



# Industrial Solutions

*Connectivity, control, sensing, clock distribution, power, and protection solutions for industrial applications from ON Semiconductor.*



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



**Industrial Automation & Robotics**



**Machine Vision**



**Human-Machine Interface (HMI)**



**Communications**



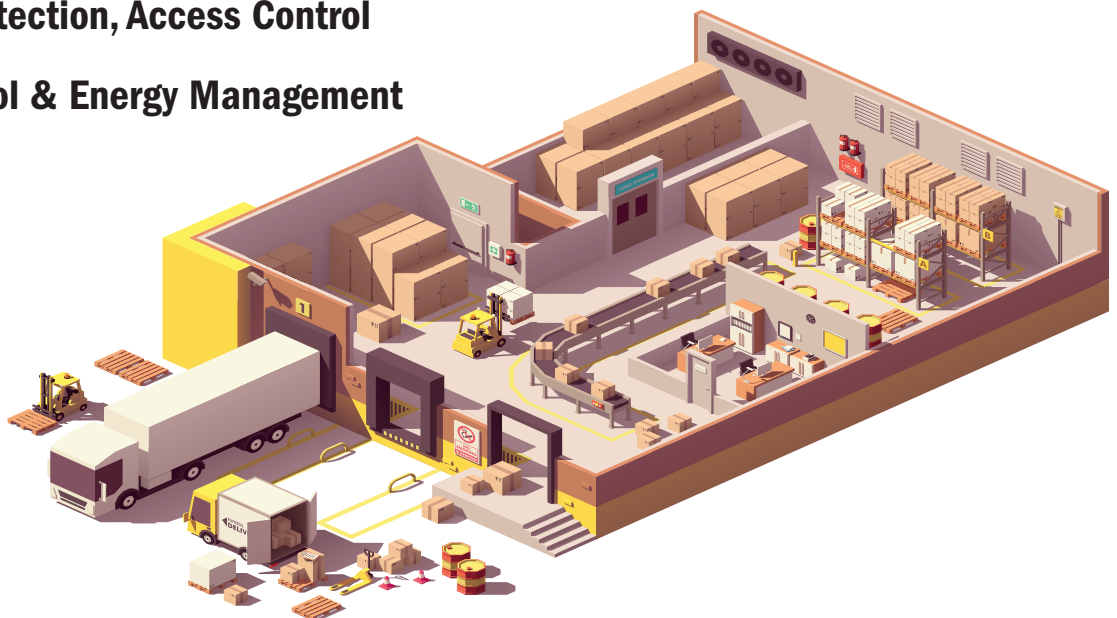
**Security, Detection, Access Control**



**HVAC Control & Energy Management**



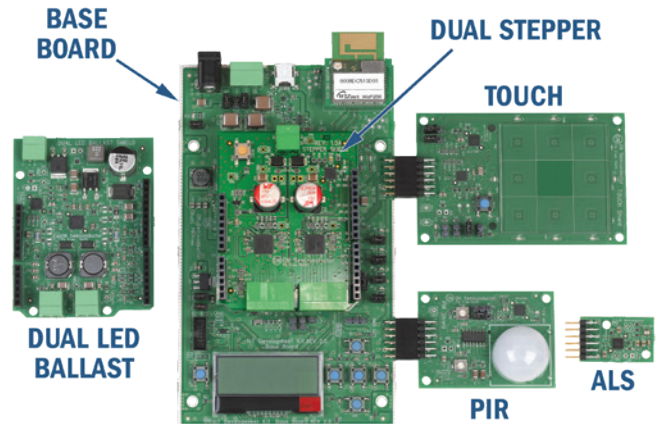
**Lighting**



## IoT Development Kit

### Features

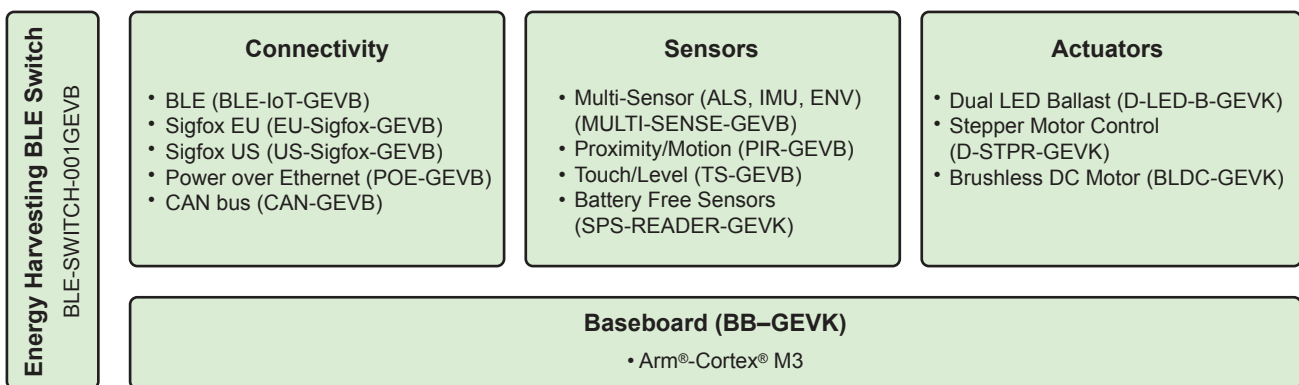
- Comprehensive portfolio of sensors, connectivity and actuators
- ARM-Cortex® M3 Processor, ARM Mbed Operating System
- Eclipse based IDE with 40+ IoT use case examples
- Secure Cloud Connectivity (AWS, IBM, Azure, Google Cloud, etc.)
- Mobile Application for Bluetooth Low Energy use cases
- Detailed documentation of system hardware (BoM, schematics and layout files) and software design



### Markets & Applications



### Modules

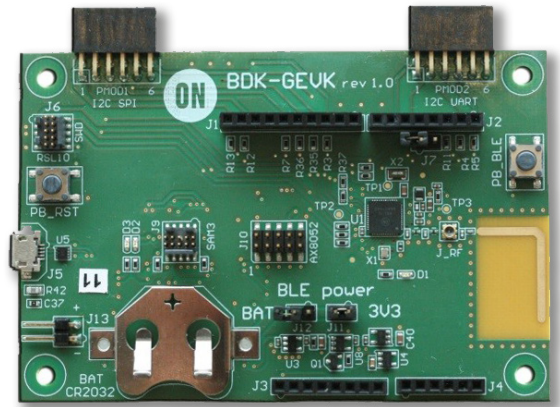




## Bluetooth IoT Development Kit

### Features

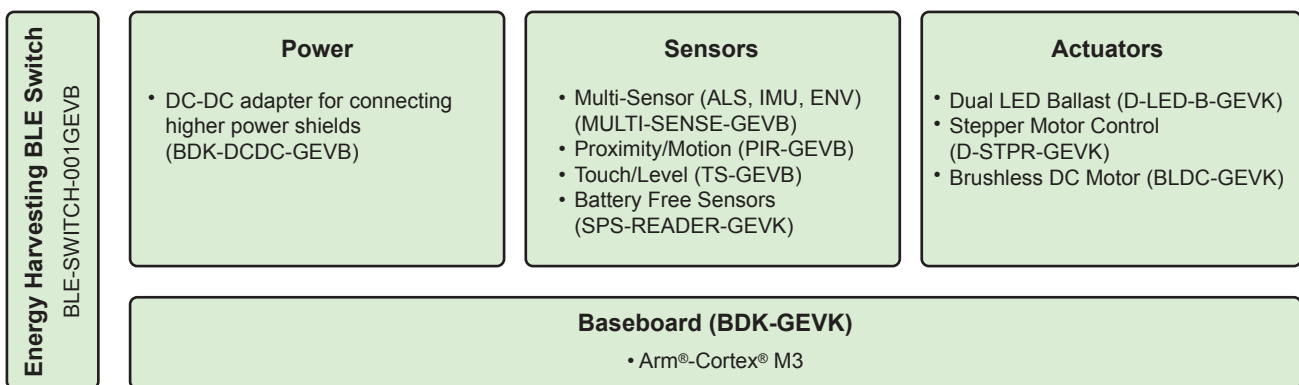
- Features Industry's Lowest Power Bluetooth 5 radio
  - 62.5 nW Deep Sleep
  - 7 mW Peak Receiving
- Configurable mobile application supporting cloud connectivity
  - Compatible with AWS, Azure, Bluemix or custom cloud services
- Ready-to-Use Sample Code
- Easily Connect to Other IoT Development Kit Shield Boards
  - Complete range of options for sensing (proximity, motion, touch), and control (dual LED, stepper motor, brushless DC)



### Markets & Applications



### Modules



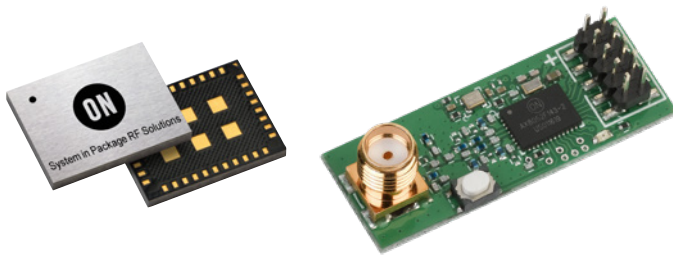


## Comprehensive Sigfox™ Solutions



### Product Features

- ON Semiconductor is a leading Sigfox device supplier
- Sigfox verified solution for all global Sigfox regions
- Reference designs are Sigfox verified and the design files are available for hassle-free copy and paste replication
- Sigfox solution provided as a modem controlled by AT commands or as a system on chip (SoC) controlled by software API
- Multi-protocol support
- New System-in-Package module for ultra-miniature applications; fully CE certified out of the box



| Device               | AT | API | Sigfox Region     | Frequency (MHz) | GPIO | Package(s) |
|----------------------|----|-----|-------------------|-----------------|------|------------|
| AX-SIP-SFEU-x-yy     | ✓  |     | RC1               | 868             | 10   | SIP-38     |
| AX-SIP-SFEU-API-x-yy |    | ✓   | RC1               | 868             | 10   | SIP-38     |
| AX-SFEU-x-yy         | ✓  |     | RC1               | 868             | 10   | QFN-40     |
| AX-SFEU-API-x-yy     |    | ✓   | RC1               | 868             | 10   | QFN-40     |
| AX-SFUS-x-yy         | ✓  |     | RC2 / RC4 (LATAM) | 902 / 920       | 10   | QFN-40     |
| AX-SFUS-API-x-yy     |    | ✓   | RC2 / RC4 (LATAM) | 902 / 920       | 10   | QFN-40     |
| AX-SFJK-x-yy         | ✓  |     | RC3               | 923             | 10   | QFN-40     |
| AX-SFJK-API-x-yy     |    | ✓   | RC3               | 923             | 10   | QFN-40     |
| AX-SFAZ-x-yy         | ✓  |     | RC4               | 920             | 10   | QFN-40     |
| AX-SFAZ-API-x-yy     |    | ✓   | RC4               | 920             | 10   | QFN-40     |

## Ultra Low Power Radio Solutions

### Sub-GHz Radio Features

- Highly flexible software defined sub-GHz radios for proprietary or standards based networking from 27 MHz to 1.05 GHz
- RadioLab – full featured radio configurator and code generator GUI
- CodeBlocks – full featured software development environment and toolchain with seamless integration of RadioLab and software stacks
- Available as either stand-alone transceivers or combined with MCU (8052 or ARM Cortex M0+) in a SoC
- Multi-protocol support



CONNECTIVITY

### 2.4 GHz Radio Features

- Highly optimized for ultra low power consumption
- Hardware defined IEEE 802.15.4 Radio SoC
- Arm® Cortex®-M3 with 640 kB FLASH and 48 kB RAM
- Advanced power management and security hardware acceleration
- Industry leading receive current of 3.6 mA
- Supports Zigbee®, Thread™, and proprietary (any 802.15.4 software stack)

### RF Transceivers

| Device | Protocol Supported                                      | Frequency (MHz)        | Data Rate (kbps) | Voltage Supply (V) | Power Consumption                    | TX Power (dBm) | RX Sensitivity (dBm) | Package(s) |
|--------|---|------------------------|------------------|--------------------|--------------------------------------|----------------|----------------------|------------|
| AX5043 | EnOcean®, Zigbee, KNX®, M-Bus, 802.15.4(g), Proprietary | 27 - 1050              | 0.1 - 125        | 1.8 - 3.6          | RX 6.5 - 9.5 mA<br>TX 7.5 mA @ 0 dBm | 16             | -137 @ 0.1 kbps      | QFN-28     |
| AX5243 |   | 27 - 1050              | 0.1 - 125        | 1.8 - 3.6          | RX 6.5 - 9.5 mA<br>TX 7.5 mA @ 0 dBm | 16             | -137 @ 0.1 kbps      | QFN-20     |
| AX5051 |   | 400 - 470<br>800 - 940 | 1 - 600          | 2.2 - 3.6          | RX 16 - 21 mA<br>TX 13 mA @ 0 dBm    | 16             | -116                 | QFN-28     |
| AX5031 |   | 400 - 470<br>800 - 940 | 1 - 2000         | 2.2 - 3.6          | RX 16 - 21 mA<br>TX 13 mA @ 0 dBm    | 16             | –                    | QFN-20     |

### RF SoCs

| Device     | Protocol Supported                                    | Frequency (MHz)        | Data Rate (kbps) | Peripheral Interface | Flash (kB)     | RAM (kB) | GPIO | Package(s) |
|------------|---|------------------------|------------------|----------------------|----------------|----------|------|------------|
| AX8052F131 | EnOcean, Zigbee, KNX, M-Bus, 802.15.4(g), Proprietary | 400 - 700<br>800 - 940 | 1 - 2000         | Configurable         | 64             | 8        | 21   | QFN-40     |
| AX8052F143 |   | 27 - 1050              | 0.1 - 125        | Configurable         | 64             | 8        | 19   | QFN-40     |
| AX8052F151 |   | 400 - 700<br>800 - 940 | 1 - 600          | Configurable         | 64             | 8        | 21   | QFN-40     |
| AXM0F243   |   | 27 - 1050              | 0.1 - 125        | Configurable         | 64             | 8        | 20   | QFN-40     |
| NCS36510   | Zigbee, Thread, 802.15.4, Proprietary                 | 2400 - 2483            | 250              | Configurable         | 320 x 2 (FOTA) | 48       | 18   | QFN-40     |

## RSL10 Bluetooth® Low Energy Technology Radio SoCs

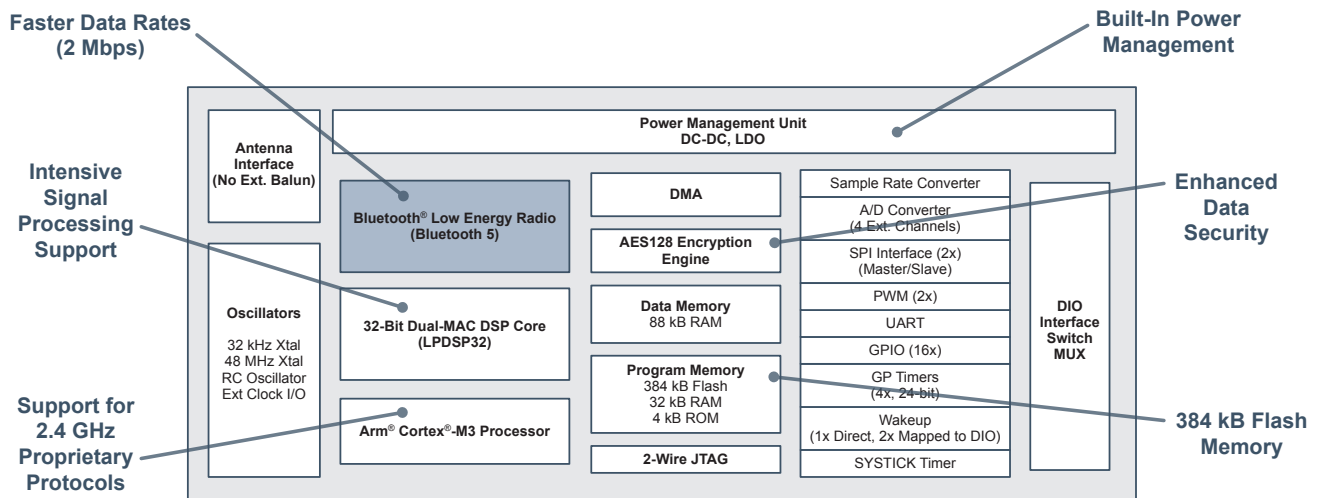
With so many options for wireless available, what sets the RSL10 radio SoC family apart? Simple. It offers the industry's lowest power Bluetooth Low Energy technology. Supporting 2 Mbps data rates provided by Bluetooth 5 (twice the speed as with previous Bluetooth generations), RSL10 enables advanced wireless functionality without compromising battery life. RSL10 can be easily integrated into any device.

### SoC Features

- Industry's lowest power consumption (62 nW in Deep Sleep, 7 mW in Receive Mode)
- Supports Bluetooth Low Energy and 2.4 GHz proprietary protocols
- Flexible Voltage Supply Range (1.1 - 3.3 V)
- IP protection feature
- Available packages WLCSP-51, QFN-48

### SIP Features

- All-in-one solution
- RSL10 radio SoC
- Integrated antenna, filtering, power management, passives
- Fully certified to worldwide regulatory standards
- Bluetooth SIG, FCC (USA), CE (Europe), IC (Canada), KCC (Korea), MIC (Japan)



## Development Tools

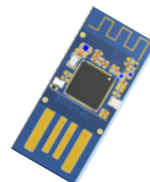
### Software Development Kit (SDK)

- IDE support for Eclipse, Keil, and IAR
- Bluetooth Low Energy protocols, precompiled sample code and libraries, technical documentation
- Support for Bluetooth Mesh networking



### RSL10 Development Board

- Compliance with Arduino form factor
- Integrated PCB antenna
- On-board J-link adapter for easy debugging

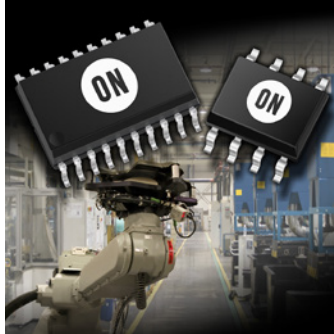


### RSL10 USB Dongle

- Provided with Bluetooth Low Energy Explorer software to help verify or diagnose wireless connections during development

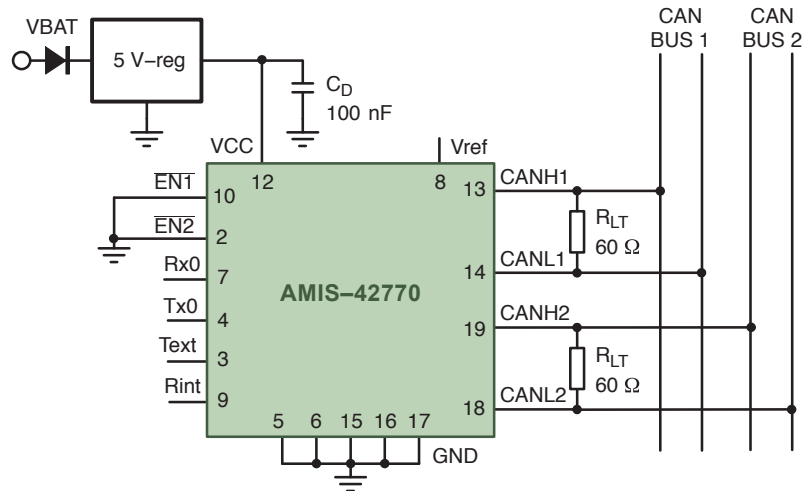


## CAN Transceivers for Long Networks, >500 m



### 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 (s) |
|-----------|--------|--|-------------|
| AMIS42770 | Dual   | High-Speed CAN Repeater                      | SOIC-20     |
| AMIS42670 | Single | High-Speed CAN Transceiver for Long Networks | SOIC-8      |

CONNECTIVITY

## KNX Transceivers

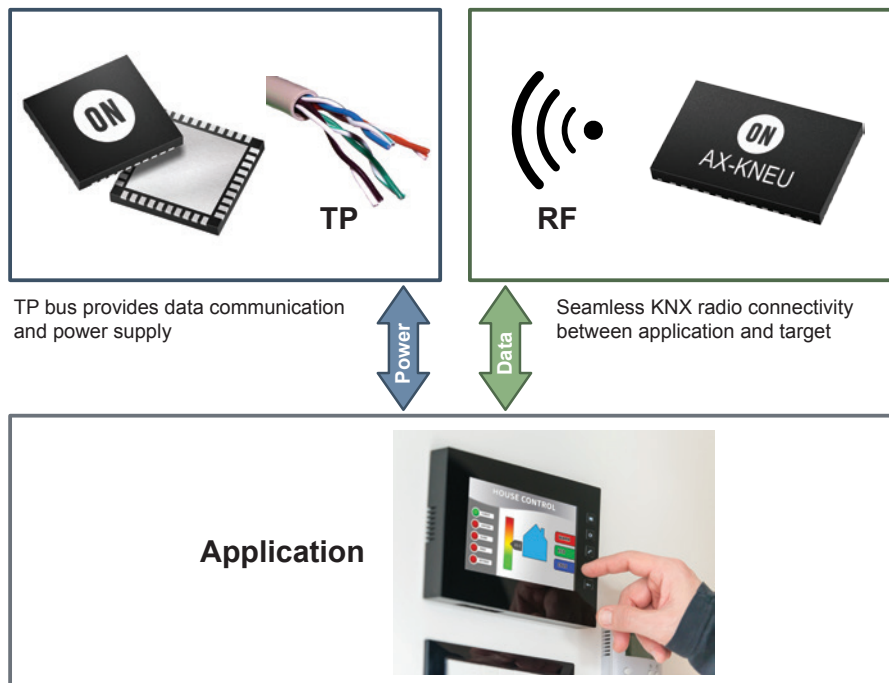
KNX is a standardized (EN 50090, ISO/IEC 14543), OSI-based network communications protocol for intelligent buildings. KNX is the successor to, and convergence of, three previous standards: the European Home Systems Protocol (EHS), BatiBUS, and the European Installation Bus (EIB or Instabus).

### 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                             | ✓          |

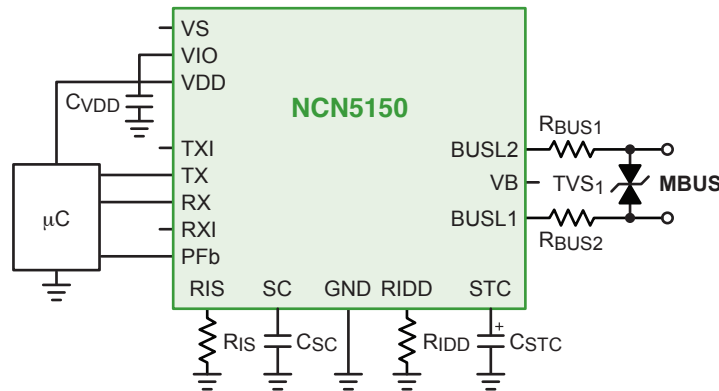
| Twisted Pair                        | NCN5121 | NCN5110 | NCN5130 |
|-------------------------------------|---------|---------|---------|
| Efficiency Increase                 | ✓       | ✓       | ✓       |
| 10/20 mA Bus Current Consumption    | ✓       |         |         |
| 5 to 40 mA Bus Current 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               | ✓       |         | ✓       |



## M-BUS Transceivers

### Wired M-Bus 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

### AX8052F143 Wireless M-Bus System on Chip

- Ultra-low-power AX8052 MCU
- CPU active mode 150 µA/MHz
- Low-power sleep modes with RAM retention
- High performance narrow-band RF transceiver
- Wide frequency range
- Large amount of memory

### Wireless M-Bus Transceivers

- Ultra-low-power
- 50 nA deep sleep current
- 500 nA power-down current
- High sensitivity & selectivity
- -126 dBm @ 1 kbps, 868 MHz, FSK
- Constant Tx output power over VDD = 1.8 - 3.6 V

### M-Bus Transceivers

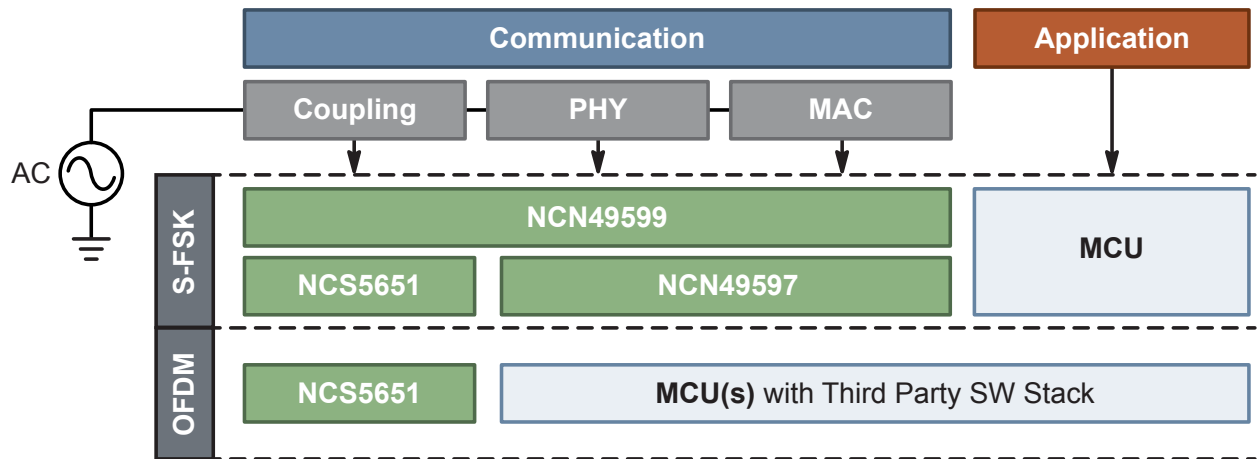
| Device | Frequency (MHz) | Data Rate (kbps) | Voltage Supply (V) | Power Consumption                  | TX Power (dBm) | RX Sensitivity (dBm)                            | Package(s) |
|--------|-----------------|------------------|--------------------|------------------------------------|----------------|---|------------|
| AX5043 | 27 - 1050       | 0.1 - 125        | 1.8 - 3.6          | RX 6.5 - 9.5 mA; TX 7.5 mA @ 0 dBm | 0 to 16        | -133 @ 0.2 kbps; -126 @ 1 kbps; -106 @ 100 kbps | QFN-28     |
| AX5243 | 27 - 1050       | 0.1 - 125        | 1.8 - 3.6          | RX 6.5 - 9.5 mA; TX 7.5 mA @ 0 dBm | 0 to 16        | -135 @ 0.1 kbps; -126 @ 1 kbps; -107 @ 100 kbps | QFN-20     |

### M-Bus System on Chip

| Device     | Protocol Supported               | Frequency (MHz) | Data Rate (kbps) | Peripheral Interface | Flash (kB) | RAM (kB) | GPIO | Package(s) |
|------------|----------------------------------|-----------------|------------------|----------------------|------------|----------|------|------------|
| AX8052F143 | EnOcean, KNX, M-Bus, Proprietary | 27-1050         | 0.1 - 125        | AT command via UART  | 64         | 8        | 19   | QFN-40     |

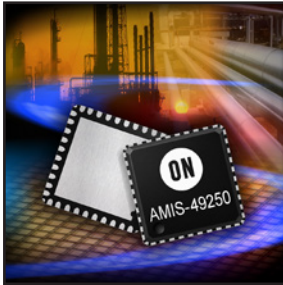


### PLC Modems/Power Line Driver



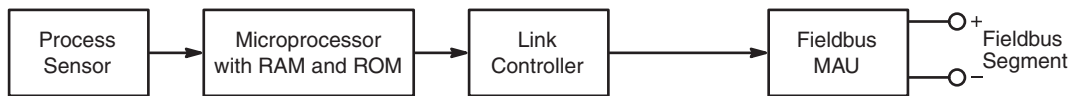
|                  | Device   | Function                    | Features   | Package(s)   |           |
|------------------|----------|-----------------------------|--|--|-----------|
| Smart Grid Modem | NCN49599 | PLC S-FSK Modem; A - D Band | <ul style="list-style-type: none"> <li>ARM Cortex M0</li> <li>Baud rate: 4800 Bauds</li> <li>S-FSK modulation</li> </ul>   | <ul style="list-style-type: none"> <li>Hardware embedded MAC + PHY</li> <li>Embedded 1.2 A, 2-stage power amplifier with current limitation and thermal protection</li> </ul>                                    | QFN-56    |
|                  | NCN49597 | PLC S-FSK Modem; A - D Band | <ul style="list-style-type: none"> <li>ARM Cortex M0</li> <li>Baud rate: 4800 Bauds</li> </ul>   | <ul style="list-style-type: none"> <li>S-FSK modulation</li> <li>Hardware embedded MAC + PHY</li> </ul>  | QFN-52    |
| Power Amplifier  | NCS5651  | Power Line Driver; Class AB | <ul style="list-style-type: none"> <li>Low distortion power line driver with optimized interface for PLC modems</li> <li>Capability to drive 2.0 A peak into reactive loads</li> </ul> | <ul style="list-style-type: none"> <li>Current shutdown minimizes power consumption during power down state</li> <li>Rail-to-Rail Drop of Only <math>\pm 1</math> V with <math>I_{out} = 1.5</math> A</li> </ul> | 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  $\mu$ A typ
- LQFP-44 and NQFP-44 packages

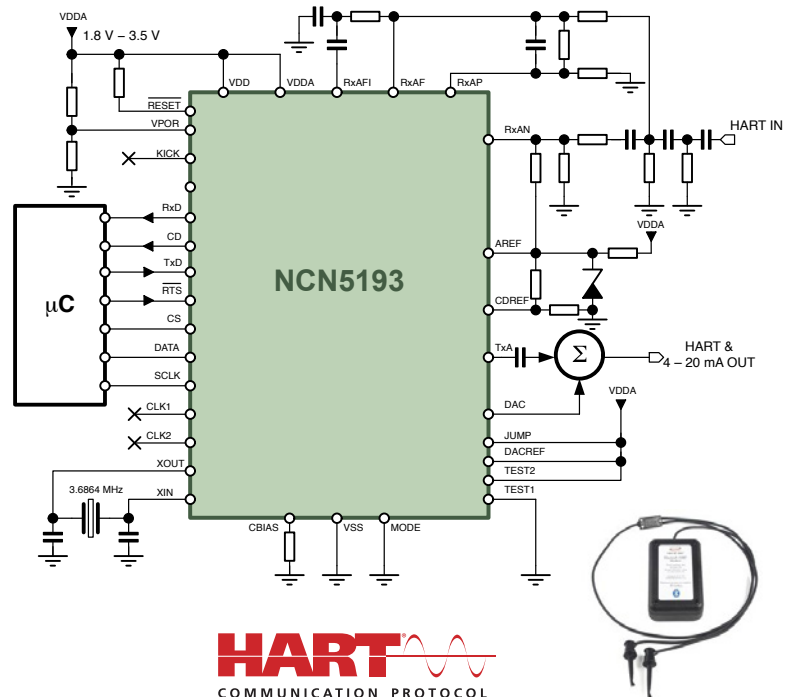


### Industrial HART Protocol Modems

- 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 (s)              |
|----------|--------------------------------|-------------------------------|-----------------|--------------------------|
| 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 |



CONNECTIVITY

## Mainstream CMOS Image Sensors

The mainstream CMOS imaging sensor portfolio from ON Semiconductor provides options for all image sensing industrial solutions, from security cameras to lighting control. With a combination of rolling shutter and global shutter options, you can choose the correct sensor for your end application and know it will have a high quality image for viewing or machine vision.

### Features

- Superior image quality with advanced pixel technology
- Low power for battery operation
- Great low light performance
- Resolution choice, including via capability from VGA to 4K (UHD)

| Device    | Sensor/<br>SOC | Resolution<br>(MP) | Optical<br>Format | Frame Rate               | Pixel Size<br>( $\mu\text{m}$ ) | Shutter Type <sup>1</sup> | CFA         | Operating<br>Temp<br>( $^{\circ}\text{C}$ ) |
|-----------|----------------|--------------------|-------------------|--------------------------|---------------------------------|---------------------------|-------------|---|
| MT9V115   | SOC            | VGA                | 1/13"             | 30 fps                   | 1.75                            | ERS                       | Color       | -30 to +70                                  |
| ASX340CS  | SOC            | VGA                | 1/4"              | 60 fps                   | 5.6                             | ERS                       | Color       | -30 to +70                                  |
| ASX370CS  | SOC            | VGA                | 1/7"              | 30 fps                   | 3.0                             | ERS                       | Color       | -30 to +70                                  |
| MT9V024   | Sensor         | WVGA               | 1/3"              | 60 fps                   | 6.0                             | GS                        | Color, Mono | -40 to +105                                 |
| MT9V034   | Sensor         | WVGA               | 1/3"              | 60 fps                   | 6.0                             | GS                        | Color, Mono | -30 to +70                                  |
| AR0141CS  | Sensor         | 1.2                | 1/4"              | 1.2 45 fps, 720P 60 fps  | 3.0                             | ERS                       | Color       | -30 to +85                                  |
| AR0144CS  | Sensor         | 1                  | 1/4"              | 60 fps                   | 3.0                             | GS                        | Color, Mono | -40 to +85                                  |
| AR0130CS  | Sensor         | 1.2                | 1/3"              | 1.2 45 fps, 720P 60 fps  | 3.75                            | ERS                       | Color, Mono | -30 to +70                                  |
| AR0134CS  | Sensor         | 1.2                | 1/3"              | 1.2 54 fps, 720 60 fps   | 3.75                            | GS                        | Color, Mono | -30 to +70                                  |
| AR0135CS  | Sensor         | 1.2                | 1/3"              | 1.2 60 fps, 720 60 fps   | 3.75                            | GS                        | 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                                  |
| AR0237CS  | Sensor         | 2.1                | 1/2.7"            | 1080P 60 fps             | 3                               | ERS                       | Color       | -30 to +85                                  |
| AR0237IR  | Sensor         | 2.1                | 1/2.7"            | 1080P 60 fps             | 3                               | ERS                       | RGB-IR      | -30 to +85                                  |
| AR0238    | Sensor         | 2.1                | 1/2.7"            | 1080P 60 fps             | 3                               | ERS                       | Color       | -30 to +85                                  |
| AR0239    | Sensor         | 2.1                | 1/2.7"            | 1080P 90 fps             | 3                               | ERS                       | Color       | -30 to +85                                  |
| AR0261    | Sensor         | 2.1                | 1/6"              | 1080P 60 fps             | 1.4                             | ERS                       | Color       | -30 to +70                                  |
| AS0260    | SOC            | 2.1                | 1/6"              | 30 fps                   | 1.4                             | ERS                       | Color       | -30 to +70                                  |
| AR0221    | Sensor         | 2.1                | 1/1.8"            | 60 fps                   | 4.2                             | ERS                       | Color       | -30 to +85                                  |
| AR0330    | Sensor         | 3.5                | 1/3"              | 1080P 60 fps             | 2.2                             | ERS, GRR                  | Color       | -30 to +70                                  |
| AR0430    | Sensor         | 4                  | 1/3"              | 120 fps                  | 2                               | ERS                       | Color       | -30 to +70                                  |
| AR0431    | Sensor         | 4                  | 1/3"              | 120 fps                  | 2                               | ERS                       | Color       | -30 to +70                                  |
| AR0521    | Sensor         | 5                  | 1/2.5"            | 60 fps                   | 2.2                             | ERS                       | Color, Mono | -30 to +85                                  |
| AR0522    | Sensor         | 5                  | 1/2.5"            | 60 fps                   | 2.2                             | ERS                       | Color, Mono | -30 to +85                                  |
| AR01011HS | 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, GRR                  | Color, Mono | -30 to +70                                  |
| AR1337    | Sensor         | 13                 | 1/3.2"            | 13 30 fps, 1080P 60 fps  | 1.1                             | ERS, GRR                  | Color       | -30 to +70                                  |
| AR1630    | Sensor         | 16                 | 1/3"              | 30 fps                   | 1                               | ERS                       | Color       | -30 to +70                                  |
| AR1820HS  | Sensor         | 18                 | 1/2.3"            | 18 24 fps, 1080P 120 fps | 1.25                            | 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

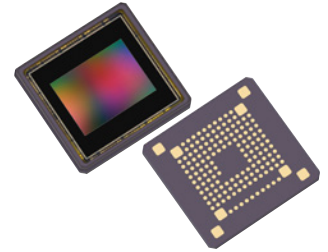
- HDR with ALTM
- Dewarp, up to 165 degrees
- Spatial Transform Engine Software Add-on
- Overlays
- GPIOs, up to 5
- Color Pipe
  - Demosaic
  - Gamma correction
  - Auto white balance
  - Defect correction
  - Noise reduction
  - Auto exposure
  - Flicker detection

| Device   | Resolution (MP) | Frame Rate (fps) | Video                       | Output Format                  | Package(s) |
|----------|-----------------|------------------|-----------------------------|--------------------------------|------------|
| AP0100CS | 1               | 45               | 1.2 MP/45 fps; 720p/60 fps  | NTSC/PAL; YUV                  | VFBGA-100  |
| AP0101CS | 1               | 45               | 1.2 MP/45 fps; 720p/60 fps  | SMPTE 296M; YUV                | VFBGA-81   |
| AP1302   | 13              | 30               | 13 MP/30 fps; 1080p/120 fps | JPEG; RAW; RGB565; RGB888; YUV | VFBGA-120  |

## XGS Global Shutter CMOS Image Sensors

XGS image sensors provide superior global shutter imaging performance with high image uniformity and low noise, enabling them to excel in the most demanding industrial imaging applications. A low power footprint and compact package enable 29 x 29 mm<sup>2</sup> camera designs for resolutions up to 12 megapixels. High frame rates and available speed grades allow imaging performance to be matched to specific applications.

XGS image sensors are members of the X-Class image sensor platform, allowing a single camera design to be leveraged not only in support of multiple product resolutions but also different pixel functionality. This allows camera manufacturers to leverage existing parts inventory and accelerate time to market for new camera designs.



| Device    | Resolution (MPix) | Pixel Count (H x V) | Pixel (μm) | Diagonal (mm) | Lens    | CFA <sup>1</sup> | FPS Max | Evaluation Kit |
|-----------|-------------------|---------------------|------------|---------------|---------|------------------|---------|----------------|
| XGS 8000  | 8.8               | 4096 x 2160         | 3.2        | 14.8          | 1 /1.1" | C/M              | 130     | ✓              |
| XGS 9400  | 9.4               | 3072 x 3072         | 3.2        | 13.9          | 1 /1.1" | C/M              | 90      | ✓              |
| XGS 12000 | 12.6              | 4096 x 3072         | 3.2        | 16.4          | 1"      | C/M              | 87      | ✓              |

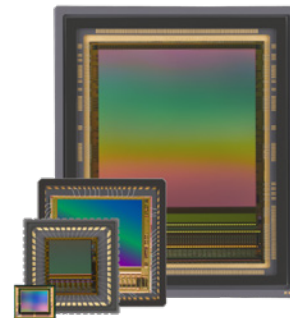
1. CFA Options - Bayer Color (C), Monochrome (M).

## PYTHON Global Shutter CMOS Image Sensors

With resolutions from VGA to 26 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 <sup>1</sup> | FPS Max | Evaluation Kit |
|-------------|-------------------|---------------------|------------|---------------|--------|------------------|---------|----------------|
| PYTHON 300  | 0.3               | 640 x 480           | 4.8        | 3.8           | 1/4"   | C/M/NIR          | 815     | ✓              |
| PYTHON 480  | 0.5               | 800 x 600           | 4.8        | 4.8           | 1/3.6" | C/M              | 120     | ✓              |
| 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 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      | ✓              |

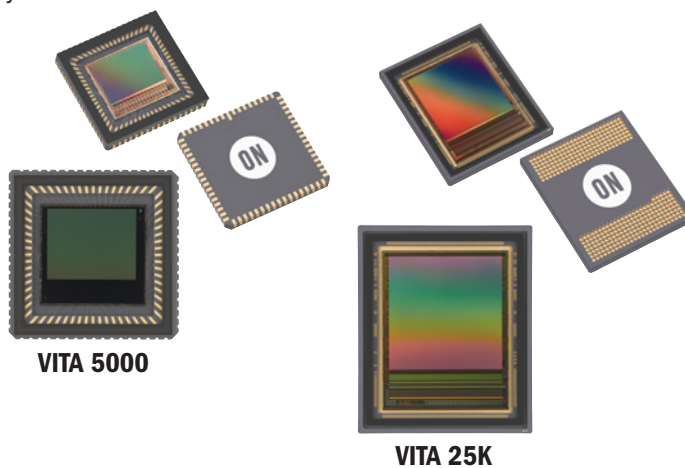
1. CFA Options - Bayer Color (C), Monochrome (M), Enhanced NIR (NIR).

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



VITA 5000

VITA 25K

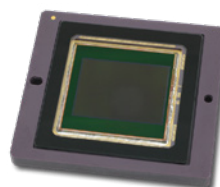
| Device    | Resolution (MPix) | Pixel Count (H x V) | Pixel ( $\mu\text{m}$ ) | Diagonal (mm) | Lens  | CFA <sup>1</sup> | FPS Max |
|-----------|-------------------|---------------------|-------------------------|---------------|-------|------------------|---------|
| VITA 1300 | 1.3               | 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              | 92      |
| 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              | 72      |

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



KAC-12040

| Device    | Resolution (MPix) | Pixel Count (H x V) | Pixel ( $\mu\text{m}$ ) | Diagonal (mm) | Lens | CFA <sup>1</sup> | FPS Max | Evaluation Kit |
|-----------|-------------------|---------------------|-------------------------|---------------|------|------------------|---------|----------------|
| KAC-12040 | 12                | 4000 x 3000         | 4.7                     | 23.5          | 4/3" | C/M              | 70      | ✓              |

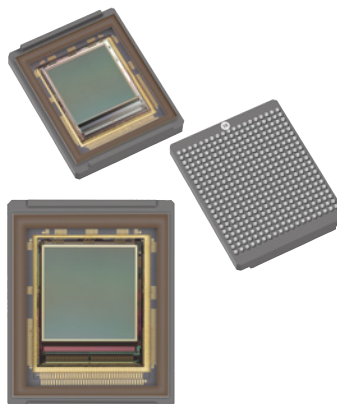
1. CFA Options - Bayer Color (C), Monochrome (M).

## High Speed CMOS Image Sensors

LUPA devices offer global shutter imaging with multiple megapixel resolution 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



**LUPA 3000**

| Device      | Resolution (MPix) | Pixel Count (H x V) | Pixel (μm) | Diagonal (mm) | Lens | CFA <sup>1</sup> | FPS Max |
|-------------|-------------------|---------------------|------------|---------------|------|------------------|---------|
| LUPA 300    | 0.3               | 640 x 480           | 9.9        | 7.9           | 1/2" | C                | 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     |

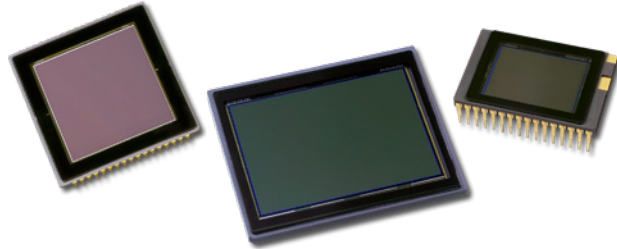
1. CFA Options - Bayer Color (C), Monochrome (M).

## 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 <sup>1</sup> | FPS Max | Evaluation Kit |
|-----------|-------------------|-------------|------------|---------------|----------|------------------|---------|----------------|
| 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-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-09001 | 9.1               | 3024 x 3024 | 12.0       | 51.3          | 645 1.3x | M                | 5.0     |                |
| 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-50100 | 50.1              | 8176 x 6132 | 6.0        | 61.3          | 645 1.1x | M                | 1.0     |                |

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



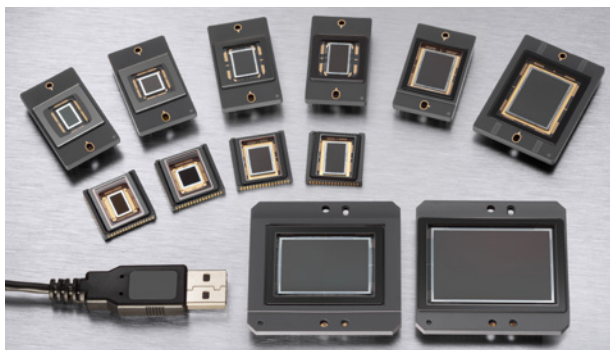


## Interline Transfer CCD Image Sensors

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  $\mu\text{m}$  and 7.4  $\mu\text{m}$  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



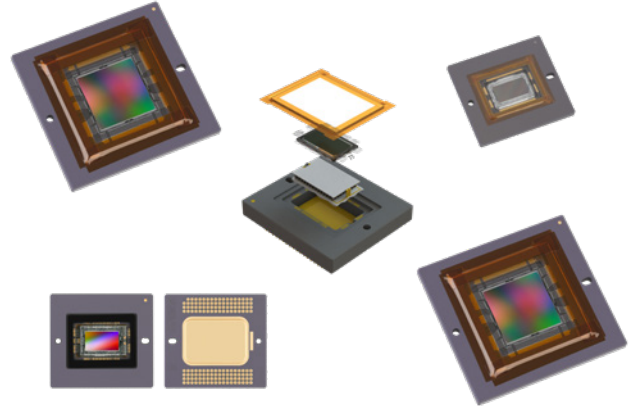
5.5  $\mu\text{m}$  Interline Transfer CCD Image Sensors

| Device                 | Resolution (MPix) | Pixel Count  | Pixel ( $\mu\text{m}$ ) | Diagonal (mm) | Lens     | CFA <sup>1</sup> | FPS Max | Enhanced NIR | Evaluation Kit |
|------------------------|-------------------|--------------|-------------------------|---------------|----------|------------------|---------|--------------|----------------|
| KAI-0340               | VGA               | 640 x 480    | 7.4                     | 5.9           | 1/3"     | C/M              | 210     |              | ✓              |
| KAI-1003               | 1                 | 1024 x 1024  | 12.8                    | 18.5          | 4/3"     | M                | 30      |              | ✓              |
| KAI-1020               | 1                 | 1000 x 1000  | 7.4                     | 10.5          | 2/3"     | C/M              | 50      |              | ✓              |
| KAI-01050 <sup>2</sup> | 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 <sup>2</sup> | 1.9               | 1600 x 1200  | 5.5                     | 11.1          | 2/3"     | C/M              | 68      |              | ✓              |
| KAI-02170 <sup>2</sup> | 2.1               | 1920 x 1080  | 7.4                     | 16.3          | 1"       | C/M/S            | 60      |              | ✓              |
| KAI-02150 <sup>2</sup> | 2.1               | 1920 x 1080  | 5.5                     | 12.1          | 2/3"     | C/M/S            | 64      |              | ✓              |
| KAI-04070 <sup>2</sup> | 4.2               | 2048 x 2048  | 7.4                     | 21.4          | 4/3"     | C/M/S            | 28      |              | ✓              |
| KAI-04050 <sup>2</sup> | 4.1               | 2336 x 1752  | 5.5                     | 16.1          | 1"       | C/M/S            | 32      |              | ✓              |
| KAI-08051 <sup>2</sup> | 8.1               | 3296 x 2472  | 5.5                     | 22.7          | 4/3"     | C/M/S            | 16      |              | ✓              |
| KAI-08052 <sup>2</sup> | 8.1               | 3296 x 2472  | 5.5                     | 22.7          | 4/3"     | C/M/S            | 16      | ✓            | ✓              |
| 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 <sup>2</sup> | 16                | 4896 x 3264  | 5.5                     | 32.4          | APS-H    | C/M/S            | 8       |              | ✓              |
| KAI-16070 <sup>2</sup> | 15.7              | 4864 x 3232  | 7.4                     | 43.2          | 35 mm    | C/M/S            | 8       |              | ✓              |
| KAI-29050 <sup>2</sup> | 28.8              | 6576 x 4384  | 5.5                     | 43.5          | 35 mm    | C/M/S            | 4       |              | ✓              |
| KAI-29052 <sup>2</sup> | 28.8              | 6576 x 4384  | 5.5                     | 43.5          | 35 mm    | C/M/S            | 4       | ✓            | ✓              |
| KAI-43140              | 43.1              | 8040 x 5360  | 4.5                     | 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       |              |                |
| KAI-47052              | 46.8              | 8856 x 5280  | 5.5                     | 56.7          | 645 1.1x | C/M/S            | 7       | ✓            |                |
| KAI-50140              | 50.1              | 10440 x 4800 | 4.5                     | 51.7          | 645 1.3x | C/M              | 3.9     |              |                |

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

## 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. Multiple configurations are available in the family, including options for different resolutions and pixel sizes, light sensitivity, integrated cooling, and sealed or taped cover glass. This flexibility and performance make Interline Transfer EMCCD image sensors ideal for light starved applications such as surveillance, scientific imaging, medical imaging, and intelligent transportation systems.



### Features

- Up to 92 dB dynamic range with sub-electron noise
- Intra-scene switchable gain
- Global shutter image capture
- Excellent image uniformity and MTF

| Device    | Resolution (MPix) | Pixel Count | Pixel (μm) | Diagonal (mm) | Lens | CFA | FPS Max | Enhanced NIR | Evaluation Kit |
|-----------|-------------------|-------------|------------|---------------|------|-----|---------|--------------|----------------|
| KAE-02150 | 2.1               | 1920 x 1080 | 5.5        | 12.1          | 2/3" | C/M | 30      |              | ✓              |
| KAE-02152 | 2.1               | 1920 x 1080 | 5.5        | 12.1          | 2/3" | C/M | 30      | ✓            | ✓              |
| KAE-04471 | 4.4               | 2096 x 2096 | 7.4        | 21.9          | 4/3" | C/M | 15      |              | ✓              |
| KAE-04472 | 4.4               | 2096 x 2096 | 7.4        | 21.9          | 4/3" | C/M | 15      | ✓            | ✓              |
| KAE-08151 | 8.2               | 2856 x 2856 | 5.5        | 22.2          | 4/3" | C/M | 8       |              | ✓              |
| KAE-08152 | 8.2               | 2856 x 2856 | 5.5        | 22.2          | 4/3" | C/M | 8       | ✓            | ✓              |

SENSING

## 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



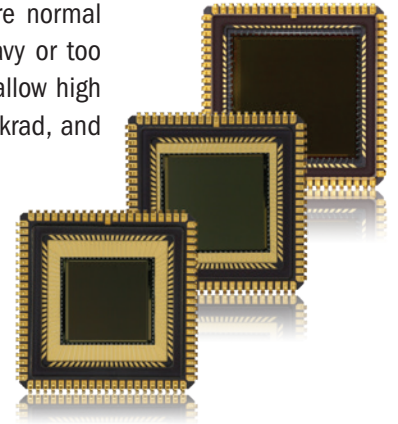
Linear CCD Image Sensors

| Device   | Pixel Count        | Pixel (μm) | Diagonal (mm) | CFA <sup>1</sup> | Evaluation Kit |
|----------|--------------------|------------|---------------|------------------|----------------|
| 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         | ✓              |

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

## Radiation Tolerant Image Sensors

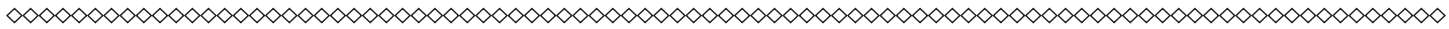
Radiation hardened CMOS images play an important role in high-radiation environments where normal CMOS or CCD imagers cannot survive, and where CRT image tubes are too expensive, too heavy or too large. STAR and HAS image sensors are designed using radiation-tolerant design techniques to allow high tolerance 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

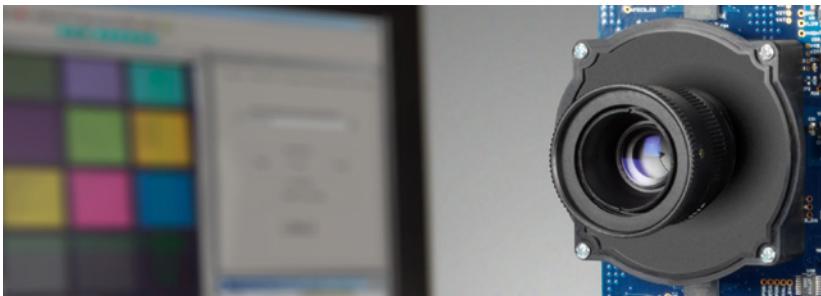
- GNC guidance, navigation, and control applications
- AOCs attitude and orbit control systems
- Nuclear power plant inspection

| 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      |



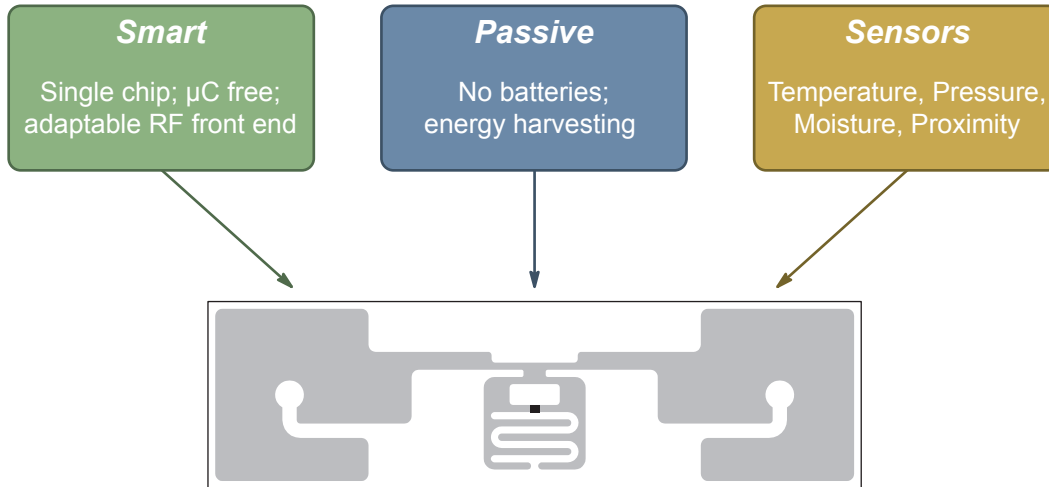
## Evaluation Support

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.



## Battery-Free Wireless Sensors

Introducing the World's First Battery-Free,  $\mu$ C-Free Sensor Tag  
Breakthrough Sensor Technology Implemented on RFID



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

| Device      | Sensing Functions | Sensor Reading Sensitivity  | Surface Placement | Form Factor  |
|-------------|-------------------|---|-------------------|--------------|
| SPS1M001FOM | Moisture          | Low Sensitivity   | Metal             | Flexible PET |
| SPS1M002PET | Moisture          | Low Sensitivity   | Non-Metal         | Flexible PET |
| SPS1F001PET | Fluid Level       | High Sensitivity  | Non-Metal         | Flexible PET |
| SPS1T001PET | Temperature       | 0 to +50°C ( $\pm 0.3^\circ\text{C}$ ) or -40 to 85°C ( $\pm 1^\circ\text{C}$ ) | Non-Metal         | Flexible PET |
| SPS1T001PCB | Temperature       | 0 to +50°C ( $\pm 0.3^\circ\text{C}$ ) or -40 to 85°C ( $\pm 1^\circ\text{C}$ ) | Metal             | Hard Tag PCB |



- High performance, 8 port reader
- USB, Ethernet, and WiFi connectivity
- Fully certified for regulatory compliance
- Options for different geographic regions

SPSPDR1-8 UHF Reader Hub

SENSING

## Capacitive Touch Sensors

*Design-Friendly, Low-Cost Operation, High Reliability*

|                                      |   |  |
|--------------------------------------|---|--|
| • Adhesive free                      | ➔ | • Reduce manufacturing cost and improve reliability by eliminating existing adhesive process |
| • Long sensor trace                  | ➔ | • Provide flexible PCB design  |
| • Wide range operational temperature | ➔ | • Available in high-temperature environment  |
| • No extra components                | ➔ | • Reduce BOM   |
| • High noise immunity                | ➔ | • Improve stability and reliability  |



HMI Applications

SENSING



## Capacitive Touch Sensors

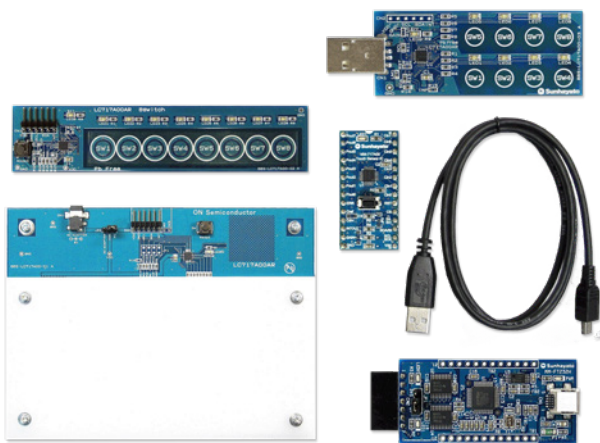
LC717A devices are high performance, cost-effective, and highly usable capacitance converters, for use in touch switch applications. They have 8 or 16 channel capacitance-sensor inputs, and can replace mechanical switches. In particular, the LC717A30 devices have superior sensitivity performance, so it can detect both hands wearing multiple layers of gloves and hands with 15 cm of distance. In addition, it can perform gesture detection.

### Features

- Differential capacitive detection using mutual capacitance
- Capacitance detection down to femtofarad level
- High sensibility performance
- High adaptability – calibration function, noise reduction, wide range temperature operation
- Design friendly – adhesive free, various circuit board design, minimal external components

| Device        | Proximity/Gesture Sensing (cm) | Sensing Inputs | Sensing Outputs | Interface Control | V <sub>DD</sub> (V) | Package(s) |
|---------------|--------------------------------|----------------|-----------------|-------------------|---------------------|------------|
| LC717A00AJ    | 0-10                           | 8              | 8               | SPI / I2C         | 2.6 - 5.5           | SSOP-30    |
| LC717A00AR    | 0-10                           | 8              | 8               | SPI / I2C         | 2.6 - 5.5           | VCT-28     |
| LC717A10AJ/PJ | 0-10                           | 16             | 0               | SPI / I2C         | 2.6 - 5.5           | SSOP-30    |
| LC717A10AR    | 0-10                           | 16             | 0               | SPI / I2C         | 2.6 - 5.5           | VCT-28     |
| LC717A30UJ    | 0-20                           | 8              | 0               | SPI / I2C         | 2.6 - 5.5           | SSOP-30    |
| LC717A30UR    | 0-20                           | 8              | 0               | SPI / I2C         | 2.6 - 5.5           | VCT-28     |

### Evaluation Kits



LC717A00ARGEVK



LC717A30UJGEVK

LC717A30URGEVK Available 1Q19

## Power-Over-Ethernet (PoE) Controllers

for Wireless Access Points, Small Cells, Surveillance Cameras, PoS Terminals, Digital Signage

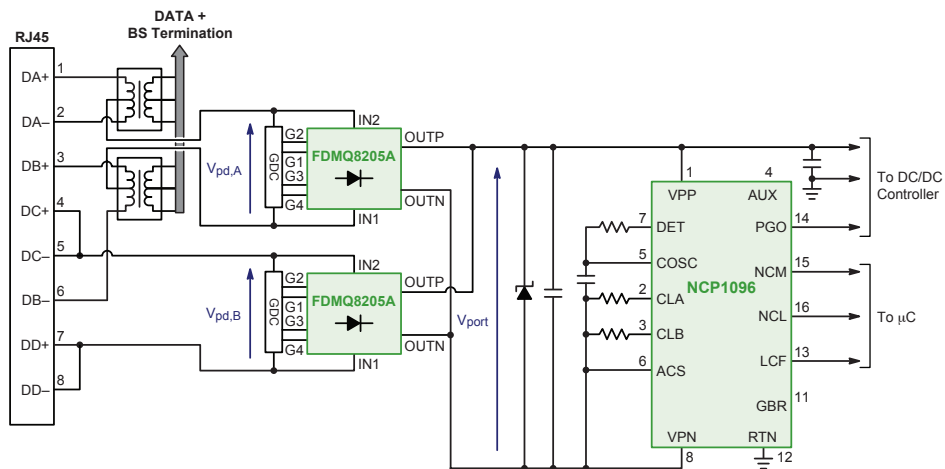
ON Semiconductor offers a complete portfolio of interface controllers for emerging PoE applications. The front-end PD device is compliant with IEEE802.3af, IEEE802.3at, and the new IEEE802.3bt standards, and power is provided using two-pair and four-pair configurations to meet all requirements. The portfolio includes ASSPs PD chips with (NCP108x) and without (NCP109x) integrated PWM controllers, which can convert PoE input power to one or more output voltages in a Powered Device.

### Features – NCP1095, NCP1096

- Fully compliant with new IEEE 802.3bt for high power up to 90 W PoE
- Supports Autoclass
- Integrated low RDS(ON) pass-switch (NCP1096)
- Support for Short MPS
- Pass Switch disabling input for rear auxiliary supply operation
- 135 mA typical inrush current limiting
- Full backward compatibility with IEEE 802.3af/at

### Complete building blocks for a highly efficient PoE Powered Device

- PoE-PD Interface controller – NCP1095, NCP1096
- Active MOSFET bridge – Greenbridge™2 FDMQ8205A
- Downstream DC-DC controller – NCP1566 Active Clamp Forward Converter
- Supplementary discrete components

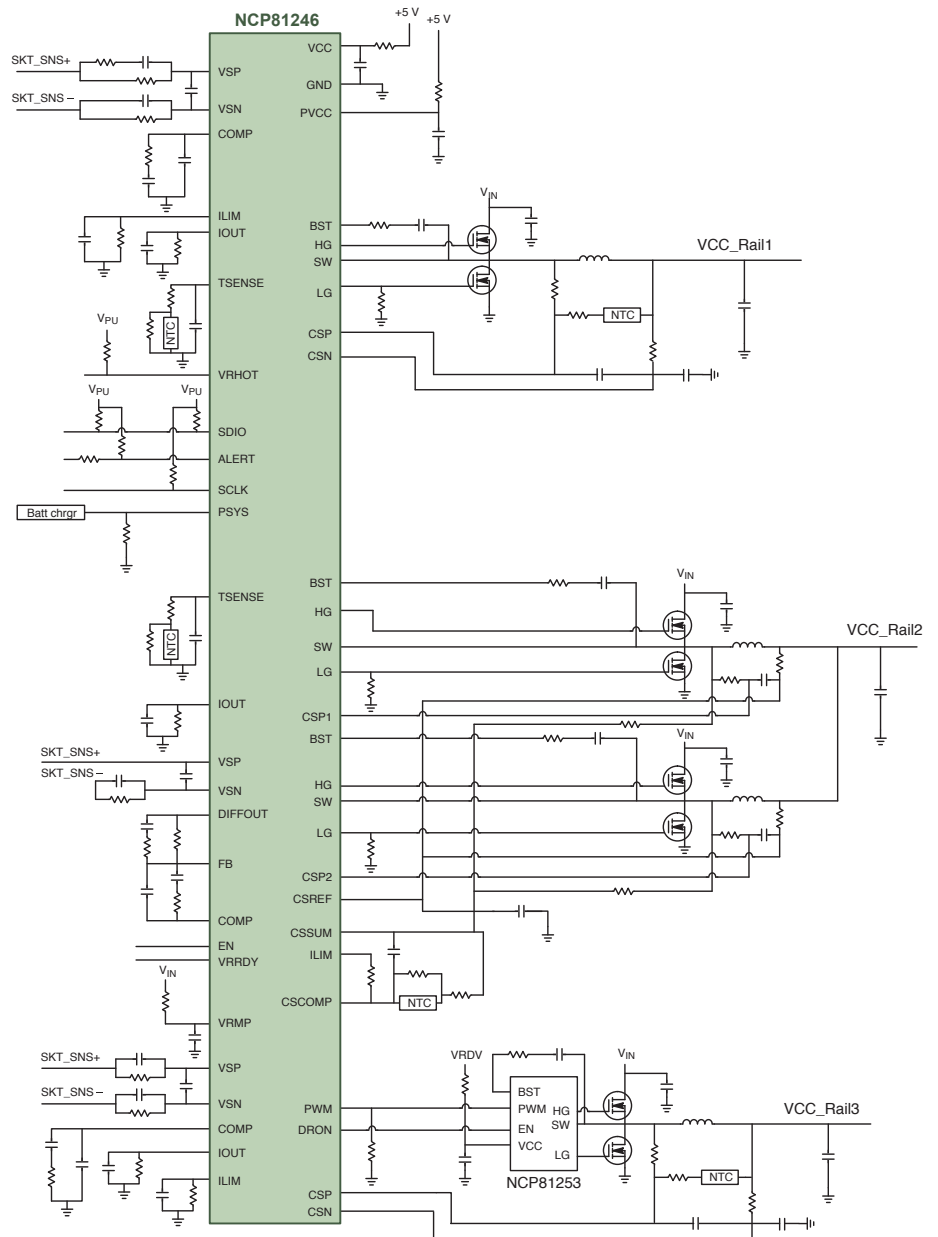


| Device  | Description   | Topology | Control Mode | V <sub>CC</sub> Min (V) | V <sub>CC</sub> Max (V) | P <sub>d</sub> Typ (W) | R <sub>on</sub> Typ (Ω) | Package(s)      |
|---------|---|----------|--------------|-------------------------|-------------------------|------------------------|-------------------------|-----------------|
| NCP1080 | PoE PD Controller and DC-DC Converter                                 | Flyback  | Current      | 0                       | 57                      | 15                     | 0.6                     | TSSOP-20        |
| NCP1081 | PoE PD Controller and DC-DC Converter                                 | Flyback  | Current      | 0                       | 57                      | 40                     | 0.6                     | TSSOP-20        |
| NCP1082 | PoE PD Controller and DC-DC Converter, with Auxiliary Supply Support  | Flyback  | Current      | 0                       | 57                      | 15                     | 0.6                     | TSSOP-20        |
| NCP1083 | PoE PD Controller and DC-DC Converter, with Auxiliary Supply Support  | Flyback  | Current      | 0                       | 57                      | 40                     | 0.6                     | TSSOP-20        |
| NCP1090 | PoE PD Interface Controller   | –        | –            | 0                       | 57                      | 15                     | 0.5                     | SOIC-8, TSSOP-8 |
| NCP1091 | PoE PD Interface Controller with Programmable UVLO                    | –        | –            | 0                       | 57                      | 15                     | 0.5                     | SOIC-8, TSSOP-8 |
| NCP1092 | PoE PD Interface Controller with Vaux Support                         | –        | –            | 0                       | 57                      | 15                     | 0.5                     | SOIC-8, TSSOP-8 |
| NCP1093 | PoE PD Interface Controller   | –        | –            | 0                       | 57                      | 25                     | 0.5                     | DFN-10          |
| NCP1094 | PoE PD Interface Controller with Vaux Support                         | –        | –            | 0                       | 57                      | 25                     | 0.5                     | DFN-10          |
| NCP1095 | 802.3bt PoE PD Interface Controller with External Hot Swap Transistor | –        | –            | 0                       | 57                      | 100                    | –                       | TSSOP-16        |
| NCP1096 | 802.3bt PoE PD Interface Controller with Internal Hot Swap Transistor | –        | –            | 0                       | 57                      | 100                    | 0.07                    | TSSOP-16 EP     |

## IMVP8 Multiphase Controllers for Embedded Applications

### Features

- Dual-edge pulse width modulation
- Single phase RPM mode
- 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



POWER

| Device   | Description                | Driver / MOSFETs          | Package(s) |
|----------|----------------------------|---------------------------|------------|
| NCP81243 | 3 + 2 IMVP8 Controller     |                           | QFN-52     |
| NCP81245 | 3 + 3 + 1 IMVP8 Controller |                           | QFN-52     |
| NCP81246 | 1 + 2 + 1 IMVP8 Controller | 3x Integrated 5 V Drivers | QFN-52     |
| NCP81247 | 4 + 2 IMVP8 Controller     |                           | QFN-52     |
| NCP81248 | 1 + 2 + 1 IMVP8 Controller |                           | QFN-48     |
| NCP81145 | 5 V Driver                 | —                         | DFN-8      |
| NCP81146 | 12 V Driver                | —                         | DFN-8      |

## DC-DC Controllers and Regulators

### DC-DC Regulators

| Device      | Vin (V) |     | Topology                           | Frequency (kHz) | Output Current (A) | Package(s)            |
|-------------|---------|-----|------------------------------------|-----------------|--------------------|-----------------------|
|             | Min     | Max |                                    |                 |                    |                       |
| LM2574      | 4.75    | 40  | Buck                               | 52              | 0.5                | D2PAK, TO-220         |
| LM2594      | 4.75    | 40  | Buck                               | 150             | 0.5                | SOIC-8, PDIP-8        |
| NCP1030     | 10      | 200 | Buck, Boost                        | 300             | 1.0                | Micro8                |
| LM2575      | 4.75    | 40  | Buck                               | 52              | 1.0                | D2PAK, TO-220         |
| LM2595      | 4.75    | 40  | Buck                               | 150             | 1.0                | D2PAK, TO-220         |
| CS51414     | 4.5     | 40  | Buck                               | 260             | 1.5                | SOIC-8                |
| NCP3063     | 3       | 40  | Buck, Boost, Inverting, Buck/Boost | up to 250       | 1.5                | DFN-8, SOIC-8, PDIP-8 |
| NCP3064     | 3       | 40  | Buck, Boost, Inverting, Buck/Boost | up to 250       | 1.5                | DFN-8, SOIC-8, PDIP-8 |
| NCP3065     | 3       | 40  | Buck, Boost, Inverting, Buck/Boost | up to 250       | 1.5                | DFN-8, SOIC-8, PDIP-8 |
| NCP3066     | 3       | 40  | Buck, Boost, Inverting, Buck/Boost | up to 250       | 1.5                | DFN-8, SOIC-8, PDIP-8 |
| MC34063A    | 3       | 40  | Buck, Boost, Inverting, Buck/Boost | up to 100       | 1.5                | DFN-8, SOIC-8, PDIP-8 |
| CS5171/2/3  | 2.7     | 30  | Boost                              | 280/560         | 1.5                | SOIC-8                |
| NCP1595     | 4       | 5.5 | Buck                               | 1200            | 1.5                | DFN-6                 |
| NCP1031     | 10      | 200 | Buck, Boost                        | 300             | 2.0                | Micro8                |
| NCP1597     | 4       | 5.5 | Buck                               | 1200            | 2.0                | DFN-6                 |
| MC34166     | 7.5     | 40  | Step-up/Step-down                  | 72              | 3.0                | D2PAK, TO-220         |
| LM2576      | 4.75    | 40  | Buck                               | 52              | 3.0                | D2PAK, TO-220         |
| LM2596      | 4.75    | 40  | Buck                               | 150             | 3.0                | D2PAK, TO-220         |
| NCP3170     | 4.5     | 18  | Buck                               | 500 / 1000      | 3.0                | SOIC-8                |
| NCP1599     | 2.7     | 5.5 | Buck                               | 1200            | 3.0                | DFN-6, DFN-10         |
| NCP1593     | 4       | 5.5 | Buck                               | 1000            | 3.0                | DFN-10                |
| NCP3133     | 2.9     | 5.5 | Buck                               | 1100            | 3.0                | QFN-16                |
| MC34163     | 2.5     | 40  | Buck, Boost, Inverting, Buck/Boost | up to 100       | 3.4                | SOIC-16, PDIP-16      |
| NCP3163     | 2.5     | 40  | Buck, Boost, Inverting, Buck/Boost | up to 300       | 3.4                | SOIC-16WB, DFN-18     |
| FAN23SV04TA | 7       | 18  | Buck                               | 200-1000        | 4.0                | PQFN-34               |
| NCP1594A    | 2.9     | 6.0 | Buck                               | 500 - 2000      | 4.0                | WQFN-24               |
| MC34167     | 7       | 40  | PWM Step-down                      | 72              | 5.0                | D2PAK, TO-220         |
| NCP3135     | 2.9     | 5.5 | Buck                               | 1100            | 5.0                | QFN-16                |
| NCP3136     | 2.9     | 5.5 | Buck                               | 1100            | 5.0                | QFN-16                |
| NCP4060     | 16      | 80  | Buck                               | 100 - 500       | 6.0                | QFN-20                |
| FAN65004B   | 4.5     | 65  | Buck                               | 100 - 1000      | 6.0                | PQFN-35               |
| FAN2356A    | 4.5     | 24  | Buck                               | 200-1000        | 6.0                | PQFN-34               |
| FAN23SV56A  | 7       | 24  | Buck                               | 200-1000        | 6.0                | PQFN-34               |
| NCP1592     | 3       | 6   | Buck                               | 350/550/280/700 | 6.0                | TSSOP-28 EP           |
| FAN65005A   | 4.5     | 65  | Buck                               | 100 - 1000      | 8.0                | PQFN-35               |
| FAN65008B   | 4.5     | 65  | Buck                               | 100 - 1000      | 10                 | PQFN-35               |
| FAN2360A    | 4.5     | 24  | Buck                               | 200-1000        | 10                 | PQFN-34               |
| FAN23SV60A  | 7       | 24  | Buck                               | 200-1000        | 10                 | PQFN-34               |
| FAN2310A    | 4.5     | 18  | Buck                               | 200-1000        | 10                 | PQFN-34               |
| FAN23SV10MA | 7       | 18  | Buck                               | 200-1000        | 10                 | PQFN-34               |

POWER

## DC-DC Controllers and Regulators

### DC-DC Regulators (cont.)

| Device      | V <sub>in</sub> (V) |     | Topology | Frequency (kHz) | Output Current (A) | Package |
|-------------|---------------------|-----|----------|-----------------|--------------------|---------|
|             | Min                 | Max |          |                 |                    |         |
| FAN2365A    | 4.5                 | 24  | Buck     | 200-1000        | 15                 | PQFN-34 |
| FAN23SV65A  | 7                   | 24  | Buck     | 200-1000        | 15                 | PQFN-34 |
| NCP3232     | 4.5                 | 21  | Buck     | 500             | 15                 | QFN-40  |
| NCP3235     | 4                   | 20  | Buck     | 550             | 15                 | QFN-40  |
| FAN2315A    | 4.5                 | 18  | Buck     | 200-1000        | 15                 | PQFN-34 |
| FAN23SV15MA | 7                   | 18  | Buck     | 200-1000        | 15                 | PQFN-34 |
| FAN23SV70A  | 7                   | 24  | Buck     | 200-1000        | 20                 | PQFN-34 |
| FAN23SV20MA | 7                   | 18  | Buck     | 200-1000        | 20                 | PQFN-34 |
| NCP3233     | 3                   | 16  | Buck     | 300/500/1000    | 20                 | QFN-40  |
| NCP3231     | 4.5                 | 18  | Buck     | 500             | 25                 | QFN-40  |
| NCP3230     | 4.5                 | 18  | Buck     | 500             | 30                 | QFN-40  |

### DC-DC Controllers

| Device     | V <sub>in</sub> (V) |      | Isolated | Frequency (kHz) | Control Mode | Package(s)                 |
|------------|---------------------|------|----------|-----------------|--------------|----------------------------|
|            | Min                 | Max  |          |                 |              |                            |
| NCP1034    | 8                   | 100  | No       | 25 - 500        | Voltage      | SOIC-16                    |
| CS5124     | 7.7                 | 75   | Yes      | 400             | Current      | SOIC-8                     |
| CS51022    | 3.3                 | 72   | Yes      | 200 - 1000      | Current      | SOIC-16, TSSOP-16          |
| CS51221    | 3.3                 | 72   | Yes      | 200 - 1000      | Voltage      | SOIC-16, TSSOP-16          |
| NCP1294    | 3.3                 | 72   | Yes      | 200 - 1000      | Voltage      | SOIC-16, TSSOP-16          |
| TL494      | 7                   | 40   | No       | 40 - 200        | Voltage      | SOIC-16, PDIP-16           |
| TL594      | 7                   | 40   | No       | 40 - 300        | Voltage      | SOIC-16, PDIP-16, TSSOP-16 |
| SG3525     | 8                   | 35   | No       | 100 - 400       | Voltage      | SOIC-16, PDIP-16           |
| NCP3011    | 4.5                 | 28   | No       | 400             | Voltage      | TSSOP-14                   |
| NCP3020A/B | 4.5                 | 28   | No       | 300/600         | Voltage      | SOIC-8                     |
| NCP3030    | 4.7                 | 28   | No       | 1200/2400       | Voltage      | SOIC-8                     |
| NCP81231   | 4.5                 | 28   | No       | 150 - 1200      | Current      | QFN-32                     |
| NCP81239   | 4.5                 | 28   | No       | 150 - 1200      | Current      | QFN-32                     |
| CS51031    | 4.5                 | 16   | No       | 200 - 700       | Hysteretic   | SOIC-8                     |
| NCP1587    | 4.5                 | 13.2 | No       | 275             | Voltage      | SOIC-8                     |





## Rugged Linear Voltage Regulators

### Wide & High Input Voltage LDO Regulators

| Device   | I <sub>o</sub> Typ (mA) | V <sub>in</sub> Max (V) | V <sub>out</sub> (V) | I <sub>q</sub> (μA) | V <sub>DO</sub> | PSRR (dB) | Package (s)                            |
|----------|-------------------------|-------------------------|----------------------|---------------------|-----------------|-----------|--|
| NCP502   | 80                      | 12                      | 1.5 - 5.0            | 40                  | 600 mV (min)    | 55        | TSOP-5, SC-70-5                        |
| NCP3335A | 500                     | 12                      | 1.5 - 5.0, Adj       | 190                 | 340 mV (typ)    | 55        | DFN-10, Micro8                         |
| NCP715   | 50                      | 24                      | 1.2 - 5.3            | 3.2                 | 230 mV (typ)    | 50        | XDFN-6, SC-70-5, TSOP-5                |
| NCP716B  | 150                     | 24                      | 3.0, 3.3, 5.0        | 3.2                 | 700 mV (typ)    | 55        | TSOP-5                                 |
| NCP718   | 300                     | 24                      | 1.2 - 5.0, Adj       | 4                   | 285 mV (typ)    | 60        | TSOT-23-5, WDFN-6                      |
| LP2950   | 100                     | 30                      | 3.0, 3.3, 5.0        | 93                  | 350 mV          | 40        | DPAK-3, TO-92                          |
| LM2931   | 100                     | 40                      | 5.0, Adj             | 400                 | 160 mV (typ)    | 90        | TO-220, DPAK-3, DPAK-5, TO-92, SOT-223 |
| NCP781   | 100                     | 150                     | 3.3, 5.0, 15, Adj    | 25                  | 4 V (typ)       | 83        | DFN-6                                  |
| NCP786L  | 5                       | 450                     | Adj                  | 10                  | —               | 70        | SOT-223                                |
| NCP786A  | 10                      | 450                     | Adj                  | 10                  | —               | 65        | DFN-6                                  |

### High Current LDO Regulators

| Device   | I <sub>o</sub> Typ (A) | V <sub>in</sub> Max (V) | V <sub>out</sub> (V) | I <sub>q</sub> | V <sub>DO</sub> (V) | PSRR (dB) | Package (s)    |
|----------|------------------------|-------------------------|----------------------|----------------|---------------------|-----------|----------------|
| NCP59800 | 1                      | 6.0                     | Adj                  | 60 μA          | 0.2                 | 63        | DFN-8          |
| NCP59748 | 1.5                    | 6.0                     | Adj                  | 1 mA           | 0.06                | 60        | DFN-10, QFN-20 |
| NCP59150 | 1.5                    | 18                      | 1.8 - 5.0, Adj       | 1.2 mA         | 0.3                 | 62        | D2PAK, DFN-8   |
| NCP5662  | 2                      | 18                      | 1.2 - 3.3, Adj       | —              | 1                   | 65        | D2PAK, DFN-8   |
| NCP59749 | 3                      | 6.0                     | Adj                  | 1 mA           | 0.12                | 60        | QFN-20         |
| NCP59744 | 3                      | 6.0                     | Adj                  | 1 mA           | 0.115               | 72        | QFN-20, DFN-10 |
| NCP58300 | 3                      | 18                      | 1.24 - 12.9          | 1.2 mA         | 0.37                | —         | D2PAK          |

### Standard Linear Regulators

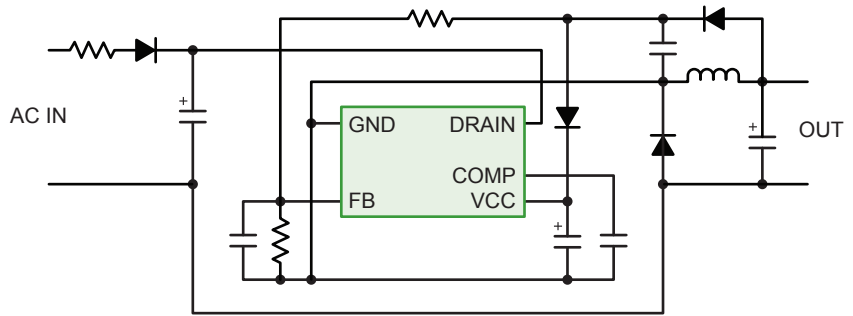
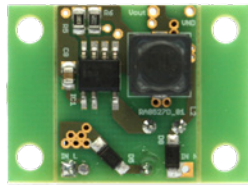
| Device         | I <sub>o</sub> Typ (A) | V <sub>in</sub> Max (V) | V <sub>out</sub> (V)    | V <sub>DO</sub> (V) | Package (s)           |
|----------------|------------------------|-------------------------|-------------------------|---------------------|-----------------------|
| KA78xx, MC78xx | 1                      | 35                      | 5 - 24                  | 2                   | TO-220, DPAK, D2PAK   |
| KA78Rxx        | 1                      | 35                      | 3.3, 5, 8, 9, 12, 15    | 0.5                 | TO-220-4              |
| KA278Rxx       | 2                      | 35                      | 3.3, 5, 12              | 0.5                 | TO-220-4              |
| KA378Rxx       | 3                      | 35                      | 3.3, 5, 12              | 0.5                 | TO-220-4              |
| KA78RH33       | 0.8                    | 15                      | 3.3                     | 1                   | DPAK                  |
| MC78Lxx        | 0.1                    | 30                      | 5, 8, 9, 12, 15, 18, 24 | 1.7                 | TO-92, SOT-89, SOIC-8 |
| NCP1117        | 1                      | 20                      | 1.5 - 12, Adj           | 1.3                 | SOT-223, DPAK         |
| LM317          | 1.5                    | 40                      | Adj                     | 2.2                 | TO-220, D2PAK         |

## Compact Power Delivery with Switching Regulators

### NCP10671 Small Form Factor Buck Converter

#### Features

- Low standby power
- Complete portfolio for 1 - 50 W
- Integrated controller and MOSFETs



NCP10671 Non-Isolated Application

| Device     | P <sub>OUT</sub> (W) | I <sub>LIMIT</sub> (mA) | Topology                          | BV <sub>DS</sub> (V) | R <sub>DS(ON)</sub> Max (Ω) | Frequency Options (kHz) | Brown-In/Out | Line OVP | Fsw Foldback | Dynamic Self Supply | Package(s)      |
|------------|----------------------|-------------------------|-----------------------------------|----------------------|-----------------------------|-------------------------|--------------|----------|--------------|---------------------|-----------------|
| NCP10670   | 1.5                  | 100                     | Buck/Non-isolated Flyback/Flyback | 700                  | 41                          | 60,100                  | No           | No       | No           | Yes                 | SOIC-7          |
| NCP10671   | 3.7                  | 250                     | Buck/Non-isolated Flyback/Flyback | 700                  | 41                          | 60,100                  | No           | No       | No           | Yes                 | SOIC-7          |
| NCP10672   | 7.8                  | 780                     | Buck/Non-isolated Flyback/Flyback | 700                  | 14                          | 60,100                  | No           | No       | No           | Yes                 | SOIC-7          |
| NCP1060    | 4                    | Adj.                    | Buck/Non-isolated Flyback/Flyback | 700                  | 41                          | 60,100                  | Yes          | No       | Yes          | Yes                 | SOIC-10, PDIP-7 |
| NCP1063    | 11                   | Adj.                    | Buck/Non-isolated Flyback/Flyback | 700                  | 14                          | 60,100                  | Yes          | No       | Yes          | Yes                 | PDIP-7, SOIC-16 |
| NCP1070    | 4                    | 250                     | Flyback                           | 700                  | 32                          | 65, 100, 130            | Yes          | No       | Yes          | Yes                 | SOT-223, PDIP-7 |
| NCP1071    | 5                    | 350                     | Flyback                           | 700                  | 32                          | 65, 100, 130            | Yes          | No       | Yes          | Yes                 | SOT-223, PDIP-7 |
| NCP1072    | 11                   | 350                     | Flyback                           | 700                  | 16                          | 65, 100, 130            | Yes          | No       | Yes          | Yes                 | SOT-223, PDIP-7 |
| NCP1075A/B | 15                   | 350                     | Flyback                           | 700                  | 17                          | 65, 100, 130            | Yes          | Yes      | Yes          | Yes                 | PDIP-7          |
| NCP1076A/B | 20                   | 650                     | Flyback                           | 700                  | 6.8                         | 65, 100, 130            | Yes          | Yes      | Yes          | Yes                 | PDIP-7          |
| NCP1077A/B | 20                   | 850                     | Flyback                           | 700                  | 6.8                         | 65, 100, 130            | Yes          | Yes      | Yes          | Yes                 | PDIP-7          |
| NCP1079A/B | 30                   | 1050                    | Flyback                           | 700                  | 3.9                         | 65, 100, 130            | Yes          | Yes      | Yes          | Yes                 | PDIP-7          |
| FSL106     | 10                   | Adj.                    | Flyback                           | 650                  | 20                          | 67, 100                 | No           | No       | No           | No                  | PDIP-8          |
| FSL116     | 14                   | Adj.                    | Flyback                           | 650                  | 10                          | 50, 100                 | No           | No       | No           | No                  | PDIP-8          |
| FSL126     | 17                   | Adj.                    | Flyback                           | 650                  | 6                           | 67, 100                 | No           | No       | No           | No                  | PDIP-8          |
| FSL136     | 20                   | Adj.                    | Flyback                           | 650                  | 4                           | 67, 100                 | No           | No       | No           | No                  | PDIP-8, LSOP-8  |
| FSL146     | 26                   | Adj.                    | Flyback                           | 650                  | 2.6                         | 67                      | No           | No       | No           | No                  | PDIP-8          |
| FSL156     | 30                   | Adj.                    | Flyback                           | 650                  | 2.2                         | 67                      | No           | No       | No           | No                  | PDIP-8          |
| FSL117     | 10                   | 800                     | Flyback                           | 700                  | 10                          | 67                      | No           | No       | No           | No                  | PDIP-8          |
| FSL137     | 20                   | 1300                    | Flyback                           | 700                  | 4.75                        | 67                      | No           | No       | No           | No                  | PDIP-8          |
| FSL126MRT  | 25                   | 1200                    | Flyback                           | 650                  | 6                           | 67                      | No           | No       | No           | No                  | TO-220F6        |
| FSL136MRT  | 35                   | 2150                    | Flyback                           | 650                  | 4                           | 67                      | No           | No       | No           | No                  | TO-220F6        |
| FSL176MRT  | 70                   | 3500                    | Flyback                           | 650                  | 1.6                         | 67                      | No           | No       | No           | No                  | TO-220F6        |
| FSL128MRT  | 25                   | 1200                    | Flyback                           | 800                  | 7.3                         | 67                      | No           | No       | No           | No                  | TO-220F6        |
| FSL138MRT  | 35                   | 2150                    | Flyback                           | 800                  | 5                           | 67                      | No           | No       | No           | No                  | TO-220F6        |
| FSL306     | 7                    | Adj.                    | Buck/Non-isolated Flyback/Flyback | 650                  | 18                          | 50                      | No           | No       | Yes          | Yes                 | PDIP-7, LSOP-7  |
| FSL336     | 20                   | Adj.                    | Buck/Non-isolated Flyback/Flyback | 650                  | 4                           | 50                      | No           | No       | Yes          | Yes                 | PDIP-7, LSOP-7  |
| FSL337     | 20                   | Adj.                    | Buck/Non-isolated Flyback/Flyback | 700                  | 4                           | 50                      | No           | No       | Yes          | Yes                 | PDIP-7, LSOP-7  |
| FSL4110    | 9                    | 520                     | Flyback                           | 1000                 | 10                          | 50                      | No           | Yes      | No           | Yes                 | PDIP-7, LSOP-7  |
| FSL518A/H* | 12                   | 460/600                 | Flyback                           | 800                  | 8                           | 100, 130                | Yes          | Yes      | Yes          | Yes                 | PDIP-7          |
| FSL538A/H* | 17                   | 660/860                 | Flyback                           | 800                  | 4.6                         | 100, 130                | Yes          | Yes      | Yes          | Yes                 | PDIP-7          |

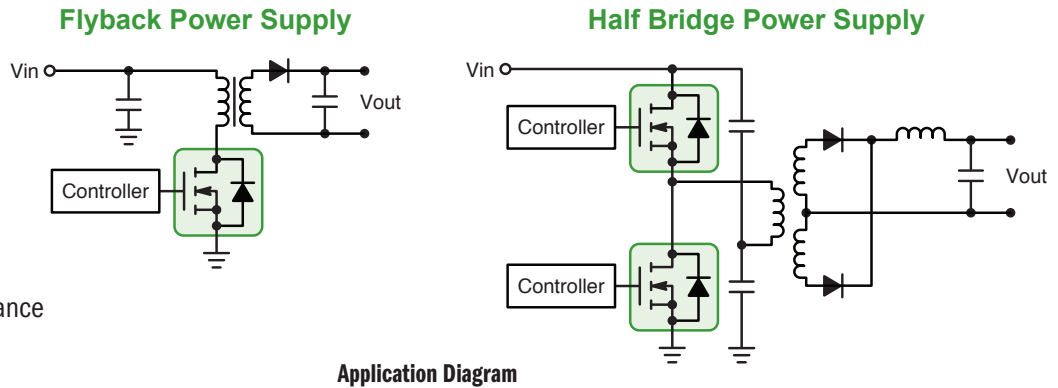
\* Pending 3Q19.

POWER

## Power MOSFETs for AC Drive

### Features

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



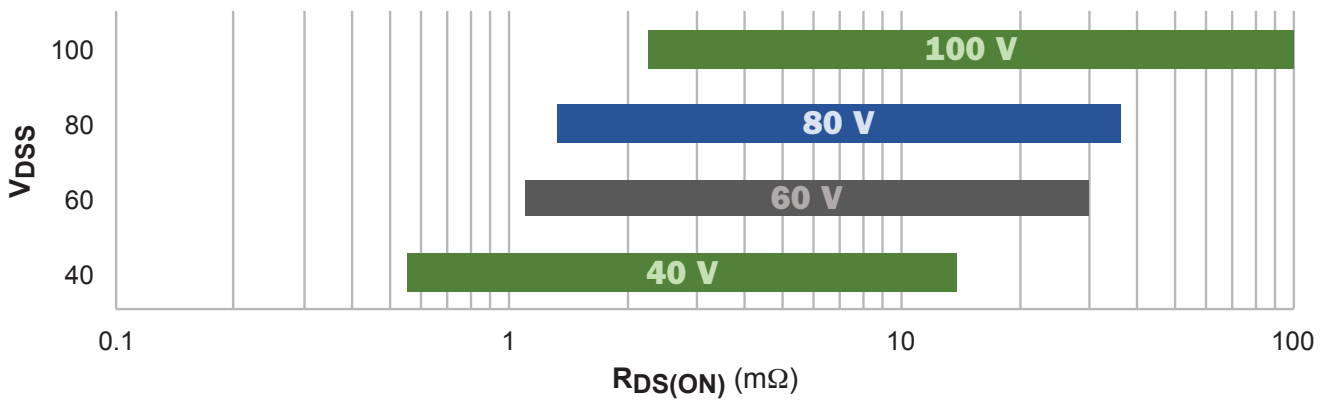
| Source Voltage | Device      | $V_{DSS}$ (V) | $I_D$ (A) | $R_{DS(on)}$ @ 10 V |                  | $C_{iss}$ (pF) | $Q_g$ (nC) | Package(s) |
|----------------|-------------|---------------|-----------|---------------------|------------------|----------------|------------|------------|
|                |             |               |           | Typ ( $\Omega$ )    | Max ( $\Omega$ ) |                |            |            |
| -240 Vac       | BFL4026     | 900           | 5         | 2.8                 | 3.6              | 650            | 33         | TO-220F    |
| 380 to 480 Vac | 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) | $R_{DS(ON)}$ @ 10 V Max (m $\Omega$ ) | $Q_g(TOT)$ (nC) | Package(s)          |
|---------------|---------|---------------|---------------------------------------|-----------------|---------------------|
| BMS3004       | P       | -75           | 8.5                                   | 300             | TO-220F-3SG (SC-67) |
| SMP3003       | P       | -75           | 8                                     | 280             | TO-263              |
| NTMFS6H800N   | N       | 80            | 2.1                                   | 85              | S0-8FL (DFN-5)      |
| FDMT1D3N08B   | N       | 80            | 1.35                                  | 186             | PQFN-8 (Power88)    |
| FDBL0150N80   | N       | 80            | 1.4                                   | 172             | TO-LL (H-PSOF)      |
| FDB0190N807L  | N       | 80            | 1.9                                   | 178             | D2-PAK7L (TO-263)   |
| NTMFS10N3D2C  | N       | 100           | 3.2                                   | 60              | PQFN-8              |
| FDB1D7N10CL7  | N       | 100           | 1.7                                   | 116             | D2-PAK7L (TO-263)   |
| FDBL0200N100  | N       | 100           | 2                                     | 95              | TO-LL (H-PSOF)      |
| FDBL0630N150  | N       | 150           | 6.3                                   | 70              | TO-LL (H-PSOF)      |
| FDB0630N1507L | N       | 150           | 6.3                                   | 97              | D2-PAK7L (TO-263)   |

## Power MOSFETs for Motor Control

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



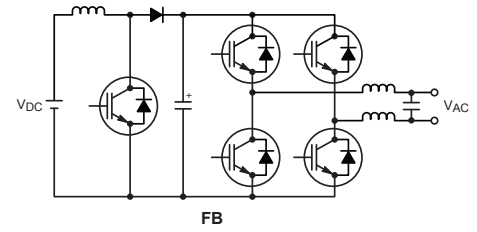
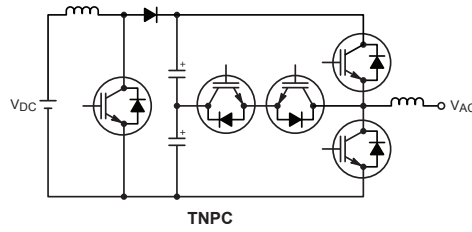
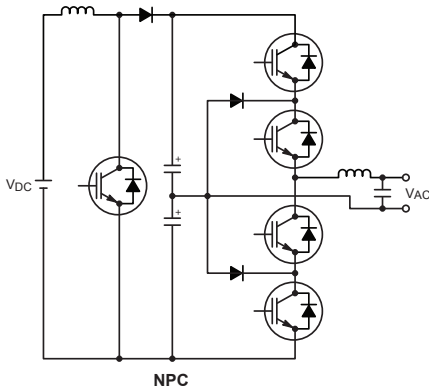
### N-Channel Power MOSFETs

| Device        | Type        | $V_{DS}$ (V) | $R_{DS(ON)}$ (mΩ) | $Q_G(TOT)$ (nC) | Package(s)         |
|---------------|-------------|--------------|-------------------|-----------------|--------------------|
| FDBL0065N40   | Single      | 40           | 0.65              | 220             | TO-LL (H-PSOF)     |
| FDBL0110N60   | Single      | 60           | 1.1               | 170             | TO-LL (H-PSOF)     |
| FDBL0150N80   | Single      | 80           | 1.4               | 172             | TO-LL (H-PSOF)     |
| FDBL0200N100  | Single      | 100          | 2                 | 95              | TO-LL (H-PSOF)     |
| FDBL0630N150  | Single      | 150          | 6.3               | 70              | TO-LL (H-PSOF)     |
| FDB0105N407L  | Single      | 40           | 0.8               | 208             | D2-PAK 7L (TO-263) |
| FDB0170N607L  | Single      | 60           | 1.4               | 173             | D2-PAK 7L (TO-263) |
| FDB0165N807L  | Single      | 80           | 1.6               | 217             | D2-PAK 7L (TO-263) |
| FDB1D7N10CL7  | Single      | 100          | 1.7               | 116             | D2-PAK 7L (TO-263) |
| FDB0630N1507L | Single      | 150          | 6.4               | 97              | D2-PAK 7L (TO-263) |
| FDMD85100     | Half Bridge | 100          | 9.9               | 22              | PQFN-8             |
| FDMD8580      | Half Bridge | 80           | 4.6               | 57              | PQFN-8             |
| FDMD8560L     | Half Bridge | 60           | 3.2               | 92              | PQFN-8             |
| FDMD8540L     | Half Bridge | 40           | 1.5               | 81              | PQFN-8             |
| FDMD82100     | Half Bridge | 100          | 19                | 12              | PQFN-12            |
| FDMD8280      | Half Bridge | 80           | 8.2               | 31              | PQFN-12            |
| FDMD8260L     | Half Bridge | 60           | 5.8               | 49              | PQFN-12            |
| FDMD8240L     | Half Bridge | 40           | 2.6               | 40              | PQFN-12            |

| Device        | Type   | $V_{DS}$ (V) | $R_{DS(ON)}$ (mΩ) | $Q_G(TOT)$ (nC) | Package(s)       |
|---------------|--------|--------------|-------------------|-----------------|------------------|
| NTMFS5C404NLT | Single | 40           | 0.67              | 181             | SO-8FL (DFN-5)   |
| NTMFS5C604NL  | Single | 60           | 1.2               | 52              | SO-8FL (DFN-5)   |
| NTMFS6H800N   | Single | 80           | 2.2               | 82              | SO-8FL (DFN-5)   |
| FDMS86180     | Single | 100          | 3.2               | 60              | Power56          |
| FDMC8360L     | Single | 40           | 2.1               | 57              | Power33          |
| NTTFS5C453NL  | Single | 40           | 3                 | 35              | u8FL             |
| FDMC86570L    | Single | 60           | 4.3               | 63              | Power33          |
| FDMC86340     | Single | 80           | 6.5               | 38              | Power33          |
| FDMC86184     | Single | 100          | 8.5               | 21              | Power33          |
| FDMT80040DC   | Single | 40           | 0.56              | 241             | PQFN-8 (Power88) |
| FDMT80060DC   | Single | 60           | 1.1               | 170             | PQFN-8 (Power88) |
| FDMT80080DC   | Single | 80           | 1.35              | 195             | PQFN-8 (Power88) |
| FDMT800100DC  | Single | 100          | 2.95              | 79              | PQFN-8 (Power88) |
| FDMT800120DC  | Single | 120          | 4.2               | 76              | PQFN-8 (Power88) |
| FDMT800150DC  | Single | 150          | 6.5               | 77              | PQFN-8 (Power88) |

POWER

## IGBTs for UPS and Solar



### IGBT Features for UPS and Solar

- High figure of merit
- Low  $T_{rr}/Q_{rr}$  soft diode
- Fast switching
- $T_{jmax} = 175^{\circ}C$

| Device           | V <sub>CEs</sub> (V) | I <sub>C</sub> @ T <sub>C</sub> = 100 °C (A) | V <sub>CE(sat)</sub> (V) | E <sub>off</sub> (mJ)                                   | Co-Packaged Diode | I <sub>F</sub> @ T <sub>C</sub> = 100 °C (A) | Package(s) |
|------------------|----------------------|--|--------------------------|---|-------------------|--|------------|
| FGA30T65SHD      | 650                  | 30   | 1.60                     | 0.167 @ I <sub>C</sub> = 30 A, R <sub>G</sub> = 6 Ω     | Yes               | 20   | TO-3P      |
| NGTG35N65FL2     | 650                  | 35   | 1.70                     | 0.28 @ I <sub>C</sub> = 35 A, R <sub>G</sub> = 10 Ω     | No                |  | TO-247     |
| FGA40T65SHD      | 650                  | 40   | 1.60                     | 0.297 @ I <sub>C</sub> = 40 A, R <sub>G</sub> = 6 Ω     | Yes               | 20   | TO-3P      |
| FGH40T65SQD      | 650                  | 40   | 1.60                     | 0.084 @ I <sub>C</sub> = 20 A, R <sub>G</sub> = 6 Ω     | Yes               | 20   | TO-247     |
| AFGHL50T65SQDC   | 650                  | 50   | 1.60                     | 0.0452 @ I <sub>C</sub> = 50 A, R <sub>G</sub> = 4.7 Ω  | Yes               | 20   | TO-247     |
| NGTB50N65FL2WAG  | 650                  | 50   | 1.80                     | 0.55 @ I <sub>C</sub> = 50 A, R <sub>G</sub> = 10 Ω     | Yes               | 50   | TO-247 4L  |
| NGTB50N65FL2     | 650                  | 50   | 1.80                     | 0.46 @ I <sub>C</sub> = 50 A, R <sub>G</sub> = 10 Ω     | Yes               | 50   | TO-247     |
| FGA50T65SHD      | 650                  | 50   | 1.60                     | 0.384 @ I <sub>C</sub> = 50 A, R <sub>G</sub> = 6 Ω     | Yes               | 30   | TO-3P      |
| FGH50T65SQD      | 650                  | 50   | 1.60                     | 0.088 @ I <sub>C</sub> = 25 A, R <sub>G</sub> = 4.7 Ω   | Yes               | 30   | TO-247     |
| FGH60T65SQD      | 650                  | 60   | 1.60                     | 0.61 @ I <sub>C</sub> = 60 A, R <sub>G</sub> = 6 Ω      | Yes               | 30   | TO-247     |
| NGTB60N65FL2     | 650                  | 60   | 1.64                     | 0.66 @ I <sub>C</sub> = 60 A, R <sub>G</sub> = 10 Ω     | Yes               | 60   | TO-247     |
| FGH75T65SQD      | 650                  | 75   | 1.60                     | 0.181 @ I <sub>C</sub> = 37.5 A, R <sub>G</sub> = 4.7 Ω | Yes               | 50   | TO-247     |
| FGH75T65SQDT     | 650                  | 75   | 1.60                     | 0.608 @ I <sub>C</sub> = 37.5 A, R <sub>G</sub> = 15 Ω  | Yes               | 75   | TO-247     |
| FGH75T65SQDTL4   | 650                  | 75   | 1.60                     | 0.608 @ I <sub>C</sub> = 37.5 A, R <sub>G</sub> = 15 Ω  | Yes               | 75   | TO-247 4L  |
| FGH40T70SHD      | 700                  | 40   | 1.70                     | 0.271 @ I <sub>C</sub> = 40 A, R <sub>G</sub> = 6 Ω     | Yes               | 20   | TO-247     |
| FGH15T120SMD     | 1200                 | 15   | 1.80                     | 0.46 @ I <sub>C</sub> = 5 A, R <sub>G</sub> = 34 Ω      | Yes               | 15   | TO-247     |
| NGTB25N120FL3    | 1200                 | 25   | 1.70                     | 0.7 @ I <sub>C</sub> = 25 A, R <sub>G</sub> = 10 Ω      | Yes               | 25   | TO-247     |
| FGH25T120SMD     | 1200                 | 25   | 1.80                     | 0.56 @ I <sub>C</sub> = 25 A, R <sub>G</sub> = 23 Ω     | Yes               | 25   | TO-247     |
| NGTB40N120FL2WAG | 1200                 | 40   | 2.10                     | 1.1 @ I <sub>C</sub> = 40 A, R <sub>G</sub> = 10 Ω      | Yes               | 40   | TO-247 4L  |
| NGTB40N120FL3    | 1200                 | 40   | 1.70                     | 1.1 @ I <sub>C</sub> = 40 A, R <sub>G</sub> = 10 Ω      | Yes               | 40   | TO-247     |
| NGTB40N120L3     | 1200                 | 40   | 1.55                     | 1.5 @ I <sub>C</sub> = 40 A, R <sub>G</sub> = 10 Ω      | Yes               | 40   | TO-247     |
| FGY40T120SMD     | 1200                 | 40   | 1.80                     | 1.1 @ I <sub>C</sub> = 40 A, R <sub>G</sub> = 10 Ω      | Yes               | 40   | TO-247     |

POWER



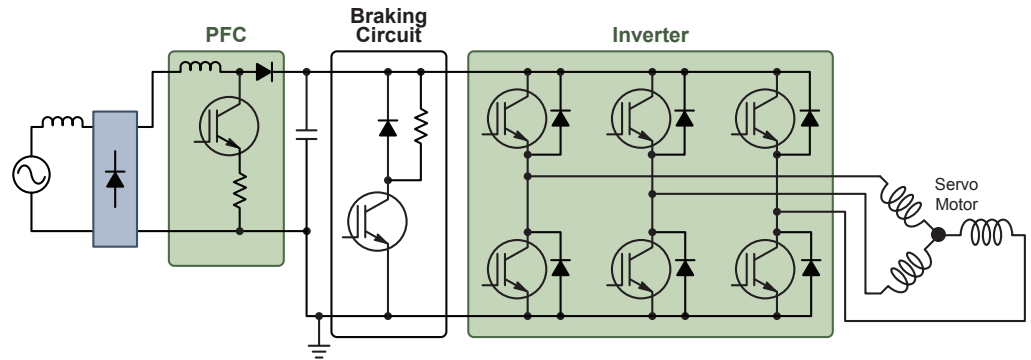
## IGBTs for Motor Control

### Features for Inverters

- Low  $V_{cesat}$
- Low  $V_f$
- Short circuit ruggedness
- $T_{jmax} = 175^{\circ}C$

### Features for PFC

- Fast switching for  $>20$  kHz
- Positive temperature coefficient for easy paralleling
- $T_{jmax} = 175^{\circ}C$



| Device          | $V_{CES}$ (V) | $I_C @ T_C = 100^{\circ}C$ (A) | $V_{CE(sat)}$ (V) | $E_{off}$ (mJ)                          | $T_{sc}$ (ms) | Co-Packaged Diode | $I_F @ T_C = 100^{\circ}C$ (A) | Package(s) |
|-----------------|---------------|--------------------------------|-------------------|---|---------------|-------------------|--------------------------------|------------|
| FGD3N60UNDF     | 600           | 3                              | 2.00              | 0.03 @ $I_C = 3$ A, $R_G = 10 \Omega$   | 10            | Yes               | 3                              | DPAK       |
| NGTB03N60R2DT4G | 600           | 4.5                            | 1.70              | 0.027 @ $I_C = 3$ A, $R_G = 30 \Omega$  | 5             | No                | 3                              | DPAK       |
| FGB5N60UNDF     | 600           | 5                              | 1.90              | 0.07 @ $I_C = 5$ A, $R_G = 10 \Omega$   | 10            | Yes               | 5                              | D2PAK      |
| FGB7N60UNDF     | 600           | 7                              | 1.90              | 0.104 @ $I_C = 7$ A, $R_G = 10 \Omega$  | 10            | Yes               | 7                              | D2PAK      |
| NGTB05N60R2DT4G | 600           | 8                              | 1.65              | 0.06 @ $I_C = 5$ A, $R_G = 30 \Omega$   | 5             | NO                | 5                              | DPAK       |
| NGTB10N60R2DT4G | 600           | 10                             | 1.70              | 0.14 @ $I_C = 10$ A, $R_G = 30 \Omega$  | 5             | No                | 10                             | DPAK       |
| FGPF10N60UNDF   | 600           | 10                             | 2.00              | 0.05 @ $I_C = 10$ A, $R_G = 10 \Omega$  | 10            | Yes               | 10                             | TO-220F    |
| FGP10N60UNDF    | 600           | 10                             | 2.00              | 0.05 @ $I_C = 10$ A, $R_G = 10 \Omega$  | 10            | Yes               | 10                             | TO-220     |
| NGTG12N60TF1G   | 600           | 12                             | 1.50              | 220 @ $I_C = 12$ A, $R_G = 30 \Omega$   | 5             | No                |                                | TO-3PF     |
| NGTB15N60R2FG   | 600           | 14                             | 1.85              | 0.22 @ $I_C = 15$ A, $R_G = 30 \Omega$  | 10            | No                | 15                             | TO-220F    |
| FGP15N60UNDF    | 600           | 15                             | 2.20              | 0.067 @ $I_C = 15$ A, $R_G = 10 \Omega$ | 10            | Yes               | 15                             | TO-220     |
| FGAF20N60SMD    | 600           | 20                             | 1.70              | 0.141 @ $I_C = 20$ A, $R_G = 10 \Omega$ |               | Yes               | 10                             | TO-3PF     |
| NGTB20N60L2TF1G | 600           | 20                             | 1.45              | 0.22 @ $I_C = 20$ A, $R_G = 30 \Omega$  |               | Yes               | 20                             | TO-3PF     |
| FGA3060ADF      | 600           | 30                             | 1.80              | 0.165 @ $I_C = 30$ A, $R_G = 6 \Omega$  |               | Yes               | 3                              | TO-3P      |
| FGA4060ADF      | 600           | 40                             | 1.80              | 0.25 @ $I_C = 40$ A, $R_G = 6 \Omega$   |               | Yes               | 10                             | TO-3P      |
| NGTB10N60FG     | 650           | 10                             | 1.50              | 220 @ $I_C = 10$ A, $R_G = 30 \Omega$   | 5             | Yes               | 10                             | TO-220F    |
| NGTB35N65FL2    | 650           | 35                             | 1.70              | 0.28 @ $I_C = 35$ A, $R_G = 10 \Omega$  | 5             | Yes               | 35                             | TO-247     |
| FGAF40S65AQ     | 650           | 40                             | 1.60              | 0.0407 @ $I_C = 20$ A, $R_G = 6 \Omega$ |               | No                | 40                             | TO-3PF     |
| FGA5065ADF      | 650           | 50                             | 1.80              | 0.309 @ $I_C = 50$ A, $R_G = 6 \Omega$  |               | Yes               | 20                             | TO-3P      |
| NGTB50N65FL2    | 650           | 50                             | 1.80              | 0.46 @ $I_C = 50$ A, $R_G = 10 \Omega$  | 5             | Yes               | 50                             | TO-247     |
| FGA6065ADF      | 650           | 60                             | 1.70              | 0.52 @ $I_C = 60$ A, $R_G = 6 \Omega$   |               | Yes               | 30                             | TO-3P      |
| NGTB60N65FL2    | 650           | 60                             | 1.64              | 0.66 @ $I_C = 60$ A, $R_G = 10 \Omega$  | 5             | Yes               | 60                             | TO-247     |
| NGTB75N65FL2    | 650           | 75                             | 1.70              | 1.1 @ $I_C = 75$ A, $R_G = 10 \Omega$   | 5             | Yes               | 75                             | TO-247     |
| NGTB75N65FL2WG  | 650           | 75                             | 1.60              | 1.1 @ $I_C = 75$ A, $R_G = 10 \Omega$   | 5             | Yes               | 75                             | TO-247     |
| FGY100T65SCDT   | 650           | 100                            | 1.60              | 3.7 @ $I_C = 100$ A, $R_G = 4.7 \Omega$ | 5             | Yes               | 100                            | TP-247     |
| NGTB15N120FL2   | 1200          | 15                             | 2.00              | 0.37 @ $I_C = 15$ A, $R_G = 10 \Omega$  | 10            | Yes               | 15                             | TO-247     |
| NGTB25N120FL2   | 1200          | 25                             | 2.00              | 0.6 @ $I_C = 25$ A, $R_G = 10 \Omega$   | 10            | Yes               | 25                             | TO-247     |
| NGTB30N120FL2   | 1200          | 30                             | 2.00              | 0.7 @ $I_C = 30$ A, $R_G = 10 \Omega$   | 10            | Yes               | 30                             | TO-247     |
| NGTB40N120FL2   | 1200          | 40                             | 2.00              | 1.1 @ $I_C = 40$ A, $R_G = 10 \Omega$   | 10            | Yes               | 40                             | TO-247     |

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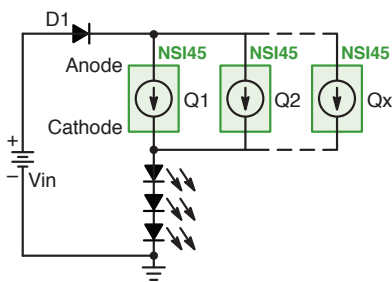
## Constant Current Regulator (CCRs) Linear LED Drivers for Displays and Channel Letters

### Features

- Low startup voltage
- Tight current regulation regardless of  $V_f$  variation
- Negative temperature coefficient protects LEDs

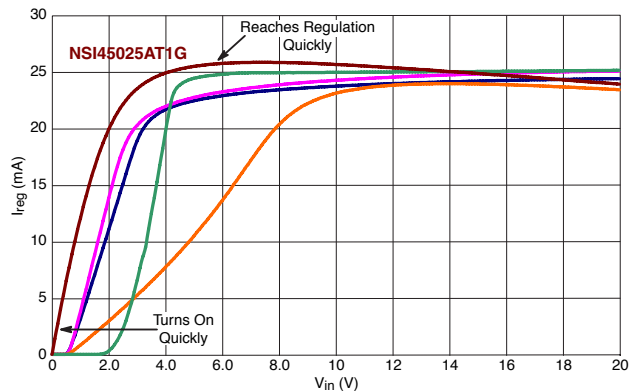
### Resources

- Sample Kit: CCR2KIT/S



| Device     | Max Anode-to-Cathode Voltage ( $V_{AK}$ ) (V) | Voltage Overhead ( $V_{in} - V_{LEDs}$ ) (V) | Constant Current $I_{reg}$ (@ $V_{AK} = 7.5$ V) (mA) | Current Tolerance Over Voltage | Max Junction Temperature ( $^{\circ}C$ ) | Package(s)       |
|------------|---|--|--|--------------------------------|--|------------------|
| NSI45xxx   | 45  | 1.8  | Fixed: 15, 20, 25, 30                                | $\pm 15\%$ , $\pm 10\%$        | 150                                      | SOD-123, SOT-223 |
| NSI50xxx   | 50  | 1.8  | Fixed: 10, 350                                       | $\pm 10\%$                     | 175                                      | SMC, DPAK        |
| NSIC20xx   | 120   | 1.8  | Fixed: 20, 30, 50                                    | $\pm 15\%$                     | 175                                      | SMB              |
| NSI45xxxJ  | 45  | 1.8  | Adjustable: 20 to 40, 35 to 70, 60 to 100, 90 to 160 | $\pm 15\%$                     | 150                                      | SOT-223, DPAK    |
| NSI50150AD | 50  | 1.8  | 150 to 350   | $\pm 10\%$                     | 175                                      | DPAK             |

NOTE: xxx in the device number represents the current level.

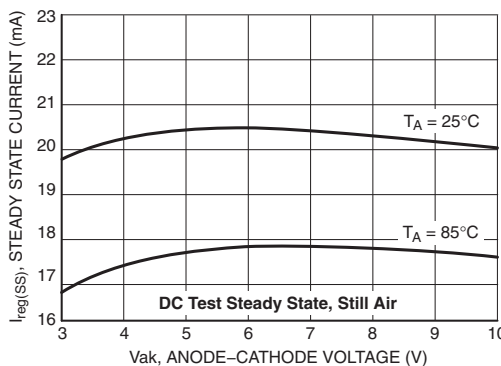
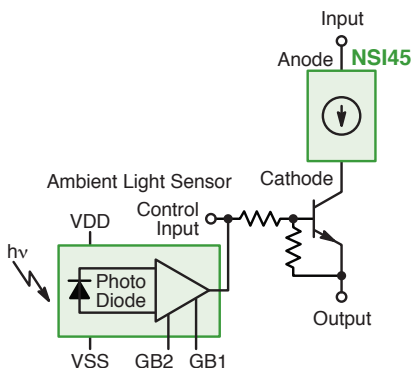


NSI45025 vs Competing Devices @ 25 mA

## Linear LED Driver Solutions

Linear solutions are the preferred approach for many lighting applications, as they are simple, straightforward to design, and allow the LEDs to be driven with a tightly regulated current, regardless of LED forward voltage or input supply variation. Because the LED drivers are linear, they must be matched to the power dissipation requirements of the application. ON Semiconductor offers a wide range of constant current linear LED drivers whose current levels span from 10 mA to 1 A.

### Constant Current Regulators – Dimming with External BRT



## Linear LED Driver Solutions (continued)

### Fixed Linear LED Drivers

| Device     | Channel Output Current (mA) | Operating Voltage Range (V) | Typical Current Tolerance | Number of Channels | Dimming Control | Typical Dropout (V) | Operating Temperature Range (°C) | Package(s) | Features           |
|------------|-----------------------------|-----------------------------|---------------------------|--------------------|-----------------|---------------------|----------------------------------|------------|--------------------|
| NSI50350AS | 350                         | 1.8 to 50                   | ±10%                      | 1                  | Ext             | 1.8                 | -40 to +125                      | SMC        | AEC-Q101 qualified |
| NSI50350AD | 350                         | 1.8 to 50                   | ±10%                      | 1                  | Ext             | 1.8                 | -40 to +125                      | DPAK       | AEC-Q101 qualified |
| NSIC2050JB | 50                          | 1.8 to 120                  | ±15%                      | 1                  | Ext             | 1.8                 | -40 to +125                      | SMB        | AEC-Q101 qualified |
| NSIC2030JB | 30                          | 1.8 to 120                  | ±15%                      | 1                  | Ext             | 1.8                 | -40 to +125                      | SMB        | AEC-Q101 qualified |
| NSI45030Z  | 30                          | 1.8 to 45                   | ±15%                      | 1                  | Ext             | 1.8                 | -40 to +125                      | SOT-223    | AEC-Q101 qualified |
| NSI45030AZ | 30                          | 1.8 to 45                   | ±10%                      | 1                  | Ext             | 1.8                 | -40 to +125                      | SOT-223    | AEC-Q101 qualified |
| NSI45030A  | 30                          | 1.8 to 45                   | ±10%                      | 1                  | Ext             | 1.8                 | -40 to +125                      | SOD-123    | AEC-Q101 qualified |
| NSI45030   | 30                          | 1.8 to 45                   | ±15%                      | 1                  | Ext             | 1.8                 | -40 to +125                      | SOD-123    | AEC-Q101 qualified |
| NSI45025Z  | 25                          | 1.8 to 45                   | ±15%                      | 1                  | Ext             | 1.8                 | -40 to +125                      | SOT-223    | AEC-Q101 qualified |
| NSI45025AZ | 25                          | 1.8 to 45                   | ±10%                      | 1                  | Ext             | 1.8                 | -40 to +125                      | SOT-223    | AEC-Q101 qualified |
| NSI45025A  | 25                          | 1.8 to 45                   | ±10%                      | 1                  | Ext             | 1.8                 | -40 to +125                      | SOD-123    | AEC-Q101 qualified |
| NSI45025   | 25                          | 1.8 to 45                   | ±15%                      | 1                  | Ext             | 1.8                 | -40 to +125                      | SOD-123    | AEC-Q101 qualified |
| NSI45020   | 20                          | 1.8 to 45                   | ±15%                      | 1                  | Ext             | 1.8                 | -40 to +125                      | SOD-123    | AEC-Q101 qualified |
| NSI45020A  | 20                          | 1.8 to 45                   | ±10%                      | 1                  | Ext             | 1.8                 | -40 to +125                      | SOD-123    | AEC-Q101 qualified |
| NSIC2020JB | 20                          | 1.8 to 120                  | ±15%                      | 1                  | Ext             | 1.8                 | -40 to +125                      | SMB        | AEC-Q101 qualified |
| NSI45015W  | 15                          | 1.8 to 45                   | ±20%                      | 1                  | Ext             | 1.8                 | -40 to +125                      | SOD-123    | AEC-Q101 qualified |
| NSI50010Y  | 10                          | 1.8 to 50                   | ±30%                      | 1                  | Ext             | 1.8                 | -40 to +125                      | SOD-123    | AEC-Q101 qualified |

### Adjustable Linear LED Drivers

| Device     | Channel Output Current (mA)              | Operating Voltage Range (V)    | Typical Current Tolerance | Number of Channels | Dimming Control  | Typical Dropout (V) | Operating Temperature Range (°C) | Package(s) | Features                                |
|------------|--|--------------------------------|---------------------------|--------------------|------------------|---------------------|----------------------------------|------------|---|
| NSI50150AD | 150 to 350                               | 1.8 to 50                      | ±10%                      | 1                  | Ext              | 1.8                 | -40 to +125                      | DPAK       | AEC-Q101 qualified                      |
| NSI45090JD | 90 to 160                                | 1.8 to 45                      | ±15%                      | 1                  | Ext              | 1.8                 | -40 to +125                      | DPAK       | AEC-Q101 qualified                      |
| NSI45060JD | 60 to 100                                | 1.8 to 45                      | ±15%                      | 1                  | Ext              | 1.8                 | -40 to +125                      | DPAK       | AEC-Q101 qualified                      |
| NSI45035JZ | 35 to 70                                 | 1.8 to 45                      | ±15%                      | 1                  | Ext              | 1.8                 | -40 to +125                      | SOT-223    | AEC-Q101 qualified                      |
| NSI45020JZ | 20 to 40                                 | 1.8 to 45                      | ±15%                      | 1                  | Ext              | 1.8                 | -40 to +125                      | SOT-223    | AEC-Q101 qualified                      |
| NSM4002MR6 | 1 to 200                                 | 1.4 to 45                      | ±3%                       | 1                  | Ext              | 1.4                 | -40 to +125                      | SC-74      | Can be used with an external transistor |
| NUD4001    | 500                                      | 2.0 to 30 (60 V Surge)         | ±3%                       | 1                  | Ext              | 1.4                 | -40 to +125                      | SOIC-8     | Can be used with an external transistor |
| NUD4011    | 70                                       | 5 to 200                       | ±3%                       | 1                  | Ext              | 5                   | -40 to +125                      | SOIC-8     | Can be used with an external transistor |
| NCV7680    | 35                                       | 6 to 16                        | ±10% @ 35 mA              | 8                  | Ext              | 1                   | -40 to +125                      | SOIC-16 EP | AEC-Q101 qualified                      |
| LV5237JA   | Constant mode 5 to 100<br>Open drain 100 | VDD 3.3 - 12.8<br>LED 0.7 - 42 | ±7%                       | 9                  | PWM<br>256 steps | 0.7                 | -25 to +85                       | SSOP-24    | General purpose                         |
| LV52511*   | Constant mode 5 to 100<br>Open drain 100 | VDD 3.3 - 20<br>LED 0.7 - 41   | ±7%                       | 24                 | PWM<br>256 steps | 0.7                 | -25 to +85                       | QFN-48     | General purpose                         |

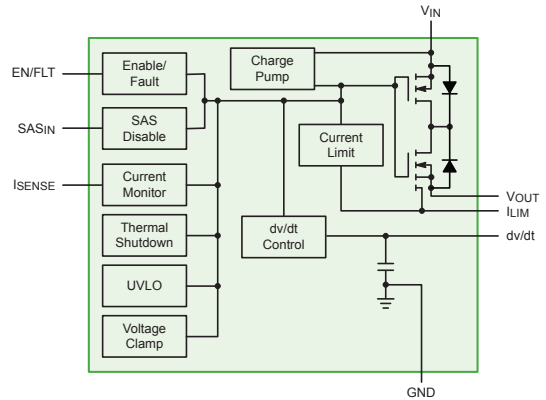
\* Pending 3Q19.

## eFuses (Electronic Fuses)

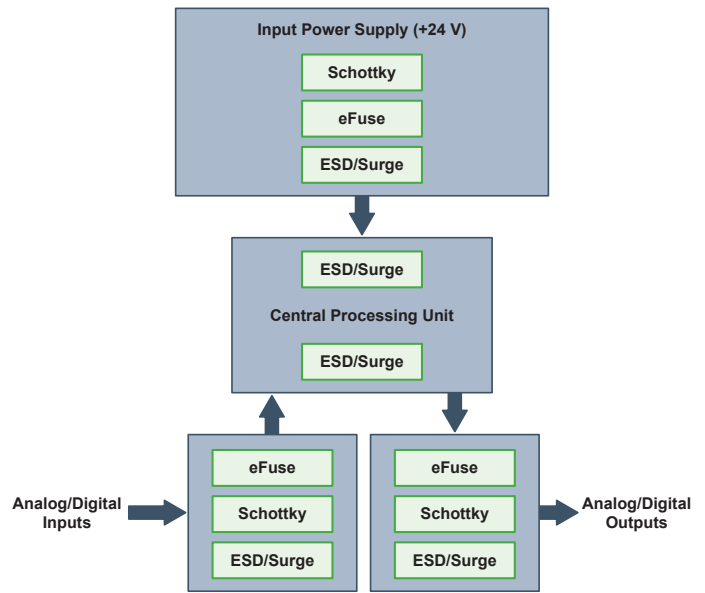
### 5 - 12 V Power Bus Hot Plug Protection

#### Features

- Low RDS(ON), high operating and trip currents (IOP, ITRIP)
- Overvoltage protection
- Precise ITRIP control
- Slew rate control
- Thermal shut-down
- EN pin for synchronizing multiple eFuses
- Outperforms poly-fuses:
  - Tighter spec tolerances
  - Lower resistance
  - Shorter trip-time
  - Superior repeatability
- High efficiency with high current capability
- eFuses in parallel achieve practically any desired level of IOP and ITRIP
- Integrated surge protection per IEC61000-4-5



Typical Block Diagram



PLC Application

| Device   | Nominal Voltage (V) | Input Voltage (V) | Output Clamping Voltage (V) | Continuous Current (A) | Trip Current (A) | RDS(ON) (mΩ) | Auto-Retry | Latching | Package (s) |
|----------|---------------------|-------------------|-----------------------------|------------------------|------------------|--------------|------------|----------|-------------|
| NIS5135  | 5                   | -0.6 to 18        | 6.65                        | 3.6                    | Adjustable       | 68           | ✓          | ✓        | DFN-10      |
| NIS5132  | 12                  | -0.6 to 18        | 15                          | 4.2                    | Adjustable       | 44           | ✓          | ✓        | DFN-10      |
| NIS5232  | 12                  | -0.6 to 18        | 15                          | 4.2                    | Adjustable       | 44           |            | ✓        | DFN-10      |
| NIS5820* | 12                  | -0.6 to 18        | 14                          | 8                      | Adjustable       | 24           | ✓          | ✓        | WDFN-10     |
| NIS5020* | 12                  | -0.6 to 18        | 14                          | 10                     | Adjustable       | 14           | ✓          | ✓        | WDFN-10     |
| NIS5021  | 12                  | -0.6 to 18        | 14                          | 12                     | Adjustable       | 14           | ✓          | ✓        | WDFN-10     |
| NIS6150* | 5                   | -0.3 to 20        | 6.1/6.9                     | 1                      | Adjustable       | 190          | ✓          | ✓        | WDFN-10     |
| NIS6351* | 5                   | -0.3 to 20        | 6.1/6.9                     | 3                      | Adjustable       | 50           | ✓          | ✓        | WDFN-10     |

\* Pending 3Q19.

## ESD and Surge Protection for Industrial Networks

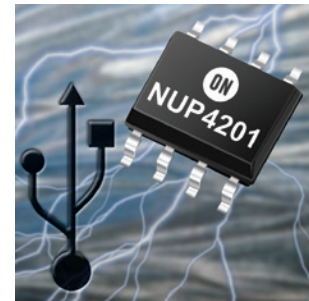
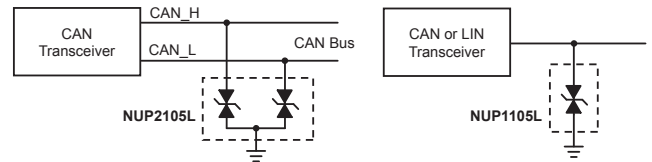
### Zener Voltage Regulators

| Device        | Power (W) | V <sub>Z</sub> (V) | V <sub>Z</sub> Tolerance (%) | Package(s)  |
|---------------|-----------|--------------------|------------------------------|-------------|
| 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 Dateline Protection

| Device    | Application                             | V <sub>rwm</sub> Max (V) | Line-to-Line Capacitance (pF) | Peak Surge Current* Max (A) | Package(s) |
|-----------|---|--------------------------|-------------------------------|-----------------------------|------------|
| 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                          | S0-8       |
| NSP4201   | USB2.0 FS                               | 5                        | 1.5                           | 25                          | TSOP-6     |
| NSP8814/8 | 10/100/1000BASE-T Ethernet, Gb Ethernet | 5                        | 1.5                           | 25                          | UDFN-10    |

\* on VP pin (pin 5).

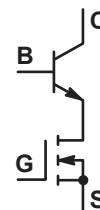


## Emitter-Switched Bipolar/MOSFET Cascode Transistors

*For high-voltage and high-switching frequency*

### Features

- Low input capacitance: ~470 pF (FET input C)
- No “Miller” feedback capacitance
- 15 pF @ 200 V output capacitance (FJP2160)
- Breakdown voltage: >1600 V
- Moderate switching speed: >150 KHz
- Rise-time/fall-time: ~50 - 100 ns
- Square RBSOA for improved reliability
- Low equivalent R<sub>DS(ON)</sub>
- Little or no influence from static dv/dt (low input Z and no Miller “C”)
- Avalanche tested



| Device     | Polarity | V <sub>CE(SAT)</sub> Max (V) | I <sub>C</sub> Cont. (A) | V <sub>CEO</sub> Min (V) | V <sub>CB0</sub> (V) | V <sub>EB0</sub> (V) | V <sub>BE</sub> (sat) (V) | hFE Min | hFE Max | fT Min (MHz) | PTM Max (W) | Package (s) |
|------------|----------|------------------------------|--------------------------|--------------------------|----------------------|----------------------|---------------------------|---------|---------|--------------|-------------|-------------|
| FJP2160DTU | NPN      | 0.75                         | 2                        | 800                      | 1600                 | 12                   | 1.2                       | 20      | 35      | 5            | 100         | T0-220-3    |
| FJPF2145TU | NPN      | 2                            | 5                        | 800                      | 1100                 | 7                    | 1.5                       | 20      | 40      | 15           | 40          | T0-220-3 FP |
| FJP2145TU  | NPN      | 2                            | 5                        | 800                      | 1100                 | 7                    | 1.5                       | 20      | 40      | 15           | 120         | T0-220-3    |

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

Four Pairs, Low Capacitance Surge and ESD Protection

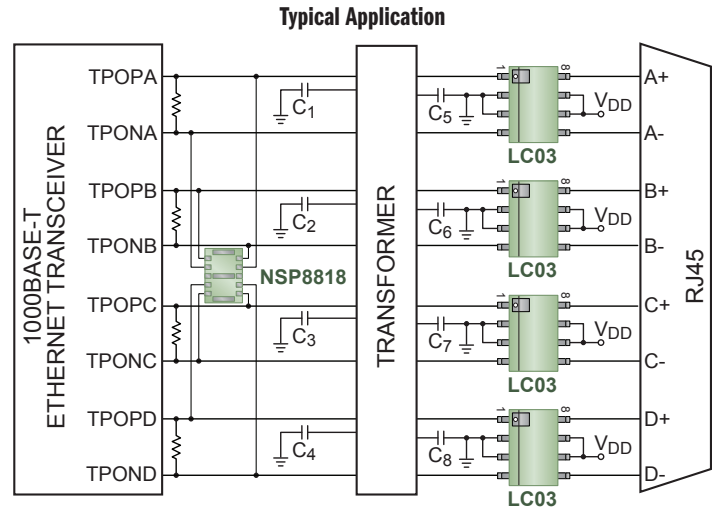
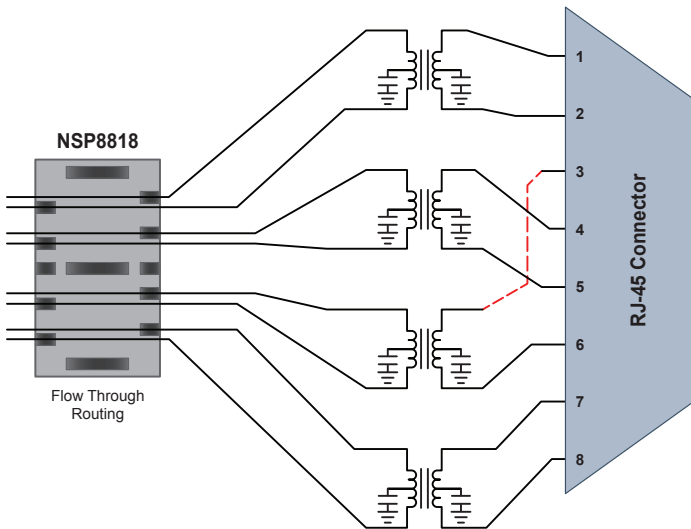
The 1000BASE-T or Gigabit Ethernet interface operating at higher bitrates is susceptible to ESD strikes, cable-discharge events and lightning-induced transients. Our products help meet IEC 61000-4-5, GR-1089-CORE and other Standards.

### Features

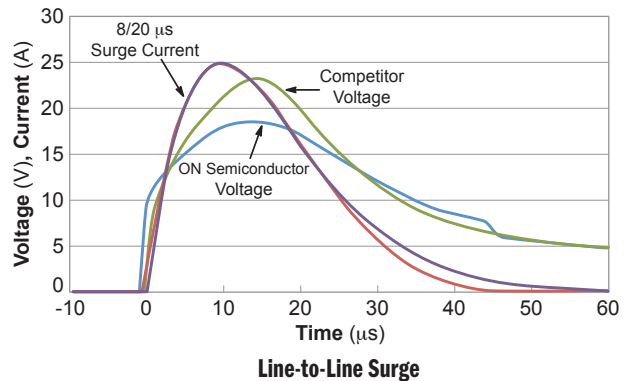
- Line-to-line capacitance < 3 pF
- $V_{clamp}$  (25 A surge) < 11 V
- IEC 61000-4-2 rating > 30 kV
- No latching danger
- Surge rating maintained to 125°C

### 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



Line Side : LC03-6 (optional)  
Transformer Side: NSP8818  
Protection against metallic (transverse) strikes



### Surge Suppressors

| Device  | $V_{DC}$ Max (V) | Line Transient Max (V) | Surge $I_{pp}$ , 8/20 $\mu$ s (A) | Typical Line-Line Capacitance (pF) | ESD Contact Rating (kV) | Package (s) |
|---------|------------------|------------------------|-----------------------------------|------------------------------------|-------------------------|-------------|
| LC03-6  | 6.7              | 7.0                    | 100                               | 8.0                                | $\pm$ 30                | SOIC-8      |
| NSP8814 | 3.0              | 3.2                    | 35                                | 1.5                                | $\pm$ 30                | UDFN-8      |
| NSP8818 | 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      |
| NSP4201 | 5.0              | 6.0                    | 2.5                               | 1.5                                | $\pm$ 30                | TSOP-6      |

PROTECTION



## USB 2.0 Protection

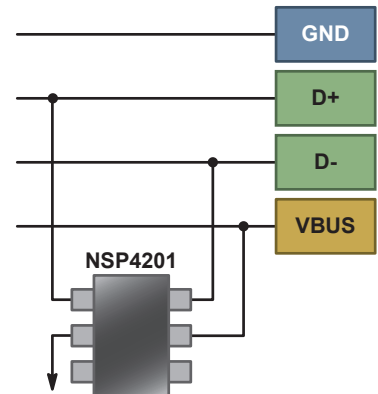
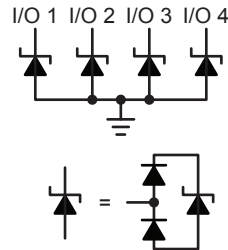
One High Speed Pair, V<sub>CC</sub>, Low Capacitance ESD Protection

### 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(s) | 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  |
| NSP4201    | 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   |
| ESD7481    | Single Line 0201                       | 0.25             | X3DFN-2    | 0.62 x 0.32 |

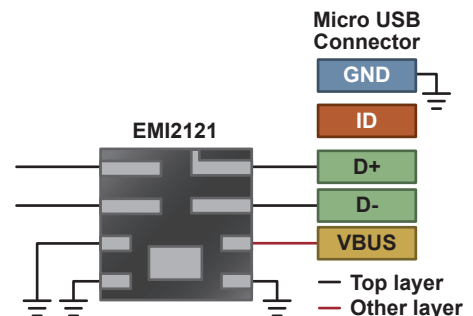
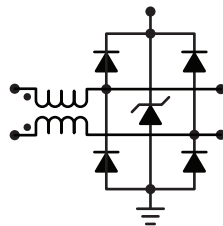
One High Speed Pair, V<sub>CC</sub>, Common Mode Filter + ESD Protection

### Key Requirement

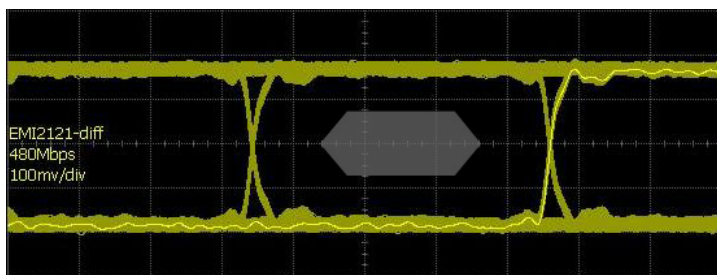
- Cap < 1.5 pF
- Common Mode Filtering

### Features

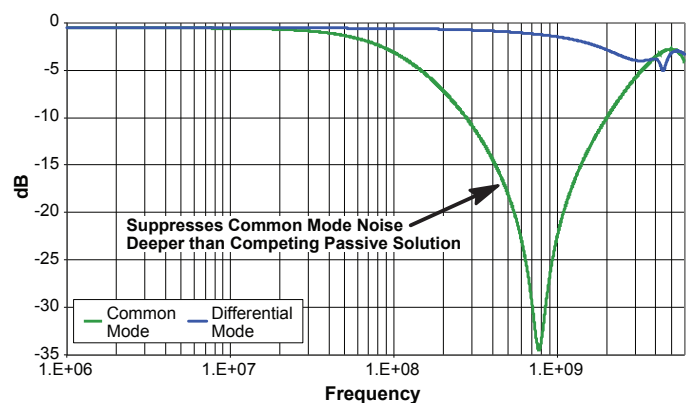
- 0.5 - 0.8 pF
- Integrated EMI suppression with ESD protection
- Industry leading low clamping voltage



| Device  | Data Lines                             | Capacitance @ 2.5 V (pF) | CM Attenuation @ 800 MHz (-dB) | DM Bandwidth F3dB (GHz) | Package(s) | 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 |



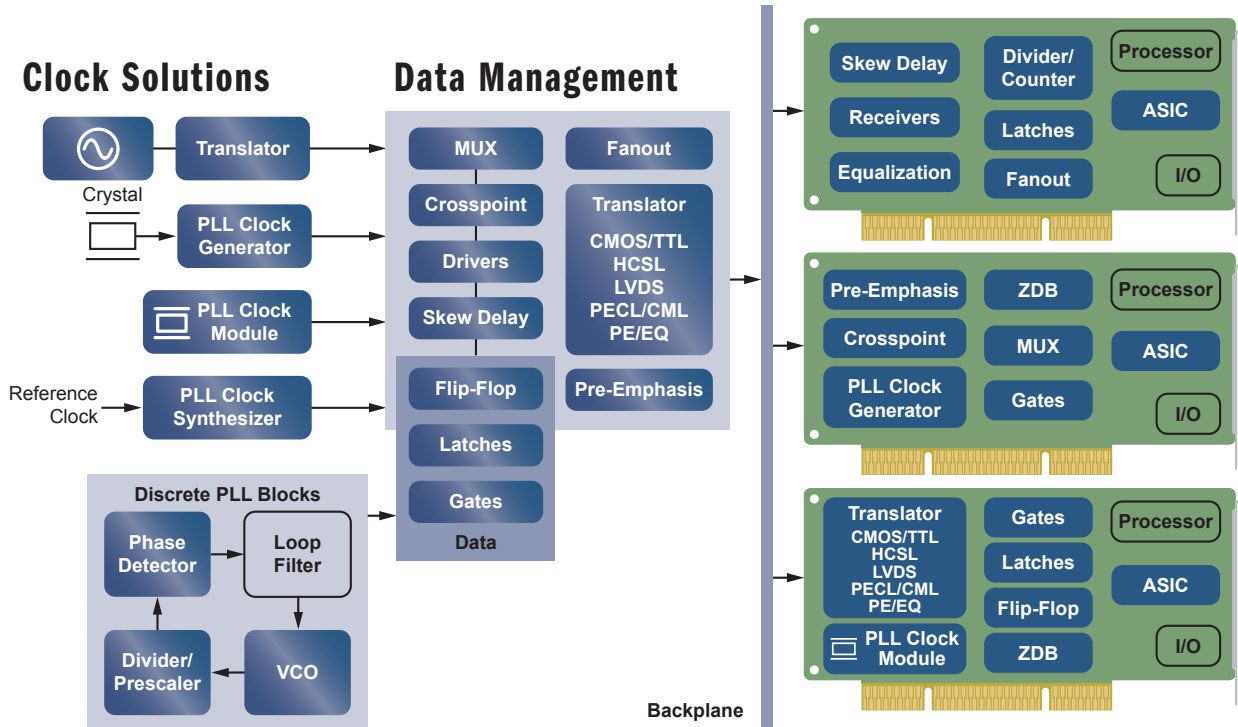
USB 2.0 @ 480 Mb/s



PROTECTION

## Timing and Data Distribution Subsystem

CLOCK DISTRIBUTION

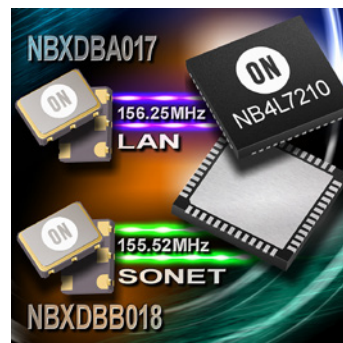


ON Semiconductor provides a complete portfolio of timing and data management solutions for all aspects of the clock tree. System designers can optimize their clock circuits with industry leading clock distribution devices, demonstrating the industry's lowest jitter and skew. A broad product portfolio, 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](http://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  $\leq -174$  dBc/Hz
- Low skew

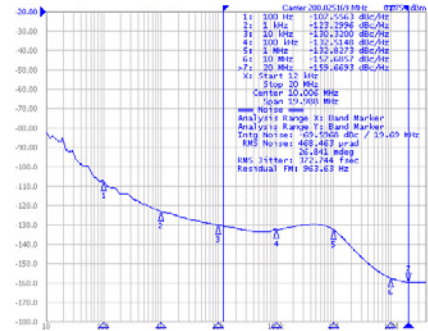


## PLL Clock Synthesizers/Generators



### 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

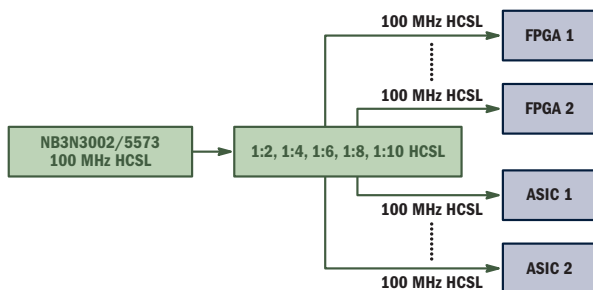


NB3N5573 Typical Phase Noise at Fc = 200 MHz

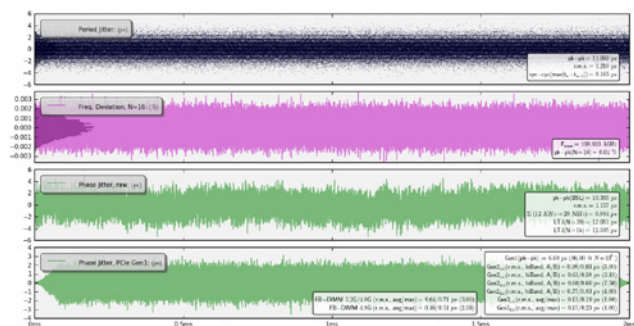
| Device    | Input (MHz) | Output (MHz)   | Application                | Input Level |     |      |        |     | Output Level | Vcc Typ (V) | Package(s) |
|-----------|-------------|----------------|----------------------------|-------------|-----|------|--------|-----|--------------|-------------|------------|
|           |             |                |                            | XTAL        | CML | CMOS | LVPECL | TTL |              |             |            |
| NB3N3002  | 25          | 25/125/200     | CPU/DIMM, PCIe Gen 1,2,3,4 | ✓           |     | ✓    |        | ✓   | HCSL         | 3.3         | TSSOP-16   |
| NB3N5573  | 25          | 25/100/125/200 | CPU/DIMM, PCIe Gen 1,2,3,4 | ✓           |     | ✓    |        | ✓   | HCSL         | 3.3         | TSSOP-16   |
| NB3N3020  | 5 to 27     | 5 to 210       | Network GigE               | ✓           | ✓   | ✓    | ✓      |     | ECL, LVTTTL  | 3.3         | TSSOP-16   |
| NB3N502   | 2 to 50     | 14 to 120      | Networking, Consumer, STB  | ✓           |     | ✓    |        |     | LVC MOS      | 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 1,2,3,4 | ✓           |     | ✓    |        |     | HCSL         | 3.3         | TSSOP-20   |
| NB3N51044 | 25          | 100/125        | CPU/DIMM, PCIe Gen 1,2,3,4 | ✓           |     | ✓    |        |     | HCSL         | 3.3         | TSSOP-28   |
| NB3N51054 | 25          | 100            | CPU/DIMM, PCIe Gen 1,2,3,4 | ✓           |     |      |        |     | HCSL         | 3.3         | TSSOP-24   |
| NBA3N5573 | 25          | 25 to 200      | CPU/DIMM, PCIe Gen 1,2,3,4 | ✓           |     | ✓    |        |     | HCSL         | 3.3         | QFNW-16    |

### 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, 4 specification
- Direct device interface eliminates external termination components and simplifies BOM



PCIe Gen 1, 2, 3, 4 Clock Generation and Distribution



Jitter Results After Fanout

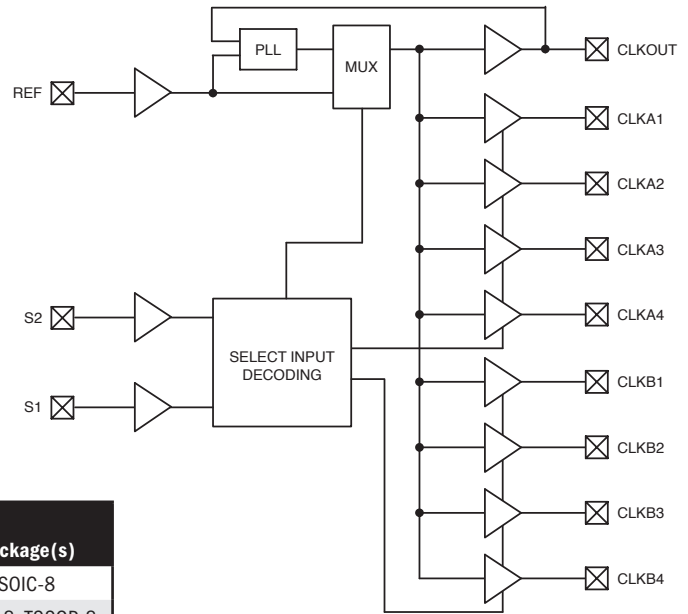
## Zero Delay Buffers



### 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 <sub>Max Typ</sub> (MHz) | Channels | tSkew 0-0 Max (ps) | Package(s)        |
|---------|-------------|--------------|-------------|----------------------------|----------|--------------------|-------------------|
| NB2304A | CMOS        | CMOS         | 3.3         | 133.3                      | 4        | 200                | SOIC-8            |
| NB2305A | CMOS        | CMOS         | 3.3         | 133.3                      | 5        | 250                | SOIC-8, TSSOP-8   |
| NB2309A | CMOS        | CMOS         | 3.3         | 133.3                      | 9        | 250                | SOIC-16, TSSOP-16 |

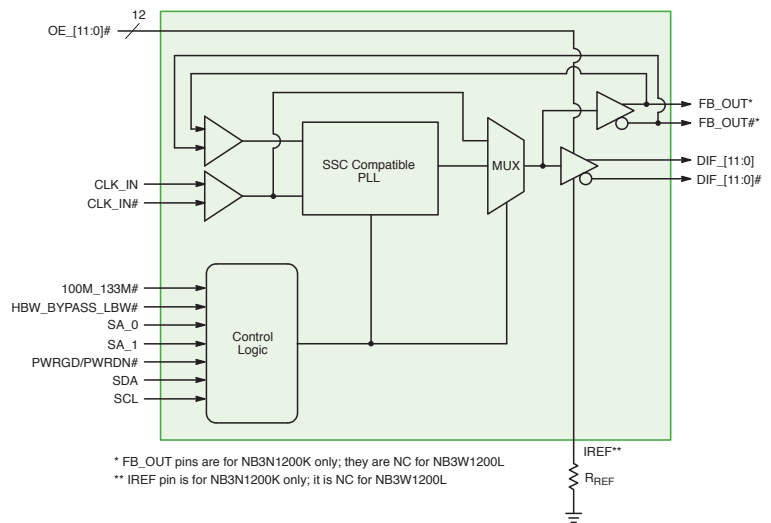


NB2309A Functional Diagram

## 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/Gen 4 and Intel QPI phase jitter specifications
- Spread spectrum compatible for low EMI
- Pseudo-external fixed-feedback for low input-to-output delay variation
- Individual OE control pin for each output
- SMBUS programmability for power down mode, PLL BW modes, PLL/Bypass mode & frequency selection



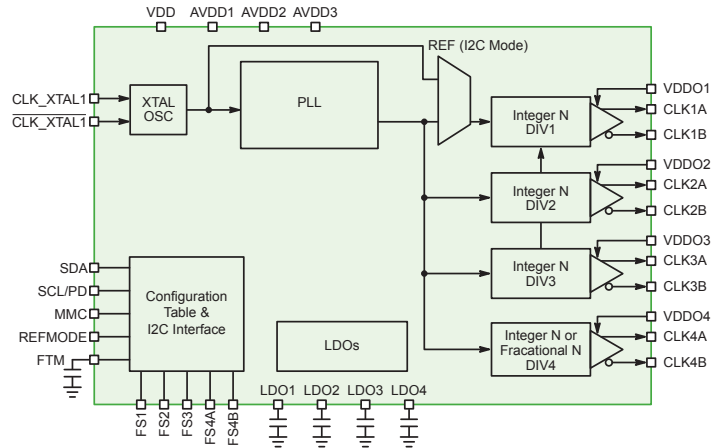
NB3N1200K Simplified Block Diagram

\* FB\_OUT pins are for NB3N1200K only; they are NC for NB3W1200L  
 \*\* IREF pin is for NB3N1200K only; it is NC for NB3W1200L

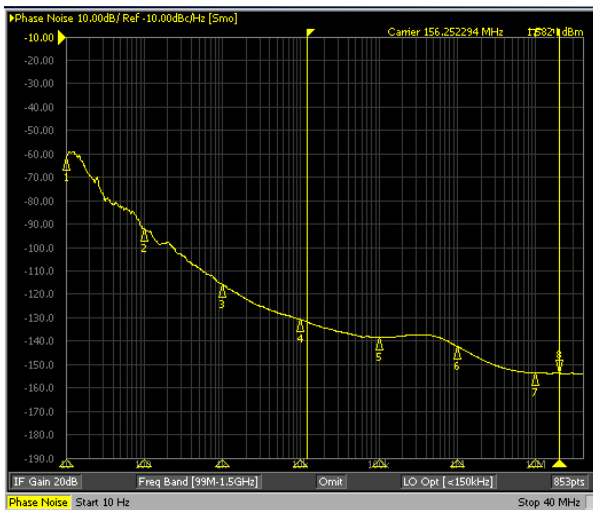
## Low Noise, Programmable Multi-Rate Clock Generator

### NB3H5150 Features

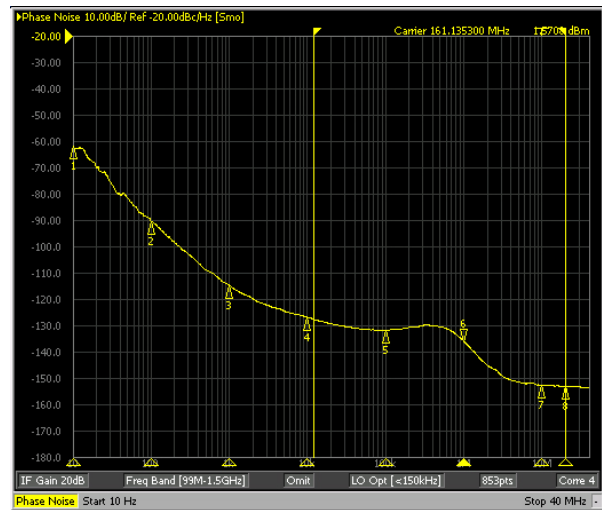
- Uses 25 MHz Crystal or reference input
- External Loop Filter is not required
- User programmable frequencies with four Independent Output Pairs:
  - CLK(1:3) are derived from Integer-N dividers, and CLK4 is derived from either an Integer-N divider or a Fractional-N divider
  - Several different output 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**

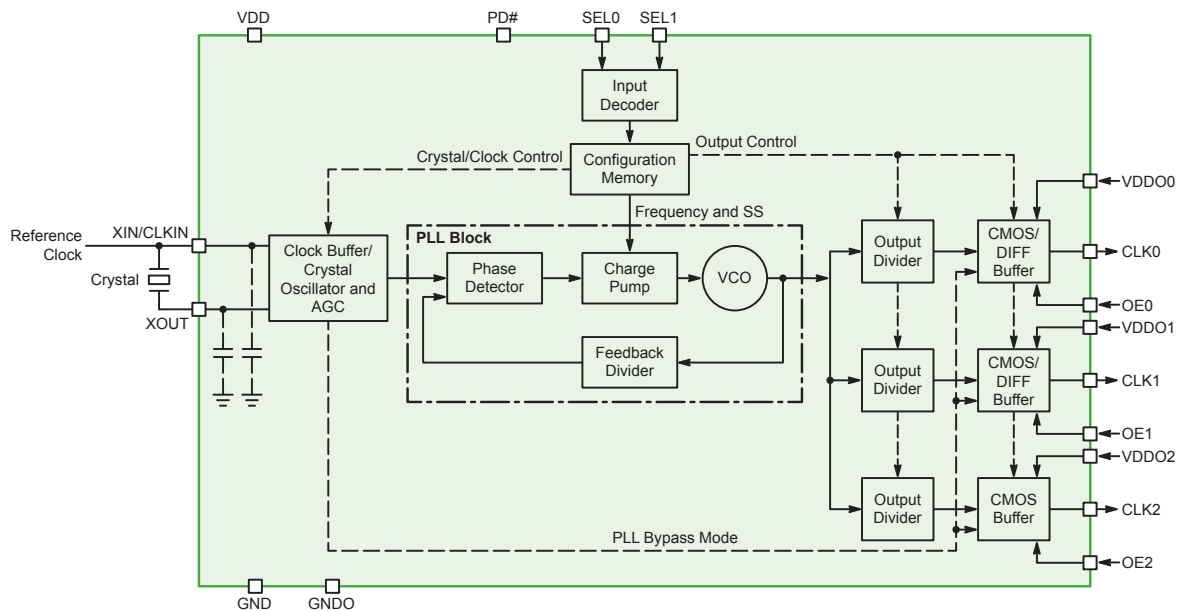


**Fractional-N Output RMS Phase Jitter = 371 fs !!**  
**Fractional-N Output Phase Noise (Max) = 1 ps**  
**Integration range = 12 kHz - 20 MHz**

## OmniClock Programmable Clock Synthesizers

### 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  $\pm 0.1$  V
- Temperature Range:  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- Available in QFN-16 (3 mm x 3 mm) and WDFN-8 (2 mm x 2 mm) packages

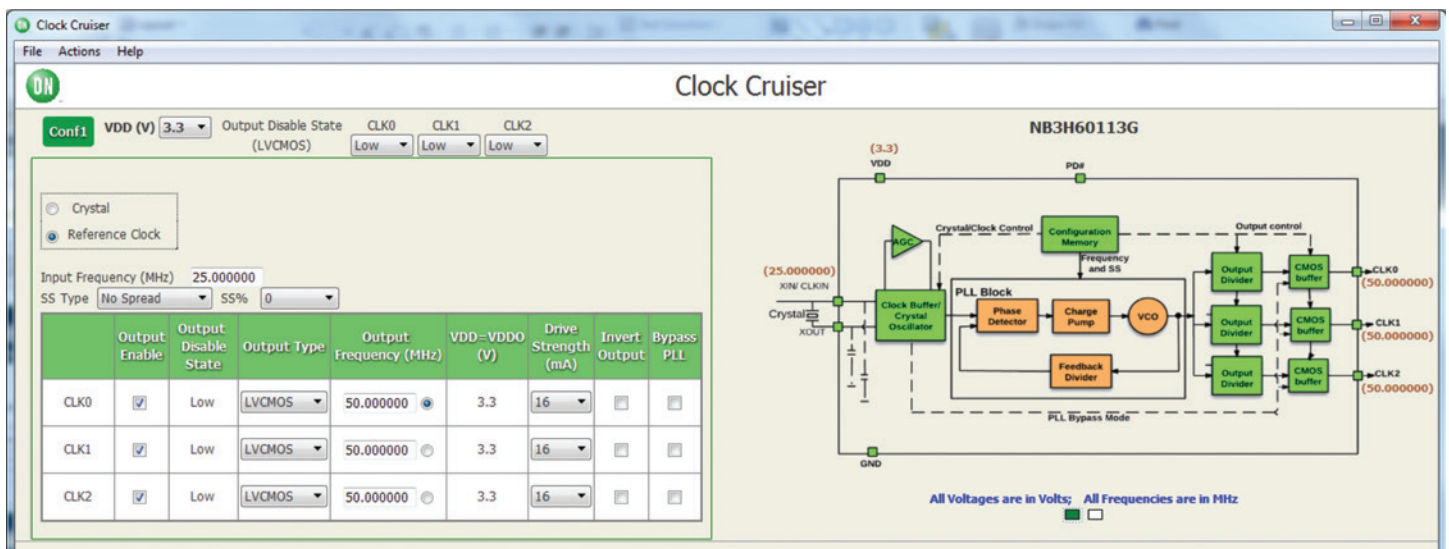
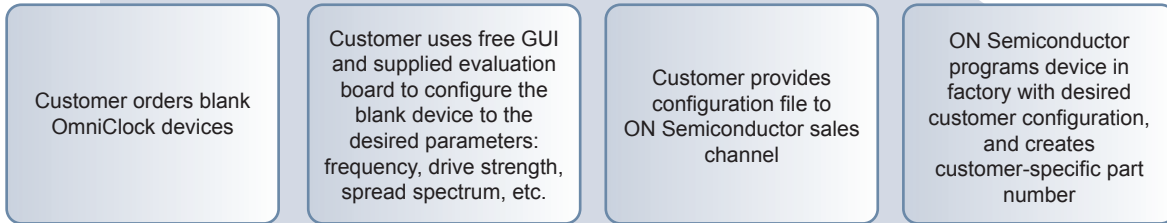


Block Diagram



## OmniClock Programmable Clock Synthesizers

### Using OmniClock in Your System



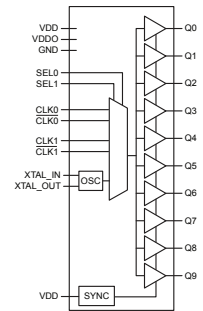
Configuration GUI

| Device     | Individual OE | Individual Vddo | Supply Voltage (V) | Number of Configurations | Number of Outputs | Package(s) |
|------------|---------------|-----------------|--------------------|--------------------------|-------------------|------------|
| 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      |

## 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

| Device                                       | Outputs per Channel | Output Level           | Input Level |      |        |       |      |      |      |     | Vcc Typ (V)        | t <sub>skew</sub> 0-0 (ps) | f <sub>Max</sub> Typ (GHz) | Package(s)                        |
|--|---------------------|------------------------|-------------|------|--------|-------|------|------|------|-----|--------------------|----------------------------|----------------------------|-----------------------------------|
|  |                     |                        | CML         | CMOS | LVPECL | HCSSL | HSTL | LVDS | XTAL | TTL |                    |                            |                            |                                   |
| NB3N106K/08K<br>NB3N111K/21K<br>NB3L202K/04K | 2, 4, 6, 8, 10, 21  | HCSSL                  |             | ✓    | ✓      | ✓     | ✓    | ✓    | ✓    | ✓   | 3.3                | 100                        | 0.4                        | QFN-52, QFN-32,<br>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                            |
| 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, LVTTL          |             | ✓    |        |       |      |      |      | ✓   | 1.5, 1.8, 2.5, 3.3 | 250                        | 0.16                       | TSSOP-8, SOIC-8                   |
| NB3N4666C                                    | 4                   | LVCMOS, LVTTL          |             | ✓    |        | ✓     |      | ✓    |      |     | 3.3                | 50                         | 0.2                        | TSSOP-16, QFN-16                  |
| NB3V1102C/3C<br>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                            |

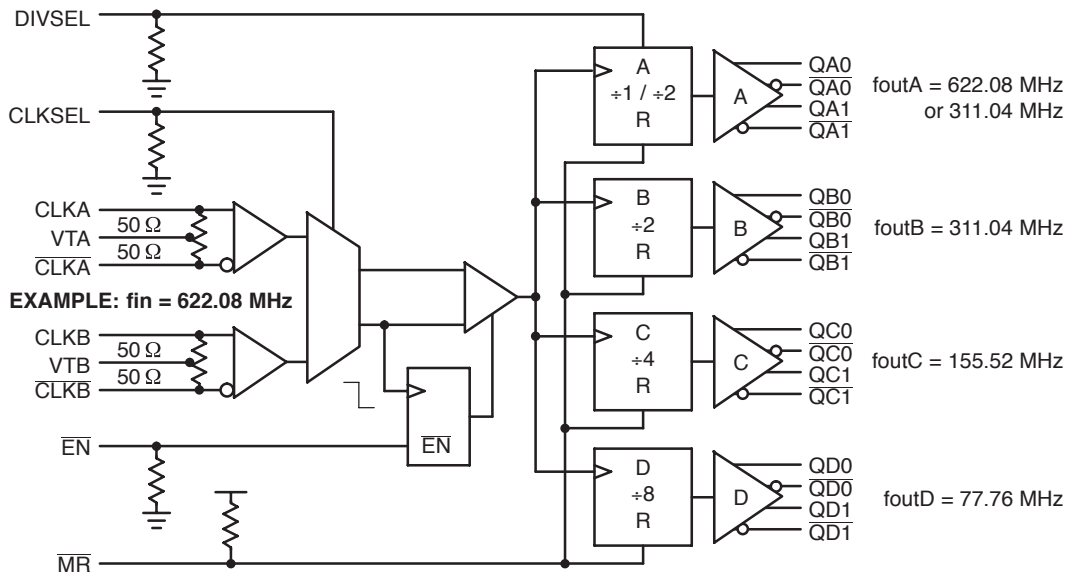
## Dividers and Counters



### 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 <sub>Max</sub> Typ (GHz) | Div Ratios        | Package(s) |
|----------|-------------|------|--------|------|--------------|-------------|----------------------------|-------------------|------------|
|          | CML         | CMOS | LVPECL | LVDS |              |             |                            |                   |            |
| 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

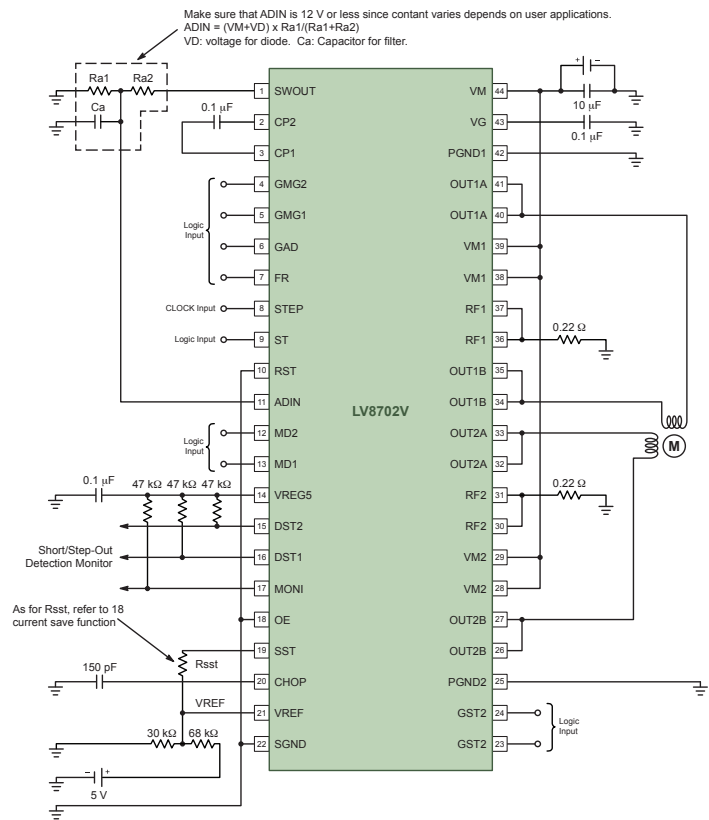
## Stepper Motor Drivers for Motion Control

### Features

- Built-in 1 channel PWM current control stepper motor driver (bipolar type)
- Ron (High-side Ron: 0.3 Ω, Low-side Ron: 0.25 Ω, total: 0.55 Ω, Ta = 25°C, IO = 2.5 A)
- Micro-step mode is configurable as follows: full step/half step full-torque/half step/quarter step
- Excitation step moves forward only with step signal input
- Built-in output short protection circuit (latch method)
- Control power supply is unnecessary
- Built-in high-efficient drive function (supports half step full-torque/half step/quarter step excitation mode)
- Built-in step-out detection function (Step-out detection may not be accurate during high speed rotation)
- BiCDMOS process IC
- IO max=2.5 A
- Built-in thermal shut down circuit

### Applications

- Printer
- Surveillance camera (CCTV)
- Scanner
- Textile machine



LV8702V Application Diagram

| Device     | Type                   | VM Max (V) | VCC Max (V) | IO Max (A) | IO Peak Max (A) | Max Step Resolution | Control Type    | Features       | Package(s)        |
|------------|------------------------|------------|-------------|------------|-----------------|---------------------|-----------------|----------------|-------------------|
| AMIS-30422 | Stepper                | 30         | 40          | Note 1     | Note 1          | 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 |
| LC898240   | Stepper Controller     | Note 7     | Note 7      | —          | —               | 1/16                | Clock; SPI      | Note 7         | SQFP-48           |
| LV8417CS   | Brush DC               | 10.5       | 5.5         | —          | 3.8             | —                   | Parallel        | Note 3         | WLP-9             |
| LV8548MC   | Stepper/2x Brush DC    | 16         | 16          | —          | 1               | 1/2                 | Parallel        | Note 3         | SOIC-10NB         |
| LV8549MC   | Stepper                | 16         | 16          | —          | 1               | 1                   | Parallel        | Note 3         | SOIC-10NB         |
| LV8702V    | Stepper                | 36         | Note 2      | 2.5        | 3               | 1/4                 | Clock           | Note 3, 5, OCP | SSOP-44J          |
| LV8711T    | Stepper / 2xBrush DC   | 18         | 6           | 0.8        | 1               | 1/2                 | Parallel        | Note 3, OCP    | TSSOP-24          |
| LV8713T    | Stepper                | 18         | 6           | 0.8        | 1               | 1/32                | Clock           | Note 3         | TSSOP-24          |
| LV8714TA   | 2xStepper / 4xBrush DC | 18         | 6           | 1.5        | 1.75            | Over 1/256          | Parallel        | Note 3, 6, OCP | TQFP-48EP         |
| LV8729V    | Stepper                | 36         | Note 2      | 1.8        | 2.5             | 1/128               | Clock           | Note 3, OCP    | SSOP-44K          |
| LV8731V    | Stepper/2x Brush DC    | 36         | Note 2      | 2          | 2.5             | 1/16                | Clock; Parallel | Note 3, OCP    | SSOP-44K          |
| LV8734V    | Stepper / 2xBrush DC   | 36         | Note 2      | 1.5        | 1.75            | 1/8                 | Clock; Parallel | Note 3, OCP    | SSOP-44K          |
| LV8736V    | Stepper / 2xBrush DC   | 36         | Note 2      | 1          | 1.5             | 1/8                 | Clock; Parallel | Note 3, OCP    | SSOP-44K          |
| LV8740V    | Stepper / 2xBrush DC   | 38         | Note 2      | 2.5        | 3               | 1/4                 | Clock; Parallel | Note 3, OCP    | SSOP-44J          |
| LV8760T    | Brush DC               | 38         | 6           | 3          | 4               | —                   | Parallel        | Note 3, OCP    | TSSOP-20J         |

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

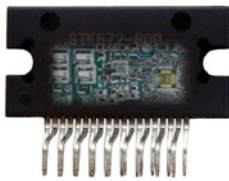
NOTE 7: Current controller for a stepper IC / AVDD Max = VDD1 Max = 4.6 V, VDD2 Max = 6.0 V

CONTROL & DRIVE

## Stepper Motor Drivers for Motion Control

### Features

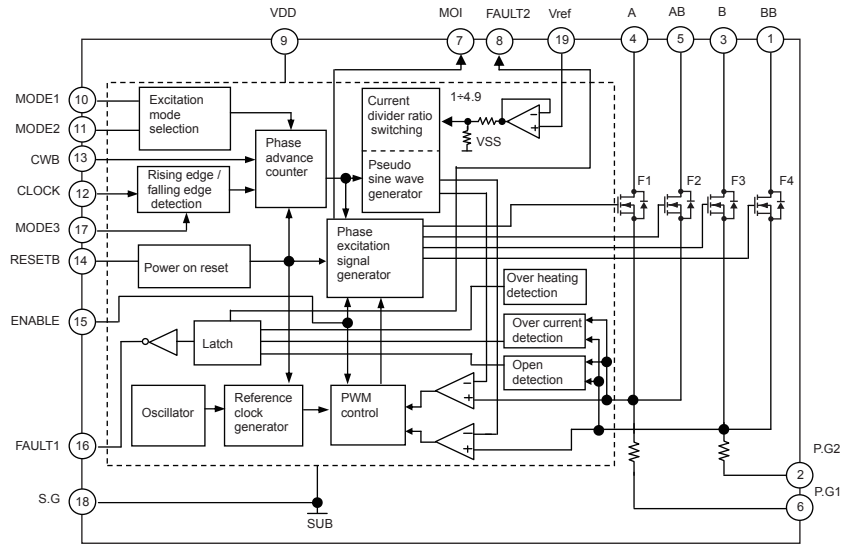
- For Unipolar Stepper Motor Drive by IPM (Intelligent Power Module)
- Current Sense, Fault Detections are Fully integrated
- Pin-compatible line up



SIP-19



SIP-19S



Block Diagram for STK672-440BN-E

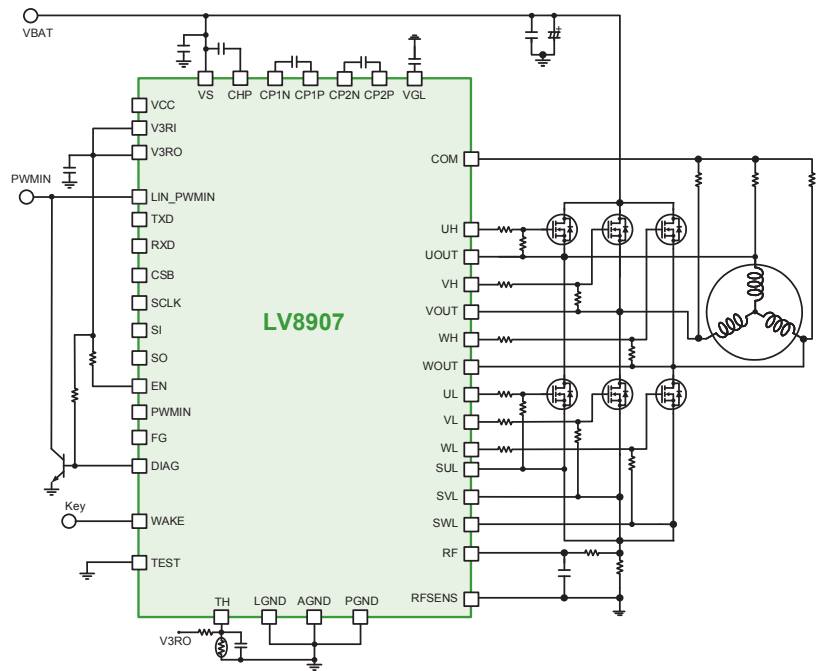
CONTROL & DRIVE

| Device         | Type    | V <sub>M</sub> Max (V) | V <sub>CC</sub> Max (V) | I <sub>O</sub> Max (A) | I <sub>O</sub> Peak Max (A) | Step Resolution | Control Type | Current Sense    | Fault Detection |         |      | Package(s) |
|----------------|---------|------------------------|-------------------------|------------------------|-----------------------------|-----------------|--------------|------------------|-----------------|---------|------|------------|
|                |         |                        |                         |                        |                             |                 |              |                  | 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     |

## Brushless DC Motor Control

### LV8907UW Features

- Integrated sensor-less control
- Integrated gate drivers for external power MOSFETs
- Integrated LIN transceiver and LDO
- Integrated protection (Under-voltage, Over-temperature, Over-current, Locked Rotor, PWM Fault)
- Operation up to 175°C junction temperature
- OTP for configuration and standalone operation
- SPI for real-time control
- VIN of 5.5 - 20 V
- SQFP-48 package



Standalone Configuration Application Diagram

| Device      | Description                           | V <sub>CC</sub> Max (V) | V <sub>M</sub> Max (V) | P <sub>O</sub> Max (W) | I <sub>O</sub> Max (mA) | Communication Sensor    | Package(s)  |
|-------------|---------------------------------------|-------------------------|------------------------|------------------------|-------------------------|-------------------------|-------------|
| LB11696V    | Brushless DC 3-Phase Motor Controller | 17                      | —                      | —                      | 30                      | 120-deg/3-Hall          | SSOP-30     |
| LB8503V     | Speed Controller                      | 6.5                     | 17                     | —                      | —                       | —                       | SSOP-16     |
| LV8121V     | Brushless DC 3-Phase Motor Driver     | 35                      | 35                     | 1.7                    | 3,500                   | 120-deg/3-Hall          | SSOP-44     |
| LV8139JA    | Brushless DC 3-Phase Motor Controller | 16.5                    | —                      | —                      | 30                      | 180-deg/3-Hall          | SSOP-30     |
| LV8316H     | Brushless DC 1-Phase Motor Driver     | 16                      | 16                     | 0.93                   | 2,000                   | 1-Hall                  | TSSOP-14 EP |
| LV8805SV    | Brushless DC 3-Phase Motor Driver     | 15                      | —                      | 0.3 - 0.95             | 1,200                   | 120-deg/Hall Sensorless | SSOP-20     |
| LV8806QA    | Brushless DC 3-Phase Motor Driver     | 6                       | 6                      | 0.8                    | 700                     | 120-deg/Hall Sensorless | QFN-16      |
| LV8811G/13G | Brushless DC 3-Phase Motor Driver     | 16                      | 16                     | 2.5                    | 2,000                   | 180-deg/1-Hall          | TSSOP-20    |
| LV8814J     | Brushless DC 3-Phase Motor Driver     | 16                      | 16                     | 1.31                   | 2,000                   | 180-deg/1-Hall          | SSOP-20     |
| LV8824QA    | Brushless DC 3-Phase Motor Pre-driver | 33                      | —                      | 1.45                   | 50                      | 120-deg/3-Hall          | VQFN-32     |
| LV8827LFQA  | Brushless DC 3-Phase Motor Driver     | 35                      | 35                     | 1.35                   | 1,500                   | 120-deg/3-Hall          | VQFN-24     |
| LV88551JA   | Brushless DC 1-Phase Motor Pre-driver | 16                      | 16                     | —                      | 50                      | 1-Hall                  | SSOP-20J    |
| LV88561JA   | Brushless DC 1-Phase Motor Pre-driver | 16                      | —                      | —                      | 50                      | 1-Hall                  | SSOP-20J    |
| LV8907UW    | Brushless DC 3-Phase Motor Pre-driver | —                       | 20                     | —                      | 50                      | 150-deg/Hall Sensorless | SQFP-48     |

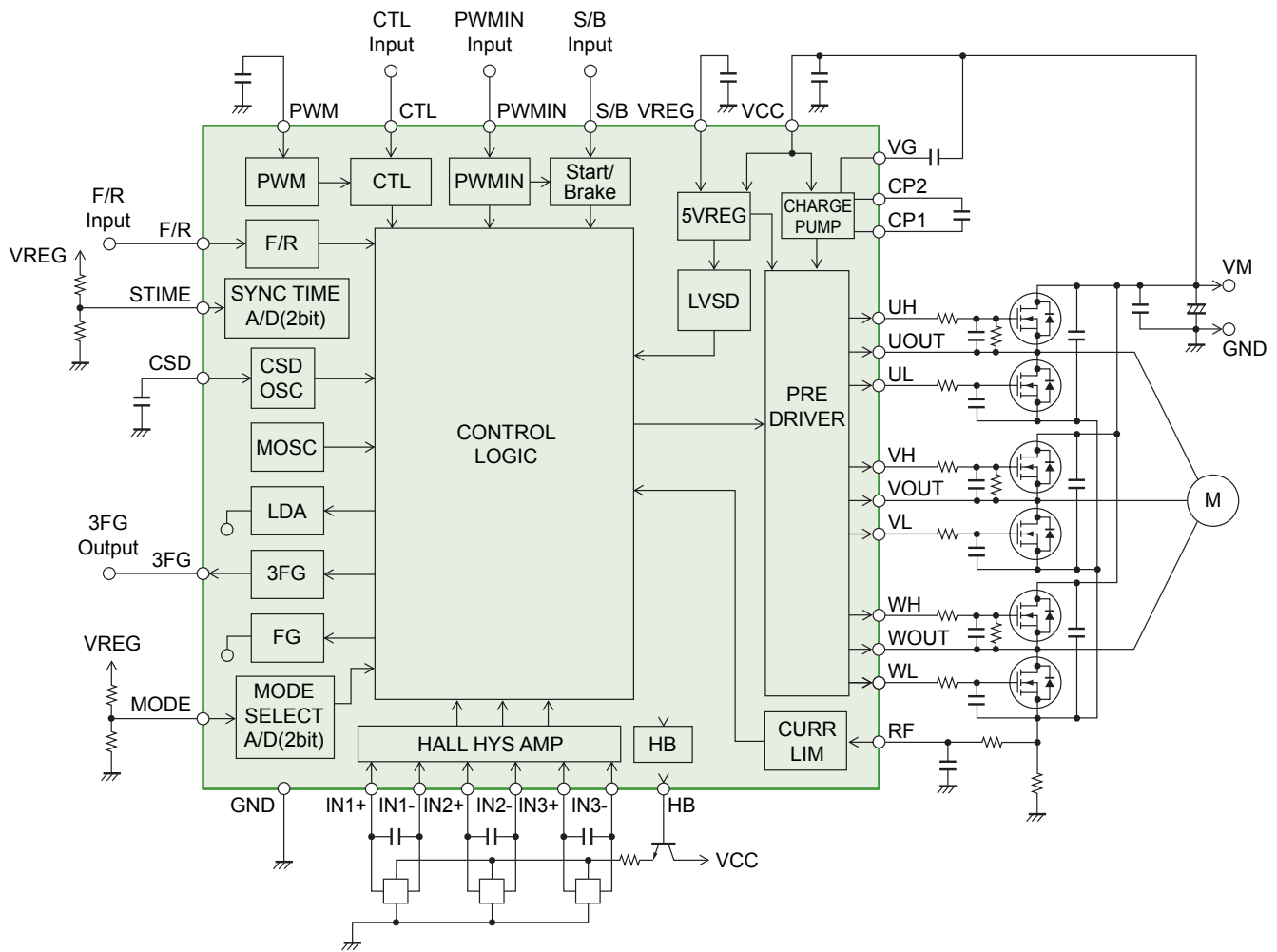


## Brushless DC Motor Control

### 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)

CONTROL & DRIVE



Application Diagram for LV8824QA

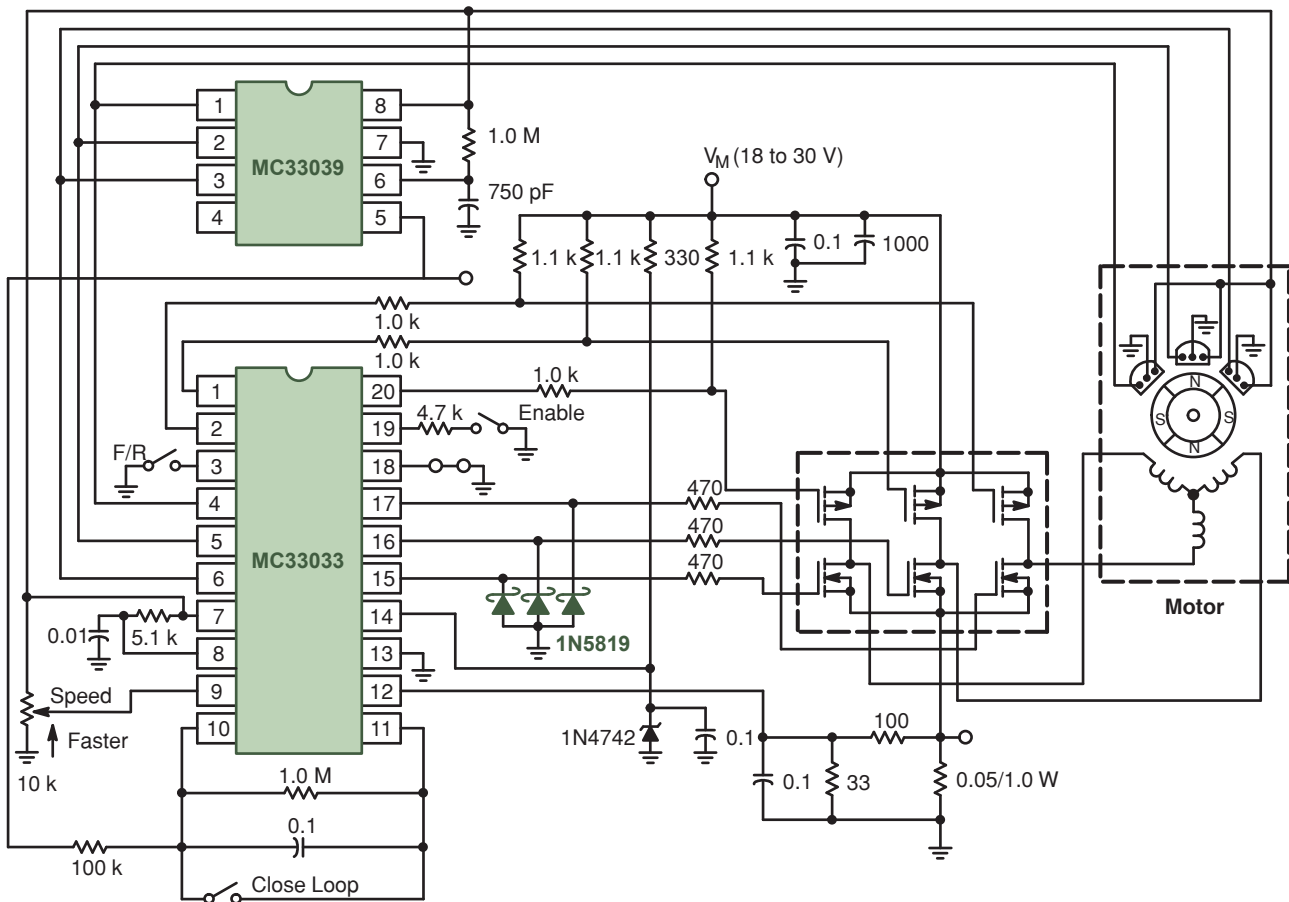
## Brushless DC Motor Control

### 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

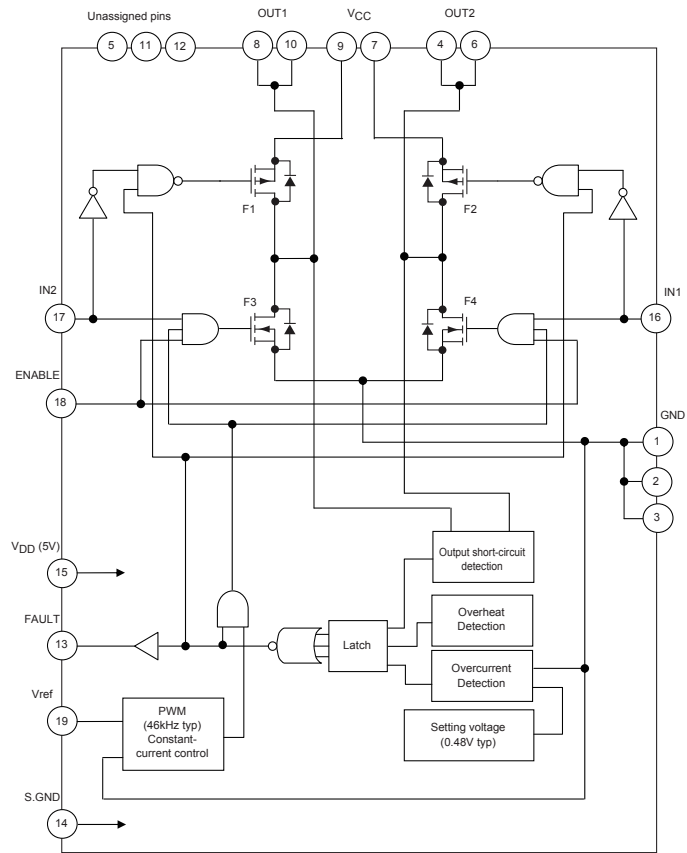
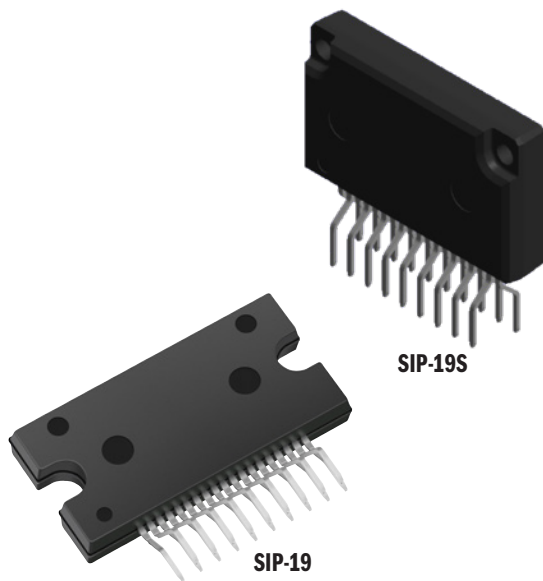


Application Diagram for MC33033 and MC33039

## Brush DC Motor Control

### Features

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



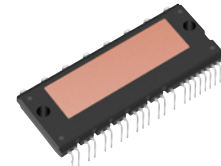
Block Diagram for STK681-332-E

| Device       | Type     | V <sub>M</sub> Max (V) | V <sub>CC</sub> Max (V) | I <sub>O</sub> Max (A) | I <sub>O</sub> Peak Max (A) | Control Type | Current Sense     | Fault Detection |         |      | Package(s) |
|--------------|----------|------------------------|-------------------------|------------------------|-----------------------------|--------------|-------------------|-----------------|---------|------|------------|
|              |          |                        |                         |                        |                             |              |                   | 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     |

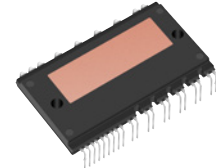
## Intelligent Power Modules (IPM) for Inverter Designs

### Features

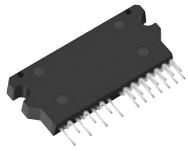
- 3-phase IGBT & MOSFET inverter including controllers for gate drive
- Support wide range of power ratings
- Single grounded power supply supported
- Protection functions such as under voltage and over current
- Optimized for low EMI
- High noise immunity
- High short-circuit and latch ruggedness
- Low thermal resistance
- DIP and SIP solutions



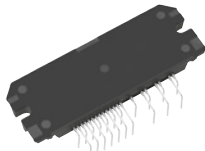
SPM-49 Package



SPM-31 Package



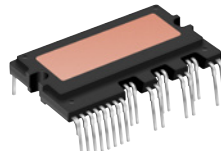
SIP-K Package



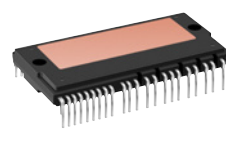
SIP-1A Package



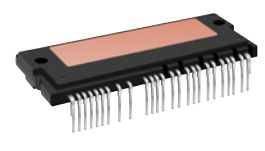
DIPS-3 Package



SPM-3V Package

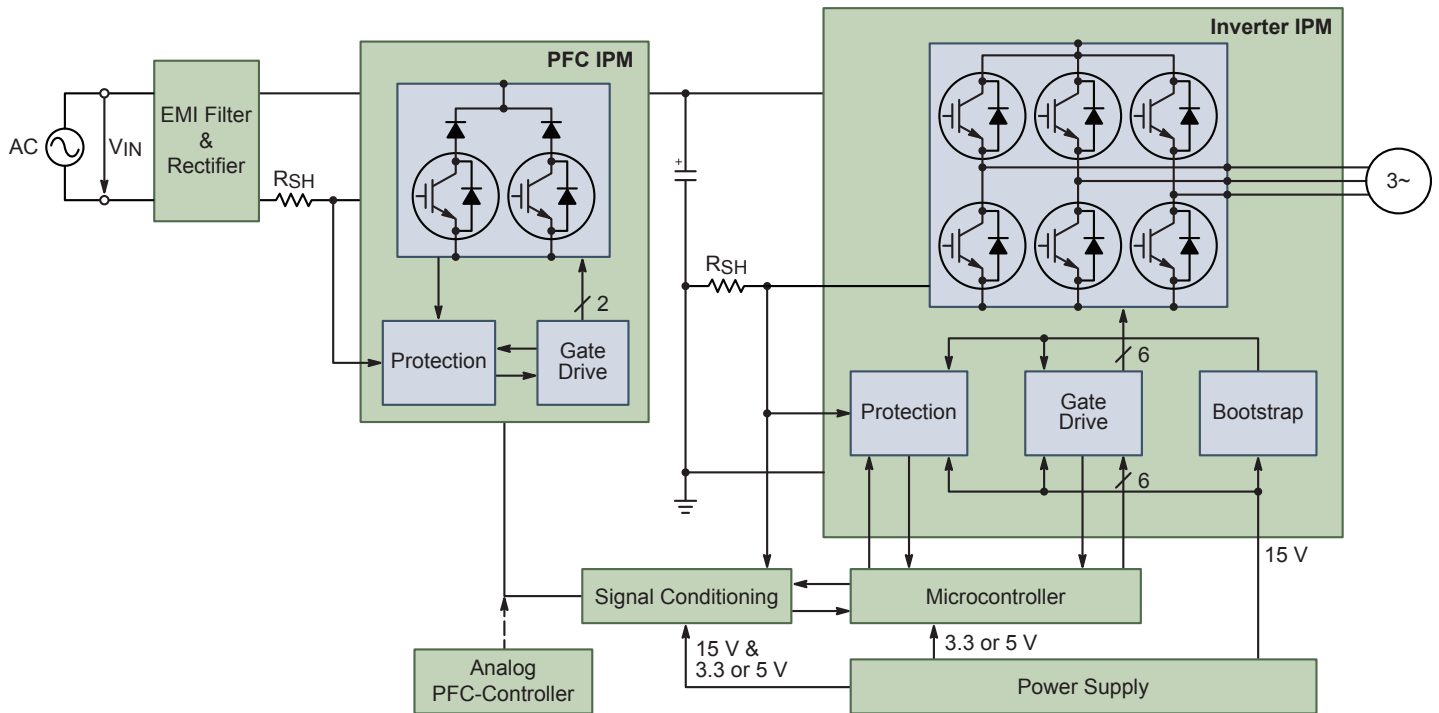


SPM-2V Package



SPM-34 Package

CONTROL & DRIVE



Application Block Diagram

## Intelligent Power Modules (IPM) for Inverter Designs

### Inverter IPMs

| Device          | Type                                  | VCE Max (V) | IC Max (A) | Substrate | Package(s) |
|-----------------|---------------------------------------|-------------|------------|-----------|------------|
| STK544UC63K-E   | 3 Emitter Pins                        | 600         | 10         | IMST      | SIP-1      |
| NFAP1060L3TT    | 3 Emitter Pins                        | 600         | 10         | IMST      | SIP-K      |
| STK554U362A/C-E | 3 Emitter Pins                        | 600         | 10         | IMST      | SIP-1A     |
| STK554U392A/C-E | 3 Emitter Pins                        | 600         | 15         | IMST      | SIP-1A     |
| STK5Q4U352J-E   | 3 Emitter Pins                        | 600         | 8          | DBC       | DIP-S3     |
| STK5Q4U362J-E   | 3 Emitter Pins                        | 600         | 10         | DBC       | DIP-S3     |
| FNA40560        | 3 Emitter Pins, fc = 5 kHz optimized  | 600         | 5          | Ceramic   | SPM-45H    |
| FNB40560        | 3 Emitter Pins, fc < 20 kHz optimized | 600         | 5          | Ceramic   | SPM-45H    |
| FNA40860        | 3 Emitter Pins, fc = 5 kHz optimized  | 600         | 8          | Ceramic   | SPM-45H    |
| FNA41060        | 3 Emitter Pins, fc = 5 kHz optimized  | 600         | 10         | Ceramic   | SPM-45H    |
| FNB41060        | 3 Emitter Pins, fc < 20 kHz optimized | 600         | 10         | Ceramic   | SPM-45H    |
| FNA41560T       | 3 Emitter Pins, fc = 5 kHz optimized  | 600         | 15         | Ceramic   | SPM-45H    |
| FNC42060F       | 3 Emitter Pins, fc = 5 kHz optimized  | 600         | 20         | Ceramic   | SPM-45H    |
| FNB43060T       | 3 Emitter Pins, fc < 20 kHz optimized | 600         | 30         | Ceramic   | SPM-45H    |
| FSBB15CH60D     | 3 Emitter Pins                        | 600         | 15         | DBC       | SPM-3V     |
| FSBB20CH60D     | 3 Emitter Pins                        | 600         | 20         | DBC       | SPM-3V     |
| FNB33060T       | 3 Emitter Pins                        | 600         | 30         | DBC       | SPM-3V     |
| FNB34060T       | 3 Emitter Pins                        | 600         | 40         | DBC       | SPM-3V     |
| FNB35060T       | 3 Emitter Pins                        | 600         | 50         | DBC       | SPM-3V     |
| FNA23060        | 3 Emitter Pins                        | 600         | 30         | DBC       | SPM-34     |
| FNA25060        | 3 Emitter Pins                        | 600         | 50         | DBC       | SPM-34     |
| FNA27560        | 3 Emitter Pins                        | 600         | 75         | DBC       | SPM-34     |
| NFAM3065L4BT    | 3 Emitter Pins                        | 650         | 30         | DBC       | SPM-31     |
| NFAM5065L4B/T   | 3 Emitter Pins                        | 650         | 50         | DBC       | SPM-31     |
| NFAL5065L4B/T   | 3 Emitter Pins                        | 650         | 50         | DBC       | SPM-49     |
| NFAL7565L4B/T   | 3 Emitter Pins                        | 650         | 75         | DBC       | SPM-49     |
| FSBB10CH120D/F  | 3 Emitter Pins                        | 1200        | 10         | DBC       | SPM-3V     |
| FSBB15CH120D/F  | 3 Emitter Pins                        | 1200        | 15         | DBC       | SPM-3V     |
| FSBB20CH120D/F  | 3 Emitter Pins                        | 1200        | 20         | DBC       | SPM-3V     |
| FNA21012A       | 3 Emitter Pins                        | 1200        | 10         | DBC       | SPM-34     |
| FNA22512A       | 3 Emitter Pins                        | 1200        | 25         | DBC       | SPM-34     |
| FNA23512A       | 3 Emitter Pins                        | 1200        | 35         | DBC       | SPM-34     |
| FNA25012A       | 3 Emitter Pins                        | 1200        | 50         | DBC       | SPM-34     |

### PFC IPMs

| Device       | Type                    | VCE Max (V) | IC Max (A) | Substrate | Package(s) |
|--------------|-------------------------|-------------|------------|-----------|------------|
| FBA42060     | Single Boost            | 600         | 20         | Ceramic   | SPM-45H    |
| FPAB20BH60B  | Single Boost            | 600         | 20         | DBC       | SPM-3V     |
| FPAB30BH60B  | Single Boost            | 600         | 30         | DBC       | SPM-3V     |
| FPDB40PH60B  | Bridgeless PFC          | 600         | 40         | DBC       | SPM-3V     |
| FPDB60PH60B  | Bridgeless PFC          | 600         | 60         | DBC       | SPM-3V     |
| FPAM30LH60   | 2-phase Interleaved PFC | 600         | 30         | DBC       | SPM-2V     |
| FPAM50LH60   | 2-phase Interleaved PFC | 600         | 50         | DBC       | SPM-2V     |
| NFL25065L4BT | 2-phase Interleaved PFC | 650         | 50         | DBC       | SPM-2V     |

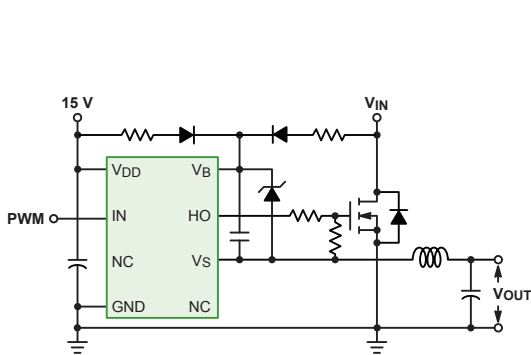
## High Voltage Gate Drivers (HVICs)

High voltage gate drivers (HVICs) from ON Semiconductor improve system reliability by utilizing an innovative common-mode dv/dt noise canceling circuit that provides excellent noise immunity. With a voltage capability up to 700 V and a very fast switching speed (dv/dt = 50 V/ns max), the devices are optimal for driving MOSFETs and IGBTs in a wide array of applications.

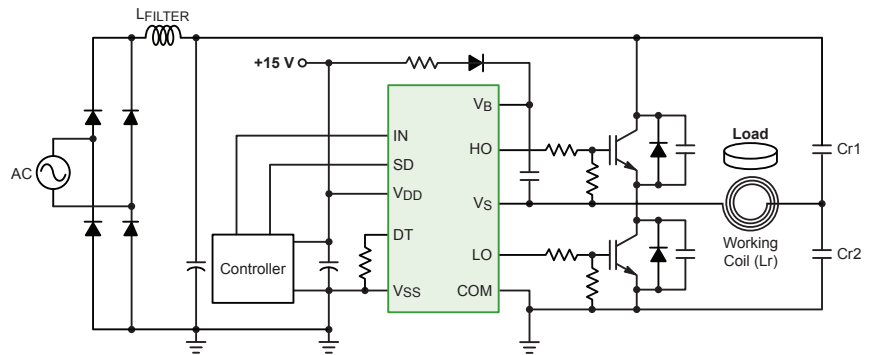
### Features

- Better noise immunity (due to noise canceling circuit over high dv/dt common-mode noise)
- Low power consumption (IQBS/IQCC are lower than competitor's device)
- dVs/dt transient immunity voltage level (50 V/ns)
- Extended allowable negative Vs swing to -9.8 V for signal propagation @ VCC = VBS = 15 V
- Matched propagation delay below 50 ns
- UVLO functions
- TTL compatible input threshold levels

CONTROL & DRIVE



High-Side Application Diagram



Half-Bridge Application Diagram

### High-Side Drivers

| Device   | Circuit       |                 | Offset Voltage (V) | Output Current |           | Delay Time |           | Shut Down | OCP | Typical Dead Time (ns) | Package(s) |
|----------|---------------|-----------------|--------------------|----------------|-----------|------------|-----------|-----------|-----|------------------------|------------|
|          | Type          | Input to Output |                    | Source (mA)    | Sink (mA) | Ton (ns)   | Toff (ns) |           |     |                        |            |
| FAN7361  | High-Side     | 1 to 1          | 600                | 250            | 500       | 120        | 90        | No        | No  | No                     | SOP-8      |
| FAN73611 | High-Side     | 1 to 1          | 600                | 250            | 500       | 120        | 90        | No        | No  | No                     | SOP-8      |
| FAN7362  | High-Side     | 1 to 1          | 600                | 250            | 500       | 120        | 90        | No        | No  | No                     | SOP-8      |
| FAN7371  | High-Side     | 1 to 1          | 600                | 4000           | 4000      | 150        | 150       | No        | No  | No                     | SOP-8      |
| FAN73711 | High-Side     | 1 to 1          | 600                | 4000           | 4000      | 150        | 150       | No        | No  | No                     | SOP-8      |
| FAN7385  | 2Ch High side | 2 to 2          | 600                | 350            | 650       | 110        | 110       | No        | No  | No                     | SOP-14     |
| FAN7385  | 2Ch High side | 2 to 2          | 600                | 350            | 650       | 110        | 110       | No        | No  | No                     | SOP-14     |
| TND523SS | High-Side     | 1 to 1          | 600                | 200            | 400       | 90         | 85        | No        | No  | No                     | SOP-8      |
| TND524VS | High-Side     | 1 to 1          | 600                | 200            | 400       | 90         | 85        | No        | No  | No                     | VEC-8      |

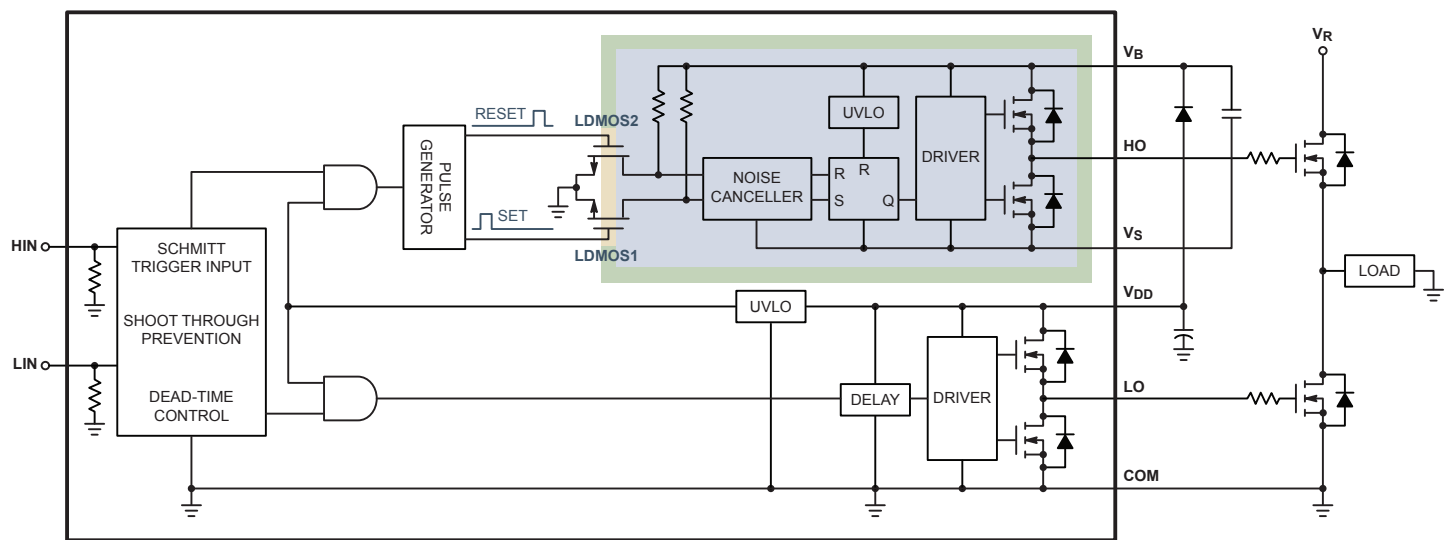


## High Voltage Gate Drivers (HVICs)

### High-Side & Low-Side Drivers

| Device    | Circuit         |                 | Offset Voltage (V) | Output Current |           | Delay Time |           | Shut Down | OCP | Typical Dead Time (ns) | Package(s)           |
|-----------|-----------------|-----------------|--------------------|----------------|-----------|------------|-----------|-----------|-----|------------------------|----------------------|
|           | Type            | Input to Output |                    | Source (mA)    | Sink (mA) | Ton (ns)   | Toff (ns) |           |     |                        |                      |
| FAN7382   | High & Low-Side | 2 to 2          | 600                | 350            | 650       | 170        | 200       | No        | No  | No                     | DIP-8, SOP-8, SOP-14 |
| FAN7390   | High & Low-Side | 2 to 2          | 600                | 4500           | 4500      | 140        | 140       | No        | No  | No                     | SOP-8, SOP-14        |
| FAN7390A  | High & Low-Side | 2 to 2          | 600                | 4500           | 4500      | 140        | 140       | No        | No  | No                     | SOP-14               |
| FAN73901  | High & Low-Side | 2 to 2          | 600                | 2500           | 2500      | 140        | 140       | No        | No  | No                     | SOP-8                |
| FAN7391   | High & Low-Side | 2 to 2          | 600                | 4500           | 4500      | 150        | 150       | No        | No  | No                     | SOP-14               |
| FAN7392   | High & Low-Side | 2 to 2          | 600                | 3000           | 3000      | 130        | 150       | Yes       | No  | No                     | WSOP-16              |
| FAN7842   | High & Low-Side | 2 to 2          | 200                | 350            | 650       | 170        | 200       | No        | No  | No                     | SOP-8                |
| FAN8811   | High & Low-Side | 2 to 2          | 100                | 3000           | 6000      | 30         | 28        | No        | No  | No                     | WDFN -10             |
| NCP5106A  | High & Low-Side | 2 to 2          | 600                | 250            | 500       | 100        | 100       | No        | No  | No                     | DIP-8, SOP-8, DFN-10 |
| NCP5109A  | High & Low-Side | 2 to 2          | 200                | 250            | 500       | 100        | 100       | No        | No  | No                     | SOP-8, DFN-10        |
| NCP5181   | High & Low-Side | 2 to 2          | 600                | 1400           | 2200      | 100        | 100       | No        | No  | No                     | DIP-8, SOP-8         |
| NCP5183   | High & Low-Side | 2 to 2          | 600                | 4300           | 4300      | 120        | 120       | No        | No  | No                     | SOP-8                |
| NCP51530A | High & Low-Side | 2 to 2          | 700                | 2200           | 1700      | 60         | 60        | No        | No  | No                     | SOIC-8, DFN-10       |
| NCP51530B | High & Low-Side | 2 to 2          | 700                | 2200           | 1700      | 25         | 25        | No        | No  | No                     | SOIC-8, DFN-10       |

CONTROL & DRIVE



HVIC Driver Block Diagram

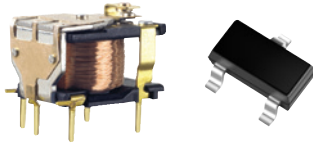
## High Voltage Gate Drivers (HVICs)

### Half Bridge Drivers

| Device   | Circuit                             |                    | Offset Voltage (V) | Output Current |           | Delay Time |           | Shut Down | OCP | Typical Dead Time (ns) | Package(s)           |
|----------|-------------------------------------|--------------------|--------------------|----------------|-----------|------------|-----------|-----------|-----|------------------------|----------------------|
|          | Type                                | Input to Output    |                    | Source (mA)    | Sink (mA) | Ton (ns)   | Toff (ns) |           |     |                        |                      |
| FAN7380  | Half-Bridge                         | 2 to 2             | 600                | 90             | 180       | 135        | 130       | No        | No  | 100                    | SOP-8                |
| FAN7383  | Half-Bridge                         | 1 to 2             | 600                | 350            | 650       | 500        | 170       | Yes       | No  | Variable               | SOP-14               |
| FAN73832 | Half-Bridge                         | 1 to 2             | 600                | 350            | 650       | 580        | 180       | Yes       | No  | Variable               | SOP-8                |
| FAN73833 | Half-Bridge                         | 2 to 2             | 600                | 350            | 650       | 150        | 140       | No        | No  | 450                    | SOP-8                |
| FAN7384  | Half-Bridge                         | 2 to 2             | 600                | 250            | 500       | 180        | 170       | Yes       | Yes | 120                    | SOP-14               |
| FAN7387  | Self Osc.                           | 1 to 2             | 600                | 350            | 650       | 550        | 160       | Yes       | No  | Variable               | SOP-8                |
| FAN7388  | 3-Phase Half-Bridge                 | 6 to 6             | 600                | 350            | 650       | 130        | 150       | No        | No  | 270                    | SOP-20               |
| FAN7389  | 3-Phase Half-Bridge                 | 6 to 6             | 600                | 350            | 650       | 500        | 500       | Yes       | Yes | 300                    | SOP-28               |
| FAN73892 | 3-Phase Half-Bridge                 | 6 to 6 (inverting) | 600                | 350            | 650       | 500        | 500       | Yes       | Yes | 290                    | SOP-28               |
| FAN73893 | 3-Phase Half-Bridge (MOSFET Target) | 6 to 6 (inverting) | 600                | 350            | 650       | 500        | 500       | Yes       | Yes | 320                    | SOP-28               |
| FAN73894 | 3-Phase Half-Bridge (IGBT Target)   | 6 to 6 (inverting) | 600                | 350            | 650       | 500        | 500       | Yes       | Yes | 320                    | SOP-28               |
| FAN73895 | 3-Phase Half-Bridge (MOSFET Target) | 6 to 6             | 600                | 350            | 650       | 500        | 500       | Yes       | Yes | 320                    | SOP-28               |
| FAN73896 | 3-Phase Half-Bridge (IGBT Target)   | 6 to 6             | 600                | 350            | 650       | 500        | 500       | Yes       | Yes | 320                    | SOP-28               |
| FAN73912 | Half Bridge                         | 2 to 2             | 1200               | 2000           | 3000      | 500        | 550       | Yes       | No  | 330                    | WSOP-16              |
| FAN7393A | Half Bridge                         | 1 to 2             | 600                | 2500           | 2500      | 530        | 130       | Yes       | No  | Variable               | SOP-14               |
| FAN73932 | Half Bridge                         | 1 to 2             | 600                | 2500           | 2500      | 600        | 200       | Yes       | No  | 400                    | SOP-8                |
| FAN73933 | Half Bridge                         | 2 to 2             | 600                | 2500           | 2500      | 160        | 160       | No        | No  | Variable               | SOP-14               |
| FAN7888  | 3-Phase Half-Bridge                 | 6 to 6             | 200                | 350            | 650       | 130        | 150       | No        | No  | 270                    | SOP-20               |
| FL73282  | Half Bridge                         | 2 to 2             | 900                | 350            | 650       | 150        | 150       | No        | No  | 170                    | SOP-8                |
| NCP1392B | Half Bridge                         | 1 to 2             | 600                | 500            | 1000      | N/A        | N/A       | No        | No  | 610                    | SOP-8                |
| NCP1392D | Half Bridge                         | 1 to 2             | 600                | 500            | 1000      | N/A        | N/A       | No        | No  | 305                    | SOP-8                |
| NCP1393B | Half Bridge                         | 1 to 2             | 600                | 1000           | 1500      | N/A        | N/A       | No        | No  | 610                    | SOP-8                |
| NCP5104  | Half Bridge                         | 1 to 2             | 600                | 250            | 500       | 620        | 100       | Yes       | No  | 520                    | DIP-8, SOP-8         |
| NCP5106B | Half Bridge                         | 2 to 2             | 600                | 250            | 500       | 100        | 100       | No        | No  | 100                    | DIP-8, SOP-8, DFN-10 |
| NCP5109B | Half Bridge                         | 2 to 2             | 200                | 250            | 500       | 100        | 100       | No        | No  | 100                    | SOP-8, DFN-10        |
| NCP5111  | Half Bridge                         | 1 to 2             | 600                | 250            | 500       | 750        | 100       | No        | No  | 650                    | DIP-8, SOP-8         |
| NCP5304  | Half Bridge                         | 2 to 2             | 600                | 250            | 500       | 100        | 100       | No        | No  | 100                    | DIP-8, SOP-8         |

## 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

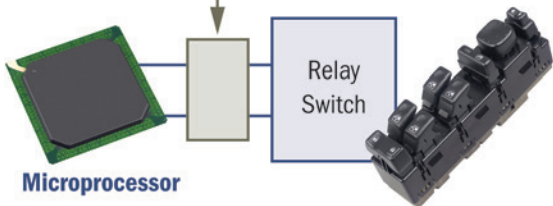
### Relay Drivers

| Device   | Configuration | Circuit Type * | Voltage (V) | Current (mA) | Package(s) |
|----------|---------------|----------------|-------------|--------------|------------|
| 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



CONTROL & DRIVE

## Operational Amplifiers for I/O Buffering and Signal Conditioning

### Low Noise Operational Amplifiers

| Device      | Channels | V <sub>S</sub> Min (V) | V <sub>S</sub> Max (V) | I <sub>Q</sub> /Ch (mA) | GBW (MHz) | V <sub>OS</sub> Max (mV) | V <sub>OS</sub> Drift (μV/°C) | I <sub>B</sub> (nA) | CMRR (dB) | e <sub>N</sub> (nV/√Hz) | Rail-to-Rail | Package(s)                         |
|-------------|----------|------------------------|------------------------|-------------------------|-----------|--------------------------|-------------------------------|---------------------|-----------|-------------------------|--------------|------------------------------------|
| MC33171/2/4 | 1, 2, 4  | 3                      | 44                     | 180                     | 1.8       | 4.5                      | 10                            | 20                  | 90        | 32                      | —            | SOIC-8, 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                      | —            | SOIC-8, WQFN-10, SOIC-14, TSSOP-14 |
| MC33178/9   | 2, 4     | 4                      | 36                     | 0.4                     | 5         | 3                        | 2                             | 100                 | 110       | 7.5                     | —            | SOIC-8, Micro8, 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                     | —            | SOIC-8                             |
| MC33078/9   | 2, 4     | 5                      | 18                     | 2.1                     | 16        | 2                        | 2                             | 300                 | 100       | 4.5                     | —            | SOIC-8, SOIC-14                    |
| MC33272/4   | 2, 4     | 3                      | 36                     | 2.2                     | 24        | 1                        | 2                             | 300                 | 100       | 18                      | —            | SOIC-8, SOIC-14, TSSOP-14          |
| MC33077     | 2        | 2.5                    | 18                     | 1.75                    | 37        | 1                        | 2                             | 280                 | 107       | 4.4                     | —            | SOIC-8                             |
| NCS20074    | 4        | 2.7                    | 36                     | 0.41                    | 3         | 3                        | 2                             | 0.005               | 111       | 20                      | Output       | SOIC-14, TSSOP-14                  |
| NCS21911    | 1        | 4                      | 36                     | 0.475                   | 2         | 0.025                    | 0.02                          | 100                 | 130       | 22                      | Output       | SOT-23-5                           |

### Current Sense Amplifiers

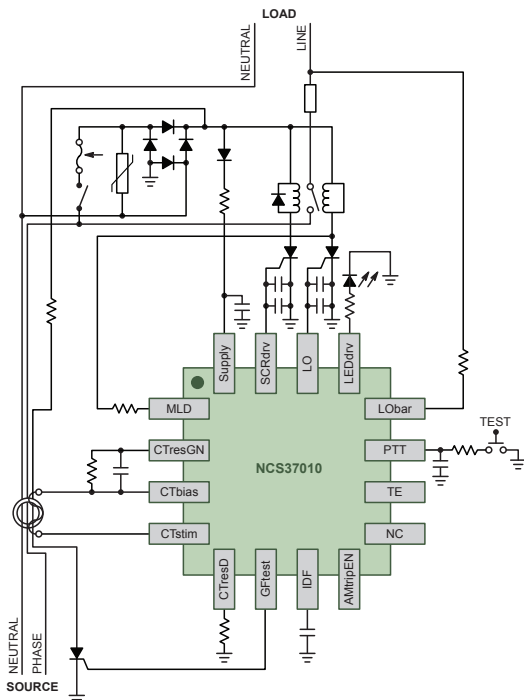
| Device           | Gain (V/V)     | Gain Error Max (%) | V <sub>S</sub> Min (V) | V <sub>S</sub> Max (V) | V <sub>CM</sub> (V) | I <sub>Q</sub> Typ (mA) | Bandwidth Typ (-3dB) | V <sub>OS</sub> Max (mV) | V <sub>OS</sub> Drift Max (μV/°C) | CMRR Typ (dB) | Package(s)                         |
|------------------|----------------|--------------------|------------------------|------------------------|---------------------|-------------------------|----------------------|--------------------------|-----------------------------------|---------------|------------------------------------|
| NCS199A1R/2R/3R  | 50/100/200     | ±1.5               | 2.2                    | 26                     | -0.3 to 26          | 0.04                    | 0.09                 | 0.15                     | 0.5                               | 120           | SC-88-6/SC-70-6/SOT-363-6          |
| NCS210R/1R/3R/4R | 50/100/200/500 | ±1                 | 2.2                    | 26                     | -0.3 to 26          | 0.04                    | 0.04                 | ±0.035                   | 0.5                               | 125           | SC-88-6/SC-70-6/SOT-363-6, UQFN-10 |

## Ground Fault/Earth Leakage Detection and Protection

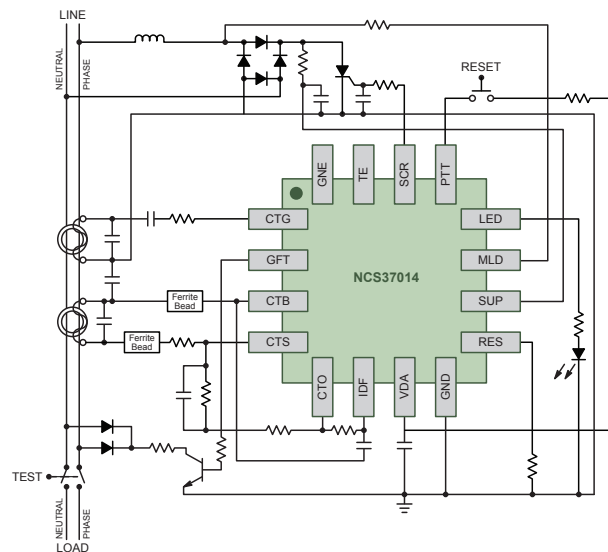
### Features

- Broad selection of GFCI controllers for a variety of applications
- Proprietary solutions for Ground Fault and Grounded Neutral Fault sensing
- Auto-monitoring (Self-Test) functions enabled for updated UL943/B
- Industrial grade reliability and quality
- Customized solutions available

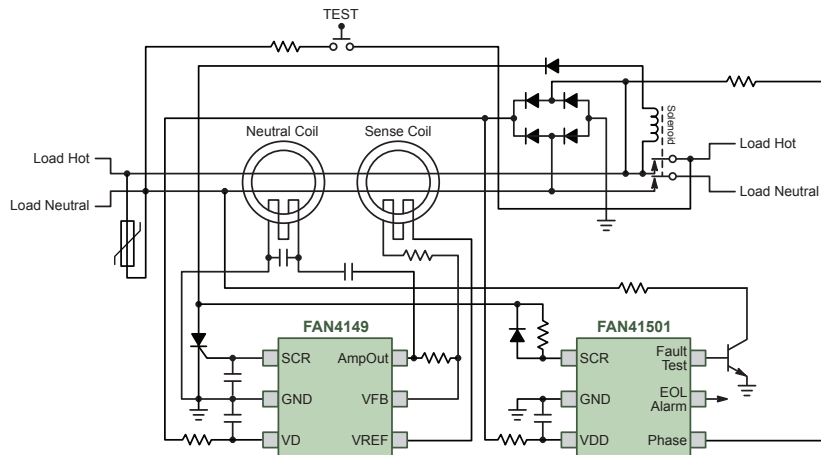
### Self-Test GFCI Solutions



**NCS37010 with a Single Coil for Both GN and GNF Sensing**



**NCS37014 with Two Coils for Low Power Consumption**

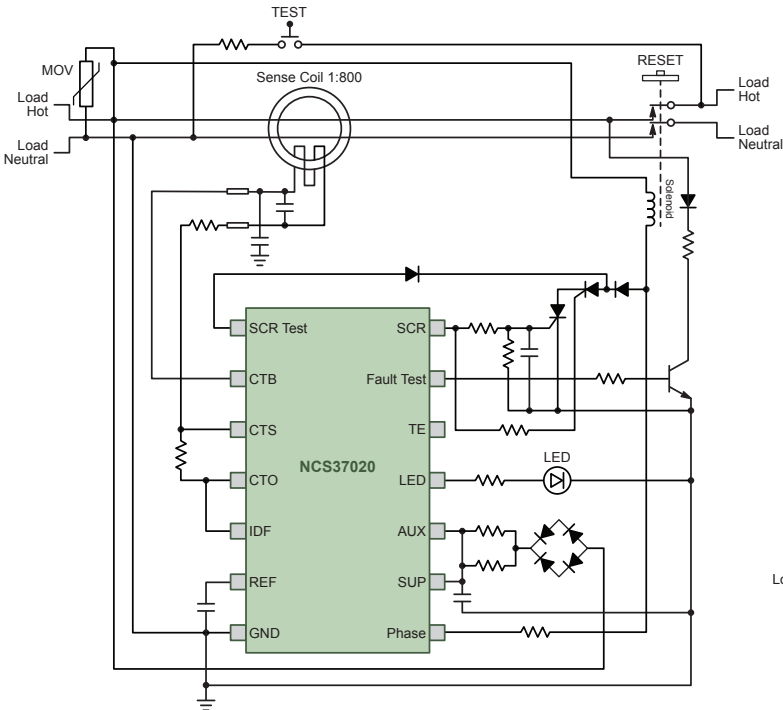


**FAN4149 + FAN41501 Combination with Two Coils for Ease of Design**

CONTROL & DRIVE

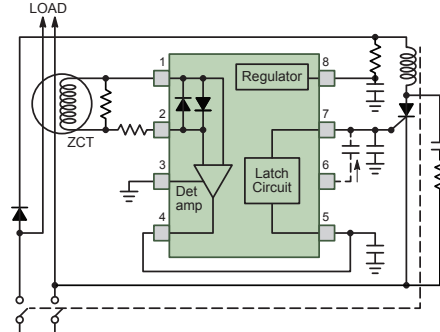
## Ground Fault/Earth Leakage Detection and Protection

### Self-Test ALCI/RCD Solution



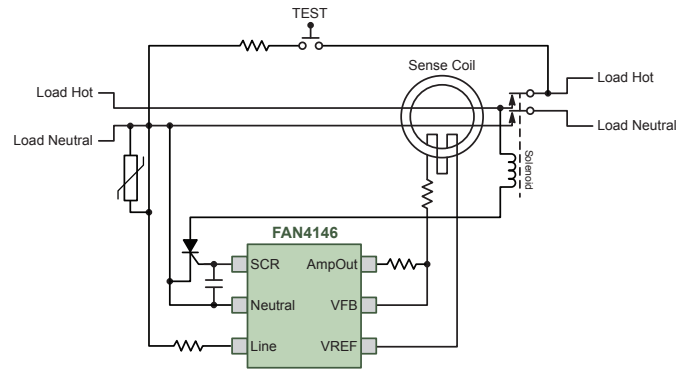
NCS37020 for Single Coil Self-Test

### Residual Current Device



KA2803B for M54123 Equivalent KA2803C with Extended Operating Temperature

### General Purpose



FAN4146E

| Device    | Function                  | Differential Fault | Grounded-Neutral Fault | Electrical Standard       | Current Transformer | Electronic Lockout | Operating Temperature (°C) | Device  | Package(s)       |
|-----------|---------------------------|--------------------|------------------------|---------------------------|---------------------|--------------------|----------------------------|---|------------------|
| NCS37010  | Self Test GFCI Controller | ✓                  | ✓                      | UL943, UL2231             | Single coil         | ✓                  | -40 to +85                 | Receptacle, circuit breaker, portable power plug  | QFN-16, TSSOP-16 |
| NCS37014* | Self Test GFCI Controller | ✓                  | ✓                      | UL943, UL2231             | Dual coil           |                    | -40 to +95                 | Receptacle, circuit breaker, portable power plug  | QFN-16           |
| FAN4149   | Self Test GFCI Controller | ✓                  | ✓                      | UL943, UL2231             | Dual coil           |                    | -35 to +85                 | Receptacle, circuit breaker, portable power plug  | SOT-23-6         |
| FAN41501  | Self Test Monitor         | ✓                  | ✓                      | UL943, UL2231             | N/A                 |                    | -35 to +85                 | Receptacle, circuit breaker, portable power plug  | SSOT-6           |
| NCS37020* | Self Test ALCI Controller | ✓                  |                        | UL943B                    | Single coil         |                    | 0 to +70                   | Portable appliances, products requiring self-test | TSSOP-14         |
| FAN4146E  | ALCI/RCD/ELB Controller   | ✓                  |                        | IEC 61008/9, GB/T 16916/7 | Single coil         |                    | -35 to +85                 | General use, compact solution for appliances      | SSOT-6           |
| KA2803B   | RCD/ELB Controller        | ✓                  |                        | IEC 61008/9, GB/T 16916/7 | Single coil         |                    | -25 to +80                 | General use, circuit breaker, portable power plug | SOP-8, DIP-8     |
| KA2803C   | RCD/ELB Controller        | ✓                  |                        | IEC 61008/9, GB/T 16916/7 | Single coil         |                    | -25 to +100                | General use, circuit breaker, portable power plug | SOP-8            |

\* Pending 3Q19.

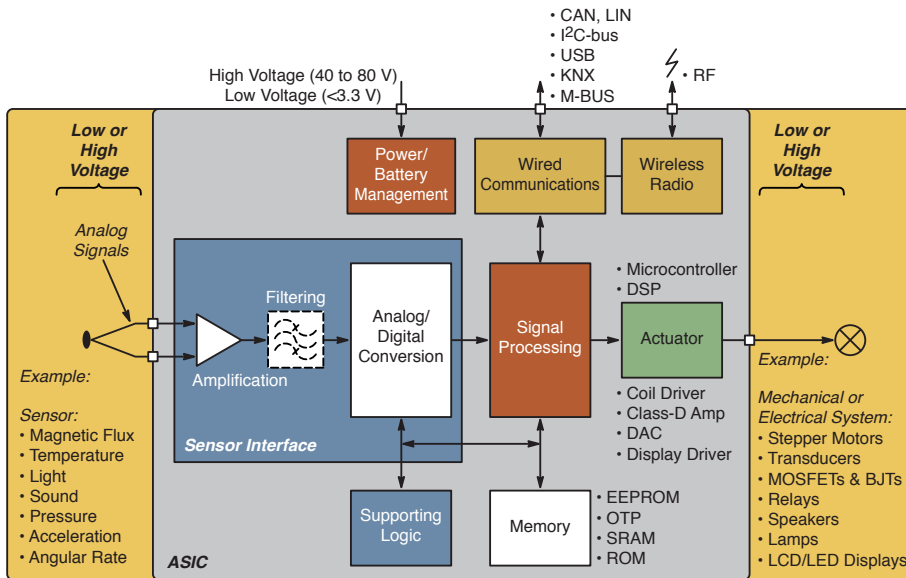
## Mixed-Signal ASIC Development Services

### 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

- $\geq 55$  nm, analog-focused CMOS/BCDMOS process technologies utilizing internal fabs and external foundry partners
- Low, medium, high voltages –  $\leq 1$  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                  |

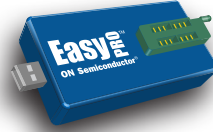
CONTROL & DRIVE



## EEPROMs for Configuration and Calibration

### Features

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



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

### EEPROMs

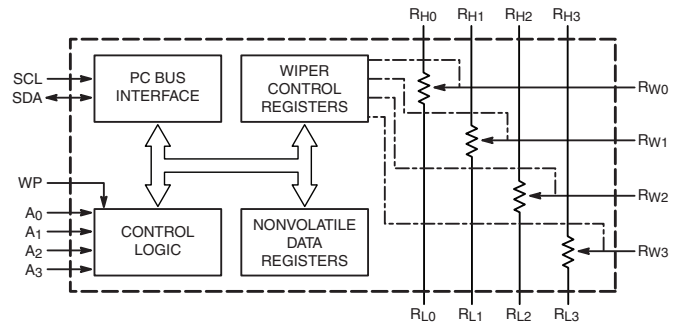
| Data Transmission Standard | Density           | Organization*      | V <sub>CC</sub> Min (V) | V <sub>CC</sub> Max (V) | f <sub>CLK</sub> Max (MHz) | Package(s)  |
|----------------------------|-------------------|--------------------|-------------------------|-------------------------|----------------------------|---|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

\* Organization for Microwire devices is selectable.

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

COMPONENTS

## Standard Logic and MiniGate™

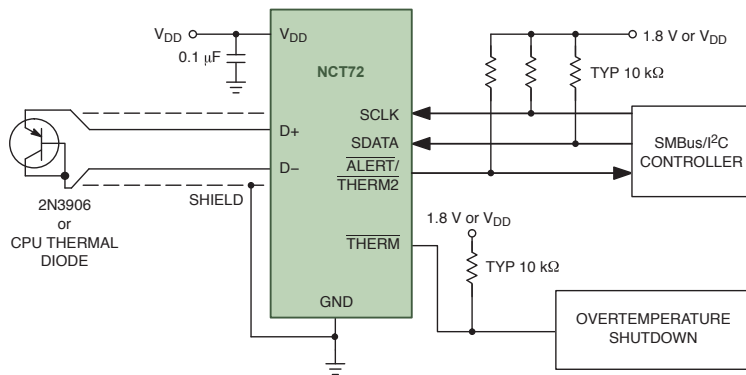
### Available logic functions

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

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

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

## 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(s)            |
|--------|------------------|-----------|---------------------|---------------------|----------------------------------|------------------------|-----------------------|
| 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         |

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