kV)	Package
LC03-6	6.7	7.0	100	8.0	\pm 30	SOIC-8
TVS8814	3.0	3.2	35	1.5	\pm 30	UDFN-8
TVS8818	3.0	3.2	35	1.5	\pm 30	UDFN-10
SRDA3.3	3.3	5.0	25	4.0	\pm 8	SOIC-8
SRDA05	5.0	7.0	23	5.0	\pm 8	SOIC-8
TVS4201	5.0	6.0	2.5	1.5	\pm 30	TSOP-6

USB 2.0 Protection

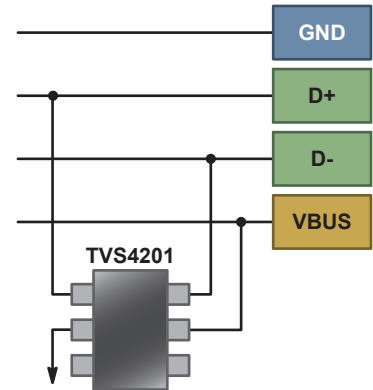
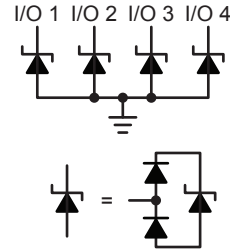
One High Speed Pair, V_{CC}, Low Capacitance ESD Protection

Key Requirement

- Cap < 5 pF

Features

- 0.5 - 3.0 pF
- 4 low speed + 1 VBUS integrated – can protect up to 2 USB ports
- Industry leading low clamping voltage



Device	Data Lines	Capacitance (pF)	Package	Size (mm)
NUP4114UCL	2 Pair + Power	0.50	SC-88	2.0 x 2.1
NUP4114UPX	2 Pair + Power	0.80	SOT-563	1.6 x 1.6
NUP4114H	2 Pair + Power	0.80	TSOP-6	3.0 x 2.75
TVS4201	2 Pair + Power	3.0	TSOP-6	3.0 x 2.75
NUP3115	1 Pair + ID + Power (D+, D-, ID, VBUS)	0.80	UDFN-6	1.6 x 1.6
ESD7L5.0	1 Pair (D+, D-)	0.50	SOT-723	1.2 x 1.2
ESD7451	Single Line 0402	0.25	XDFN-2	1.0 x 0.6
ESD7481	Single Line 0201	0.25	X3DFN-2	0.62 x 0.32

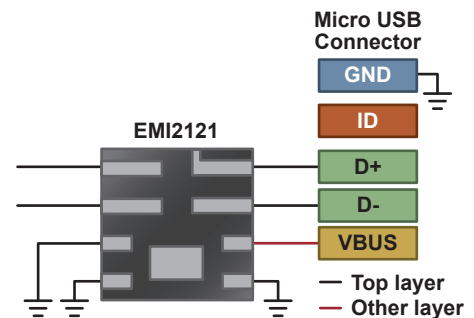
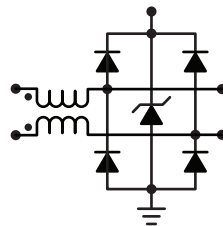
One High Speed Pair, V_{CC}, Common Mode Filter + ESD Protection

Key Requirement

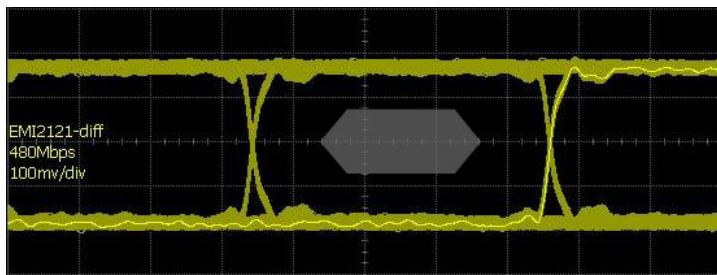
- Cap < 1.5 pF
- Common Mode Filtering

Features

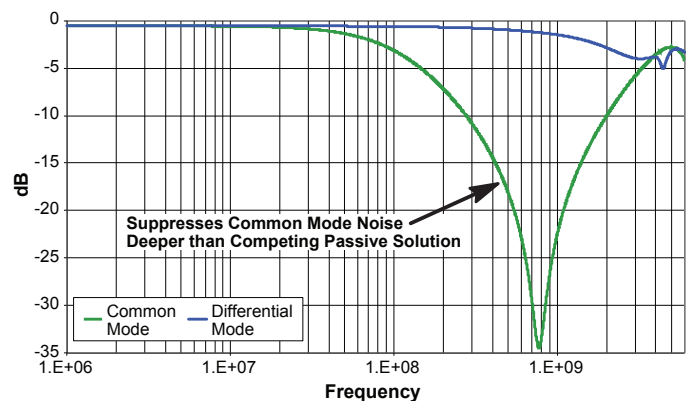
- 0.5 - 0.8 pF
- Integrated EMI suppression with ESD protection
- Industry leading low clamping voltage



Device	Data Lines	Capacitance @ 2.5 V (pF)	CM Attenuation @ 800 MHz (-dB)	DM Bandwidth F3dB (GHz)	Package	Size (mm)
EMI2121	1 Pair + Power (D+, D-, VBUS)	0.9	-25	2.5	WQFN	2.2 x 2.0 x 0.75
EMI2124	1 Pair + ID + Power (D+, D-, ID, VBUS)	0.9	-25	2.5	WQFN	2.2 x 2.0 x 0.75



USB 2.0 @ 480 Mb/s



General and LCD MCUs

MCU Features

- Pins: 10 – 100
- ROM: 4 – 768 KBytes
- RAM: 256 – 48,640 Bytes
- ADC: 3 – 16 channels
- Operation Voltage: 1.8 – 5.5 (V)
- Stand-by IDD: 0.02 μ A
- RTC (Clock) IDD: 0.45 μ A (with low power model)



Device	Type	ROM (kByte)	RAM (Byte)	I/Os	PWMs	UARTs	ADC	LVD	POR	Features	Package
LC87FBG08A	8-bit General	8	256	21	2	1	12/8-bit x 9ch	✓	✓	High accuracy internal OSC ($\pm 2.0\%$); all operation is minimum 1.8 V	SSOP-24, VCT-24
LC87FBK08A	8-bit General	8	256	21	2	–	12/8-bit x 8ch	✓	✓	High accuracy internal OSC ($\pm 3.0\%$); Support Mask Type	SSOP-24
LC87FBL08A	8-bit General	8	256	26	2	–	12/8-bit x 11ch	✓	✓	High accuracy internal OSC ($\pm 3.0\%$)	QFP-36
LC87FBH08A	8-bit General	8	256	26	2	1	12/8-bit x 11ch	✓	✓	High accuracy internal OSC ($\pm 3.0\%$)	QFP-36
LC87F2R04A	8-bit General	4	128	21	–	–	12/8-bit x 8ch	✓	✓	Small scale 8bit MCU; Remote Control Receiver Circuit	SSOP-24
LC87BK08A*	8-bit General	8	256	21	2	–	12/8-bit x 8ch	✓	✓	Mask ROM edition of LC87FBK08A	SSOP-24
LC87F2416A	8-bit General	16	512	26	2	1	12/8-bit x 10ch	–	–	–	QFP-36
LC87F2J32A	8-bit General	32	1024	41	2	1	12/8-bit x 14ch	✓	✓	–	SQFP-48, QIP-48
LC87F2W48A	8-bit General	50	1536	40	2	1	12/8-bit x 14ch	✓	–	–	SQFP-48
LC87F2C64A	8-bit General	64	2048	73	4	2	12/8-bit x 16ch	✓	✓	RTC; low power consumption	QFP-80
LC87FC096A	8-bit General	96	4096	55	6	2	12/8-bit x 11ch	✓	✓	12-bit PWM x 6	QIP-64E
LC87F2608A	8-bit General	8	512	7	1	–	12/8-bit x 3ch	✓	✓	High speed 12-bit PWM; Analog Comparator	MFP-10SK
LC87F0808A	8-bit General	8	256	30	6	1	10/8-bit x 10ch	✓	✓	MCPWM; High speed ADC (10-bit); Analog Comparator/Amplifier x 2	QFP-36
LC87F0N04A	8-bit General	4.5	128	12	4	–	10/8-bit x 6ch	✓	✓	MCPWM; High speed ADC (10-bit); Analog Comparator x 2	SSOP-16
LC87F0G08A	8-bit General	8	256	18	3	–	12/8-bit x 7ch	–	–	MCPWM, OP-AMP, Analog comparator	SSOP-24
LC87F0A08A	8-bit General	8	256	30	2	–	12/8-bit x 8ch	✓	✓	OP-AMP, Analog comparator, Constant current output port	QFP-36
LC87F5VP6A	8-bit General	256	10240	89	4	2	8-bit x 15ch	–	–	Large scale memory	QIP-100E
LC88F58B0A	16-bit General	128	6144	54	2	2	12/8-bit x 11ch	–	✓	Motor control signal generator	SQFP-64
LC88FC3H0A	16-bit General	512	49152	90	4	3	12/8-bit x 8ch	✓	✓	2 x SMIC, SLIIC; RTC; CRC calculation circuit	TQFP-100
LC88FC3J0A	16-bit General	640	49152	90	4	3	12/8-bit x 8ch	✓	✓	2 x SMIC, SLIIC; RTC; CRC calculation circuit	TQFP-100
LC88FC3K0A	16-bit General	768	49152	90	4	3	12/8-bit x 16ch	✓	✓	2 x SMIC, SLIIC; RTC; CRC calculation circuit	TQFP-100
LC87F7932B	8-bit LCD	32	2048	49	2	1	12/8-bit x 7ch	–	✓	32 x 4 segment driver; RTC; low power consumption	SQFP-64
LC87F7J32A	8-bit LCD	32	1024	51	2	1	12/8-bit x 12ch	✓	✓	24 x 4 segment driver; support 5 V/3 V for LCD-panel	TQFP-64
LC87F76C8A	8-bit LCD	128	4096	71	2	1	12/8-bit x 12ch	–	–	32 x 4 segment driver	QFP-80
LC87F7DC8A	8-bit LCD	128	4096	91	2	2	12/8-bit x 15ch	–	–	54 x 4 segment driver; many segment drivers	QIP-100E
LC87F7NC8A	8-bit LCD	128	4096	91	2	2	12/8-bit x 15ch	–	–	54 x 4 segment driver; large scale memory	QIP-100E
LC87F7NJ2A	8-bit LCD	192	8192	91	2	2	12/8-bit x 15ch	–	–	54 x 4 segment driver; large scale memory	QIP-100E
LC87F7NP6A	8-bit LCD	256	8192	91	2	2	12/8-bit x 15ch	–	–	54 x 4 segment driver; large scale memory	QIP-100E

* Mask ROM Device; Contact ON Semiconductor for additional information.

MCUs for USB

MCU Features

- USB 2.0 full-speed / low speed functions
- USB device function / USB host function
- Integrated voltage regulator
- USB D+ line pull-up function

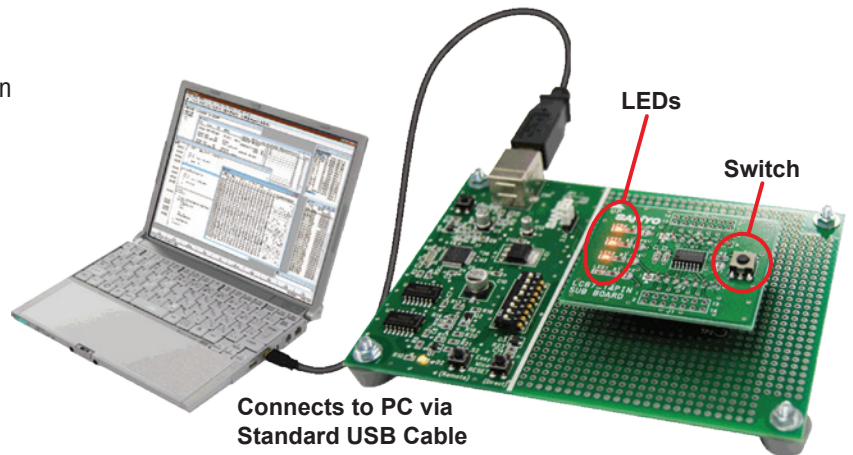
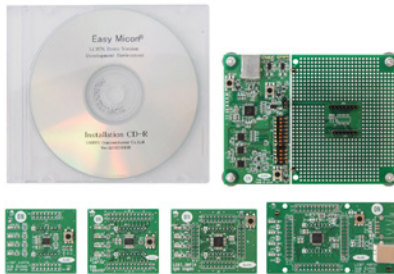


Device	Type	ROM (kByte)	RAM (Byte)	I/Os	PWMs	UARTs	ADC	LVD	POR	Features	Package
LC87F1A32A	8-bit USB	32	2048	39	2	1	12/8-bit x 12ch	-	-	IR reciever	SQFP-48
LC87F1M16A	8-bit USB	16	1024	38	2	1	12/8-bit x 20ch	✓	✓	UART & SCUART; high current driver	SQFP-48
LC87F1K64A	8-bit USB	64	8192	39	2	1	12-bit x 12ch	✓	✓	USB I/F x 2; USB Host; Audio I/F	SQFP-48
LC87F17C8A	8-bit USB	128	8192	39	2	1	12/8-bit x 12ch	✓	✓	USB 2.0 full speed host/device controller x2; audio IF	SQFP-48
LC87F1HC8A	8-bit USB	128	16384	39	2	1	8-bit x 12ch	-	-	USB Host; Audio I/F	SQFP-48
LC87F1J2A	8-bit USB	192	16384	39	2	1	8-bit x 12ch	-	-	USB Host; Audio I/F	SQFP-48
LC87F1J4A	8-bit USB	192	20480	39	2	1	8-bit x 12ch	-	-	USB Host; Audio I/F	SQFP-48
LC87F1J8A	8-bit USB	192	24576	39	2	1	8-bit x 12ch	-	-	USB Host; Audio I/F	SQFP-48

MCU Starter Kit for Software Development

Trial kit includes Main Board, Sub Board, and Development Environment CD. With Main Board as a base, it is possible to connect different Sub Boards with different pin numbers.

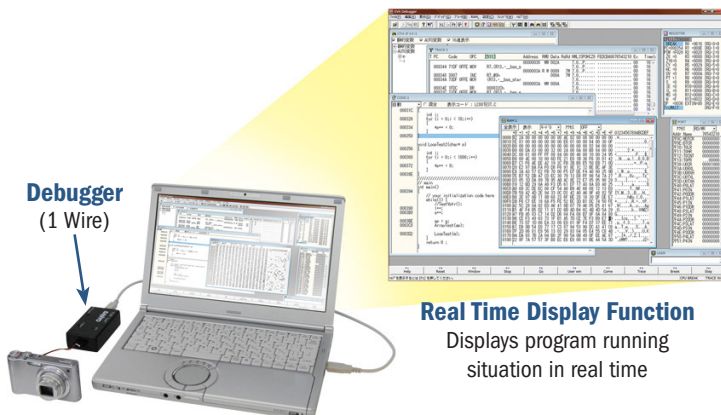
- 8 bit Easy Micon Development Tool
Sub Board Line Up: 16-pin, 24-pin, 36-pin, 48-pin
- 16 bit Xstromy16 Development Tool
Sub Board Line Up: 48-pin, 64-pin, 100-pin



OTHER

MCU On-Chip Debugger System

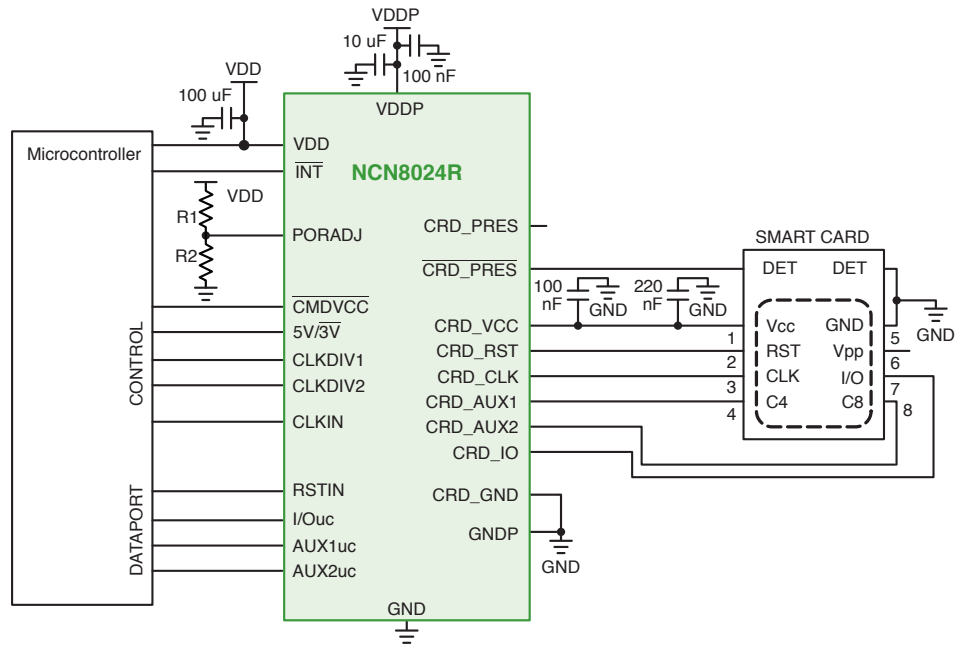
- Software development with 1 wire communication
- Reduction of development time with Real Time Display function, Break function, and Trace function



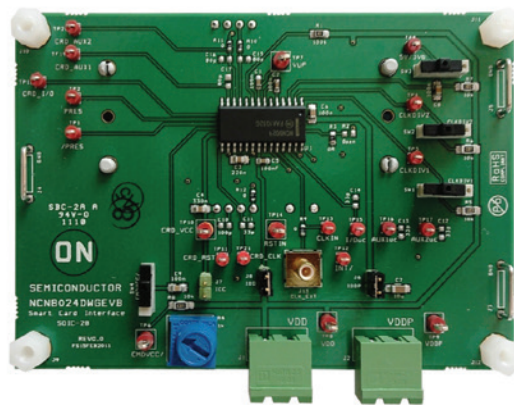
Smart Card Interfaces

Features

- ISO & EMV compliance
- ESD protection on card pins up to +8kV (Human Body Model)



	Device	Ports	Control Interface	Card Type	VDD μ C Interface (V)	Power Supply	Sequencer	Card Detect	Clock Divider	Standards	Package(s)
Smart Card	NCN6001	1	SPI	A, B, C	2.7 - 5.5	Inductive DC-DC	Yes	Yes	Yes	ISO7816; EMV4.3	TSSOP-20, TLLGA-20
	NCN8024R	1	Parallel	A, B	2.7 - 5.5	LDO	Yes	Yes	Yes	ISO7816; EMV4.3	SOIC-28W
	NCN8025/A (SAM/SIM)	1/3	Parallel	A, B, C	2.7 - 5.5	LDO	Yes	Yes	Yes	ISO7816; EMV4.3; UICC	QFN-16, QFN-24
	NCN8026 (SAM/SIM)	1	Parallel	A, B, C	1.6 - 5.5	LDO	Yes	Yes	Yes	ISO7816; EMV4.3; UICC; SIM	QFN-24
SAM	NCN4555	1	Parallel	B, C	1.8 - 5.5	LDO	No	No	No	UICC; SIM	QFN-16



NCN8024R Demo Board

OTHER

Integrated Interface with Configurable DC-DC Controller for Power-over-Ethernet

PoE Controllers

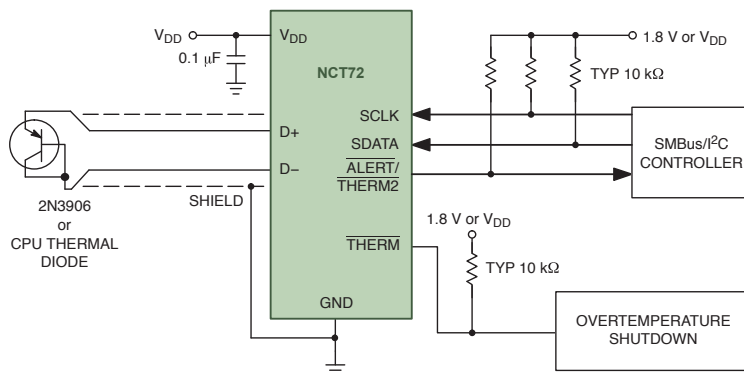
Device	Power (W)	Standard	Interface	Controller	Package
NCP1080	13	IEEE 802.3af	✓	✓	TSSOP-20 EP
NCP1082	13	IEEE 802.3af + Auxiliary	✓	✓	TSSOP-20 EP
NCP1081	40	IEEE 802.3at	✓	✓	TSSOP-20 EP
NCP1083	40	IEEE 802.3at + Auxiliary	✓	✓	TSSOP-20 EP
NCP1090	13	IEEE 802.3af	✓		TSSOP-8, SOIC-8
NCP1091	13	IEEE 802.3af	✓		TSSOP-8, SOIC-8
NCP1092	13	IEEE 802.3af	✓		TSSOP-8, SOIC-8
NCP1093	25	IEEE 802.3at	✓		DFN-10
NCP1094	25	IEEE 802.3at	✓		DFN-10
NCP1030	6	IEEE 802.3af		✓	SOIC-8, DFN-8
NCP1031	3	IEEE 802.3af		✓	Micro8™

Features

- 3.0 kV cable ESD robustness
- 8.0-15 kV system ESD robustness
- IEC61000-4-5 surge compliant without external protection



Temperature Monitors with Series Resistance Cancellation



Features

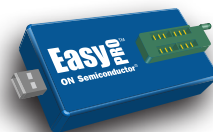
- On-chip and remote temperature sensor
- 0.25°C resolution/1°C accuracy on remote channel
- 1°C resolution/1°C accuracy on local channel
- Series resistance cancellation up to 1.5 kΩ (NCT72)
- Extended, switchable temperature measurement range 0°C to +127°C (default) or -64°C to +191°C

Device	Supply Range (V)	Interface	Number of Addresses	Temperature Sensors	Temperature Sensor Accuracy (°C)	Temperature Range (°C)	Package
NCT375	3.0 - 5.5	SMBus	8	1 Local	±1	-55 to +125	Micro8, SOIC-8, DFN-8
NCT72	2.8 - 3.6	I2C/SMBus	2	1 Local; 1 Remote	±1	-40 to +125	WDFN-8, DFN-8

EEPROMs for Configuration and Calibration

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
- Error-code correction
- Lockable ID page



EasyPRO™ is a user-friendly, portable programming tool for ON Semiconductor serial EEPROMs (I²C, SPI, Microwire)

EEPROMs

Data Transmission Standard	Device	Density	Organization*	Vcc Min (V)	Vcc Max (V)	fCLK Max (MHz)	Package(s)
I ² C	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
	LE2464CXA	64 kb	8k x 8	1.7	3.6	0.4	WLCSP-6
	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
	LE24162LBXA	16 kb	2k x 8	1.7	3.6	0.4	WLCSP-6
	LE24163LBXA	16 kb	2k x 8	1.7	3.6	0.4	WLCSP-5
	LE2416RLBXA	16 kb	2k x 8	1.7	3.6	0.4	WLCSP-6
	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
	LE24L042CS-B	4 kb	512 x 8	1.7	3.6	0.4	WLCSP-4
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
CAT93C46B	1 kb	128 x 8 / 64 x 16	1.8 / 1.65	5.5	4	SOIC-8, TSSOP-8, UDFN-8	

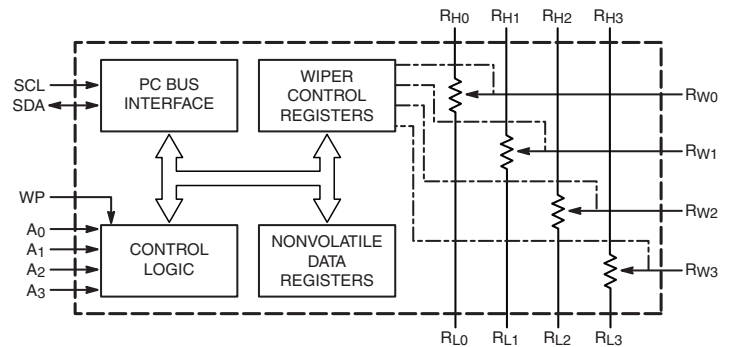
* Organization for Microwire devices is selectable.

OTHER

Digital Potentiometers (POTs) for Trimming and Calibration

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



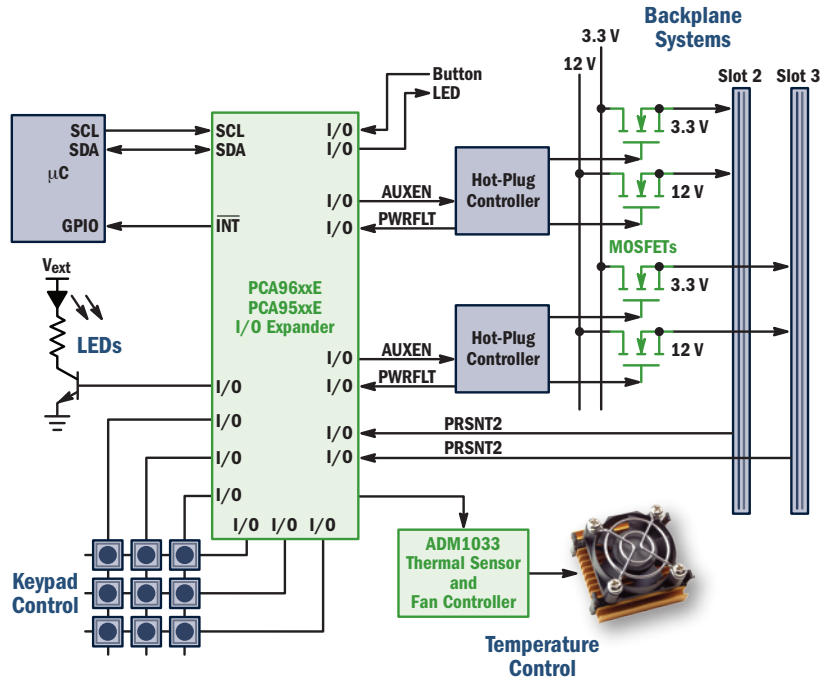
Device	Number of Pots	Number of Taps	Resistance (kΩ)	Buffered Wiper	Interface	Volatile	Non-Volatile	Packages
CAT5120/1/2	1	16	10, 50, 100		UP/DOWN	✓		SOT-23-6, SC-70-6
CAT5110	1	32	10, 50, 100		UP/DOWN	✓		SOT-23-6, SC-70-6
CAT5112	1	32	10, 50, 100	✓	UP/DOWN		✓	PDIP-8, SOIC-8, MSOP-8, TSSOP-8
CAT5114	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
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 ² C		✓	MSOP-10
CAT5133	1	128	10, 50, 100		UP/DOWN		✓	MSOP-10
CAT5137	1	128	50		I ² C		✓	SC-88-6, SC-70-6
CAT5138	1	128	10		I ² C		✓	SC-88-6, SC-70-6
CAT5140	1	256	50, 100		I ² C		✓	MSOP-8
CAT5171	1	256	50, 100		I ² C		✓	SOT-23-8
CAT5172	1	256	50		SPI		✓	SOT-23-8
CAT5221	2	64	2.5, 10, 50, 100		I ² 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 ² C		✓	SOIC-24, TSSOP-24
CAT5261	2	256	50, 100		SPI		✓	SOIC-24, TSSOP-24
CAT5269	2	256	50, 100		I ² C		✓	SOIC-24, TSSOP-24
CAT5271	2	256	50, 100		I ² C		✓	MSOP-10
CAT5273	2	256	50		I ² C		✓	MSOP-10
CAT5241	4	64	2.5, 10, 50, 100		I ² 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 ² C		✓	SOIC-24, TSSOP-24
CAT5251	4	256	50, 100		SPI		✓	SOIC-24, TSSOP-24
CAT5259	4	256	50, 100		I ² C		✓	SOIC-24, TSSOP-24

OTHER

Cascadable I/O Expanders

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	LED Blink/PWM	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

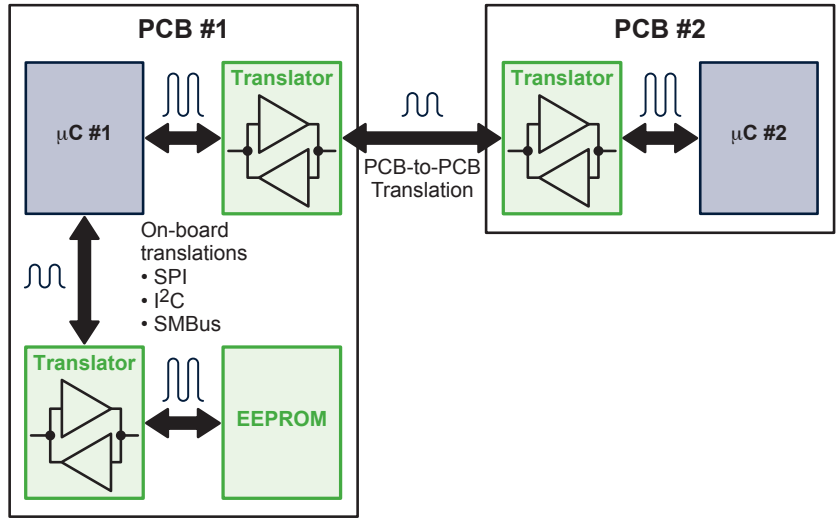
OTHER

Logic Translators

Dual supply voltage logic translators connect ICs and PCBs together that operate at different supply voltages.

Key Features

- Industry's first devices with independent power supplies ($V_L < V_{CC}$, $V_L = V_{CC}$, or $V_L > V_{CC}$)
- High 100 pF capacitive drive capability
- Overvoltage tolerant enable and I/O pins
- Non-preferential power-up sequencing
- Power-off protection



	Unidirectional Translator	Autosense Bidirectional Translator (Push-Pull Output)	Autosense Bidirectional Translator (Open-Drain Output)	Bidirectional Translator (with Direction Pin)
Block Diagram				
Attributes	<ul style="list-style-type: none"> • High Data Rate • Low Power Consumption 	<ul style="list-style-type: none"> • High Data Rate • Low Power Consumption 	<ul style="list-style-type: none"> • High Data Rate • Low Power Consumption • Flexible PCB Design 	<ul style="list-style-type: none"> • High Data Rate • Low Power Consumption • Flexible PCB Design
Trade-Offs	<ul style="list-style-type: none"> • Fixed Input & Output Pins 	<ul style="list-style-type: none"> • Modest Output Current 	<ul style="list-style-type: none"> • Modest Bandwidth 	<ul style="list-style-type: none"> • Directional Control Pin Required
Applications	<ul style="list-style-type: none"> • SPI • GPIO 	<ul style="list-style-type: none"> • SPI • GPIO 	<ul style="list-style-type: none"> • I²C, SMBus, PMBus • GPIO • SDIO Cards • 1-Wire Bus 	<ul style="list-style-type: none"> • GPIO
Sample Device (I/O Channels, Package)	<ul style="list-style-type: none"> • NLSV1T34 (1-Bit, ULLGA-6) • NLSV1T240/244 (1-Bit, UDFN-6) • NLSV2T240/244 (2-Bit, UDFN-8) • NLSV4T240/244 (4-Bit, UDFN-12) • NLSV4T3234 (4-Bit, CSP-11) • NLSV8T240/244 (8-Bit, UDFN-20) 	<ul style="list-style-type: none"> • NLSX3013 (8-Bit, CSP-20) • NLSX3018 (8-Bit, UDFN-20) • NLSX5011 (1-Bit, ULLGA-6, UDFN-6) • NLSX5012 (2-Bit, UDFN-8) • NLSX5014 (4-Bit, UDFN-12) 	<ul style="list-style-type: none"> • NLSX4373 (2-Bit, UDFN-8) • NLSX4378 (4-Bit, CSP-12) • NLSX4401 (1-Bit, UDFN-6) • NLSX4402 (2-Bit, UDFN-8) 	<ul style="list-style-type: none"> • NLSV1T45 (1-Bit, ULLGA-6) • NLSV2T245 (2-Bit, UQFN-10) • NLSV2T3236 (2-Bit, UQFN-10) • NLA16T245 (16-Bit, TSSOP-48)

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