NOVOSENSE
纳芯微电子

MOTOR DRIVER INTRODUCTION

NOVOSENSE

2023 Q1

Motor Driver Application

Stepper Motor

Product: 40-60V Dual Stepper Motor Driver

- MOSFET integrated
- Fast Decay/Slow Decay/Mixed Decay
- Micro-stepping
- Current regulation
- Fully protected

Product: NSD8641/8644/NSD8381

Automotive:
- AFS, Water Valve, Coolant Valve

Industrial:
- Refrigerator, Surveillance, ATM, EPOS, Printer, Textile, Stage lighting, 3D printer





Relay & Solenoid

Product: 40-60V Multi channel smart driver with diagnosis

- Multi channel ½ H Bridge wit diagnosis
- Low side driver with diagnosis
- SPI with daisy chain

Product: NSD5604/NSD12409/NSD12416

Automotive :
- Domain Controller, VCU，BCM，Thermal System，Electric Mirror

Industrial :
- Industrial Automation，PLC，Massage Chair，Textile，Commercial HVAC





Brushed DC Motor

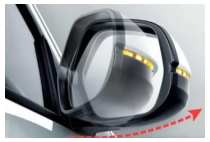
Product: 40-60V Brushed DC Motor Driver

- Pre-Driver & MOSFET Integrated
- Integrated current mirror for sensing
- Slew Rate control
- Current regulation
- Fully protected

Product: NSD731x, NSD830x, NSD360x

Automotive :
- OBC, Door, Trunk, Window, Wiper, Mirror, Seat, Thermal System, Throttle

Industrial :
- Vacuum Robotic, Coffee Machine, Elock EPOS, Printer, Textile, Pump, Massage






Brushless DC Motor

Product：40-100V Brushless DC Motor

- Pre-Driver & MOSFET Integrated
- External MOSFET diagnosis
- Slew rate control
- Fully protected

Product: NSD36xx(Concept)

Automotive:
- Pump，Valve，SCR，Fan, EPS, Transmission, GDU, Brake

Industrial:
- E-bike, Power Tool, Appliance, AGV, Industrial Robotics, Garden Tool.





Motor Driver RoadMamp

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RTMed
Sampling
In Design

Industrial & Appliance

DC Motor Drivers

- NSD7310L — 5V-40V, H-Bridge, Peak 3.5A, 600m Ohm, HSOP8
- NSD7310/2Q1 — 5V-40V, H-Bridge, Peak 3.5A, 520m Ohm, HSOP8
- NSD7314L — 4.5V-40V, H-Bridge, Peak 6A, 200m HTSSOP16, Sample Q1 2023
- NSD7314-Q1 — 4.5V-40V, H-Bridge, Peak 6A, 200m HTSSOP16
- NSD7640 — 8V – 60V, H-Bridge, Peak 6A, 200m(HS + LS) HTSSOP28, Sample Q1 2023
- NSD7315-Q1 — 4.5V-40V, H-Bridge, Peak 10A, 150m, SPI, HTSSOP24

NSD7312-Q1: 560mOhm OBC Elock
Replacement: DRV8872-Q1(P2P)
NSD7314-Q1: 200mOhm Door Elock/Elatch
Replacement : DRV8874-Q1 (P2P), VNH5200
NSD7315-Q1: 150mOhm Throttle/Door Handle
Replacement : DRV8873-Q1 (P2P), L9960

Relay & Solenoid

- NSD5604 — 8V - 60V, 4 Low Side Driver, 260mOhm, HTSSOP-20/TSSOP-16
- NSD5604-Q1 — 8V - 60V, 4 Low Side Driver, 260mOhm, HTSSOP-16, Sample 2023 Mar
- NSD56008-Q1 — 5.5V - 40V, 8 Channel Low Side Driver, Peak 1.1A, Rds(on) = Low Side 1 Ohm, SPI, HTSSOP-24
- NSD12409-Q1 — 2CH Rdson 90mohm, SOP-8, Sample 2023 Feb
- NSD11/2416-Q1 — 1/2CH Rdson 160mohm, SOP-8/SOT-223, Sample 2023 Feb

NSD56008-Q1: 8 Channel Low side driver
Replacement : TLE75008 (P2P), NCV7240

NSD11/216/09-Q1: 1/2 Channel Low side driver
Replacement : VNLD5090(P2P), VNL5160(P2P), VNLD5160(P2P)

Stepers and Multi-CH 1/2 H Bridge

- NSD8308/06 Q1 — 5.5-40V, 8 x HB Driver, Peak 1.1A, 1.5 Ohm, SPI, HTSSOP24
- NSD8641 — 8V – 60V, H-Bridge, Peak 2.5A, 400m(HS + LS) HTSSOP28
- NSD8644 — 8V – 60V, H-Bridge, Peak 2.5A, Bipolar Supply, 400m(HS + LS) HTSSOP28
- NSD8381 Q1 — 5.5V - 40V, 32 Micro stepping, 4 x HB Driver 1200mOhm, QFN40/QFN32, Sample Q3 2023
- NSD8312/10 Q1 — 5.5-40V, 12 x HB Driver, Peak 1.1A, 1.5 Ohm, SPI, HTSSOP24

NSD8381-Q1: 1/32 Micro-step Stepper
Replacement : L99SM81(P2P), NCV7051x/21

NSD8308/06/12-Q1: 6/8/10/12 Channel Half Bridge Driver
Replacement : DRV8912/10/08/06(P2P), TLE94112/10/08/06(P2P)

Pre-driver

- NSD3608 Q1 — 4.9-40V, 8 x HB Pre-Driver, with two CS, SPI Enabled, QFN56, Sample 2023 Q1
- NSD3604 Q1 — 4.9-40V, 4 x HB Pre-Driver, SPI, QFN40/56, Sample 2023 Q1
- NSD3602 — 4.9-40V, 2 x HB Pre-Driver, SPI, QFN24/32, Sample 2023 Q3

NSD3608/04-Q1: 8 Channel Half Bridge Pre-Driver
Replacement : DRV8718/4(P2P), TLE92108/04

NSD3602-Q1: 2 Channel Half Bride Pre-Driver
Replacement : DRV8705/6(P2P)

2022 2023

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Industrial Motor Driver

Textile Machine & Massage Chair

Solenoid Driver
NSD5604N（AMR 55V Clamp）

Needle Driver
NSD8644

Massage Motor
NSD7314L (AMR 40V)
NSD7640 (AMR 60V)

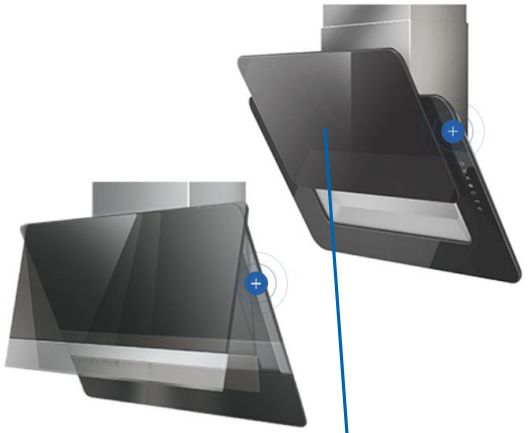
Air Pump
NSD5604(AMR 55V Clamp)

Head Move
NSD8641 (AMR 60V)

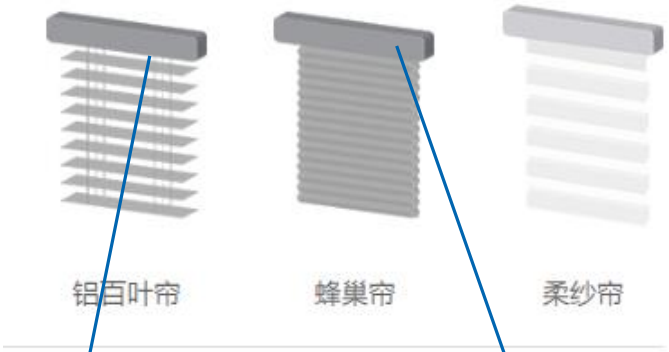
X/Y Move
NSD8641 (AMR 60V)

Paper Cut
NSD731xL

Lift
NSD7640
NSD7314



Hood Lift/Shift
NSD7314



BDC Motor >35mm
NSD7314

BDC Motor <35mm
NSD7310/NSD7310L

Wheel/Brush
NSD7310A/NSD7310L

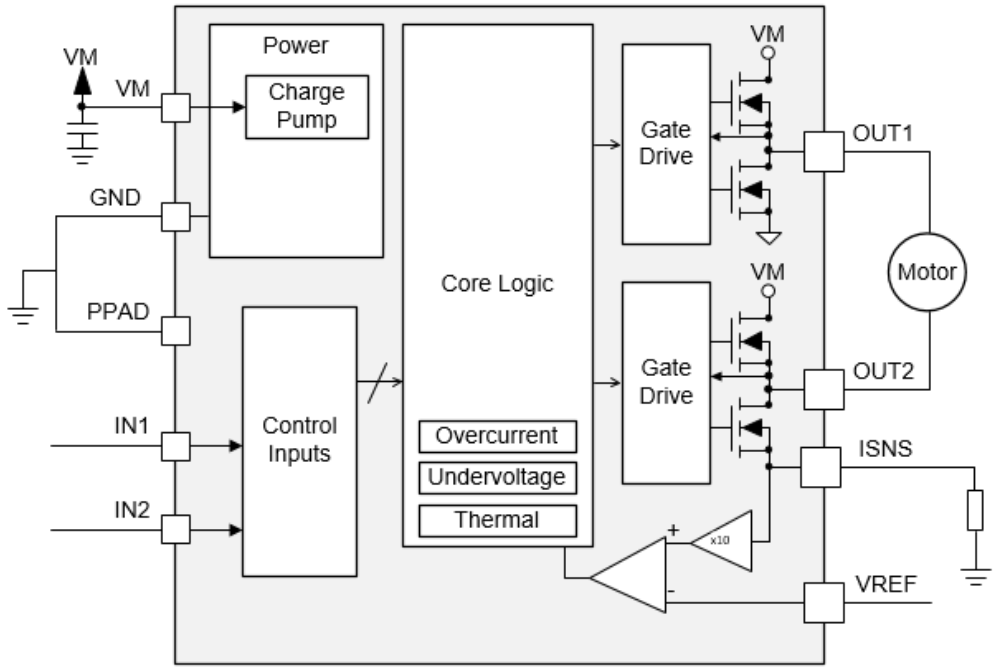
40V BRUSHED DC DRIVER WITH INTERNAL CURRENT SENSE

Features

- **Single H bridge motor driver**
  - Supply voltage: **4.5 to 36 V (abs max 40 V)**
  - Peak Current: **3.6 A**
  - RDS(ON): **520 mΩ HS + LS (at 24 V, 25°C)**
- **Devices in the Family:**
  - NSD7310: Current regulation
  - NSD7310A: Integrated Current Sensing
  - NSD7312-Q1: Includes nFAULT pin (VREF is set internally)
- **Inrush current protection**
  - PWM current regulation
- **Fully Protected:**
  - Supply undervoltage UVLO
  - Overcurrent protection
  - Thermal shutdown
- **Package:**
  - Small 8 pin HSOIC package: 4.9mm x 6mm
- **Drop-in replacement of :**
  - DRV8870
  - A4950

Applications

- ePOS & Currency Counting
- ATM Machine
- Laser-Beam Printers
- Vacuum Robotics



40V BRUSHED DC DRIVER WITH INTERNAL CURRENT SENSE

Features

- **Single H bridge motor driver**
  - Supply voltage: **4.5 to 36 V (abs max 40 V)**
  - Peak Current: **3.6 A**
  - RDS(ON): **600 mΩ HS + LS (at 24 V, 25°C)**
- **Devices in the Family:**
  - NSD7310L: Current regulation
- **Inrush current protection**
  - PWM current regulation
- **Fully Protected:**
  - Supply undervoltage UVLO
  - Overcurrent protection
  - Thermal shutdown
- **Package:**
  - Small 8 pin HSOIC package: 4.9mm x 6mm
- **Drop-in replacement of :**
  - DRV8870
  - A4950

Applications

- ePOS & Currency Counting
- ATM Machine
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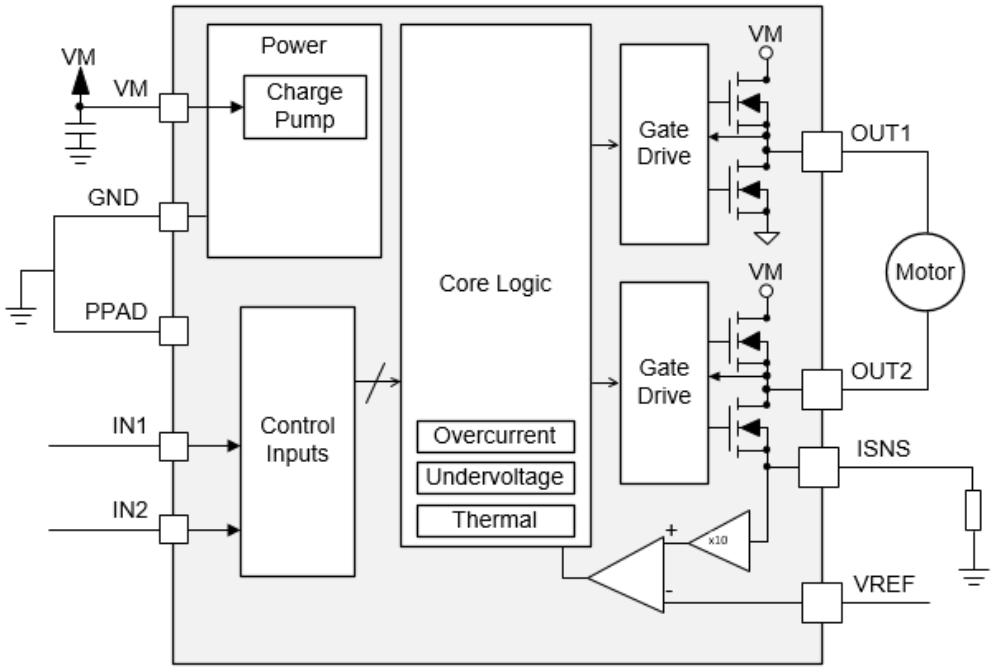


NSD7310/NSD7310A Comparison Table

GPN	NSD7310	NSD7310A	NSD7310L	NSD7312	AT8870	DRV8870	DRV8872	A4950
Supplier	NOVOSENSE	NOVOSENSE	NOVOSENSE	NOVOSENSE	ZKM	TI	TI	Allegro
Number of Full Bridges	1	1	1	1	1	1	1	1
Operating Voltage Min (V)	5	5	5	5	6.5	6.5	6.5	8
Operating Voltage Max (V)	36	36	36	36	38	45	45	40
Abs Max Voltage Support (V)	40	40	40	40	40	50	50	40
Peak Current (A)	3.6	3.6	3.6	3.6	3.6	3.7	3.6	3.5
Typical RDSon (HS+LS) (mOhms)	520	520	**600**	520	350	565	565	600
Control Mode	PWM	PWM	PWM	PWM	PWM	PWM	PWM	PWM
Control Interface	Hardware (GPIO)	Hardware (GPIO)	Hardware (GPIO)	Hardware (GPIO)	Hardware (GPIO)	Hardware (GPIO)	Hardware (GPIO)	Hardware (GPIO)
Max PWM Frequency (kHz)	200	200	200	200	N/A	200	200	N/A
Typical Sleep Current 25°C (uA)	10	10	10	10	10	3	10	10
Integrated Current Sense Amplifier (Y/N)	N	Y	N	N	N	N	N	N
Typical Current Sense Accuracy (+/-__%)	N/A	10%	N/A	N/A	N/A	N/A	N/A	N/A
External power sense resistor required (Y/N)	Y	N	Y	Y	N	Y	Y	Y
UVLO, OCP, TSD (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y
nFAULT Pin (Y/N)	N	N	N	Y	N	N	Y	N
Integrated Current Sensing	N	Integrated Current Sensing	N	N	N	N	N	N
Current Regulation	Current Regulation	Current Regulation	Current Regulation	Current Regulation	Current Regulation	Current Regulation	Current Regulation	Current Regulation
Operating Ambient (°C)	-40 to 125	-40 to 125	-40 to 125	-40 to 125	-40 to 125	-40 to 125	-40 to 125	–40 to 125
MaxJunctionTemp (°C)	150	150	150	150	150	150	150	150
Package	HSOP-8	HSOP-8	HSOP-8	HSOP-8	HSOP-8	HSOP-8	HSOP-8	HSOP-8

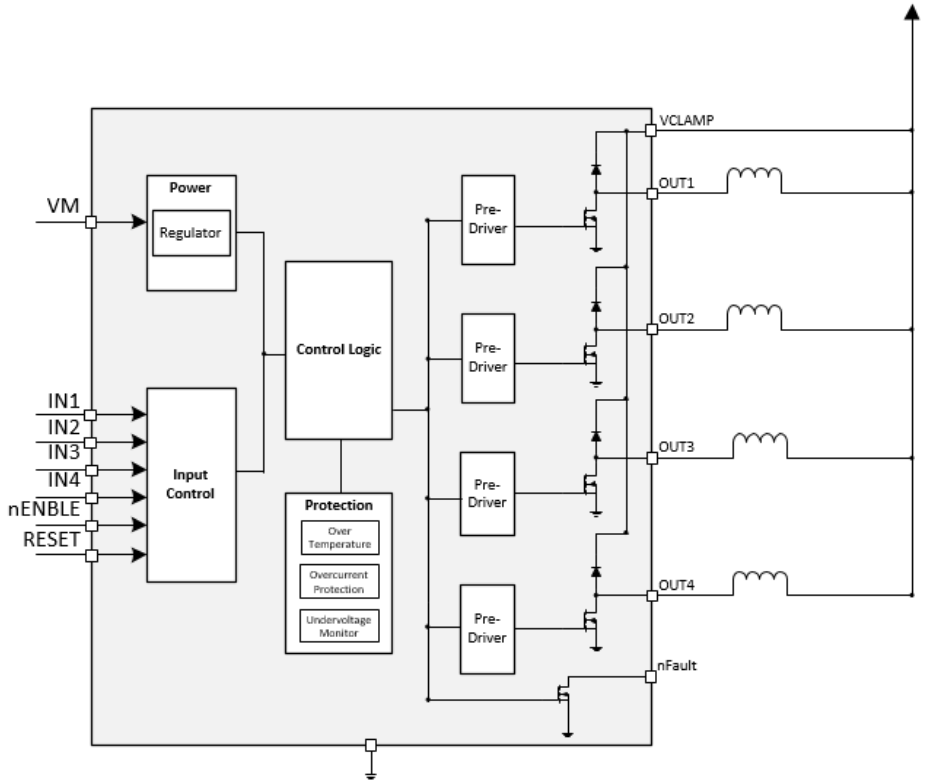
55V LOW SIDE DRIVER

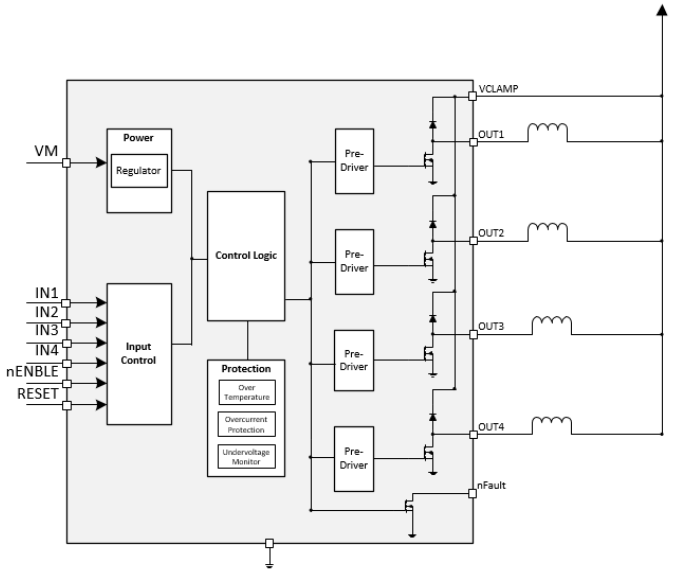
Features

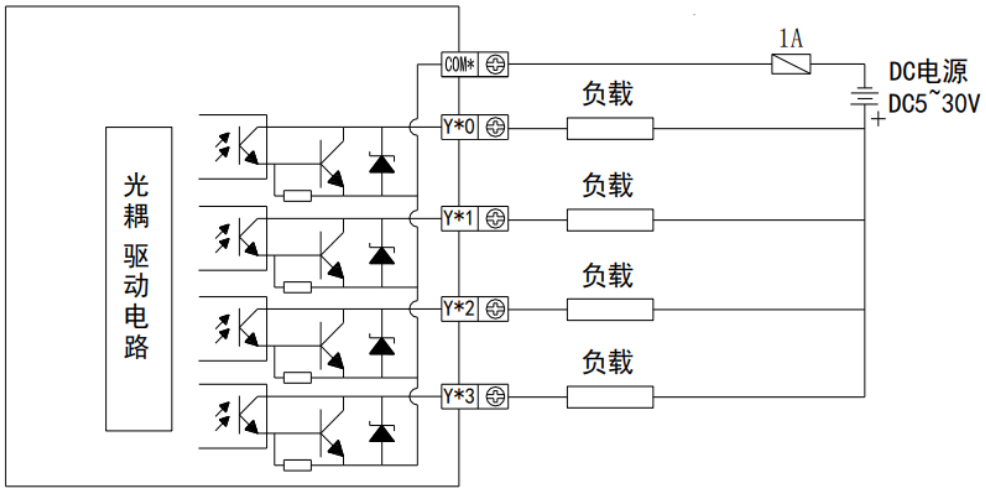
- Quad ½-H bridge motor driver
  - Supply voltage: **8 to 50 V (abs max 55 V)**
  - Peak Current: **500m A per channel**
  - RDS(ON): **260 mΩ LS** (at 24 V, 25°C)
- Output works up to 200kHz Switching Frequency
- Parallel configurations supported
- Typ Overcurrent 3A
- Integrated 5V 20mA Output
- **Enhanced ESD Protection**
  - IEC61000-4-2 Contact 8kV, Air 16kV
- **Fully Protected:**
  - Supply and charge pump undervoltage
  - Overcurrent protection
  - Thermal shutdown
- **Drop-in replacement of :**
  - DRV8803
  - IPS4260
- **Package**
  - HTSSOP-16
  - HTSSOP-20

Applications

- Textile & Factory Automation
- Programmable Logic Controller
- Relay Driver





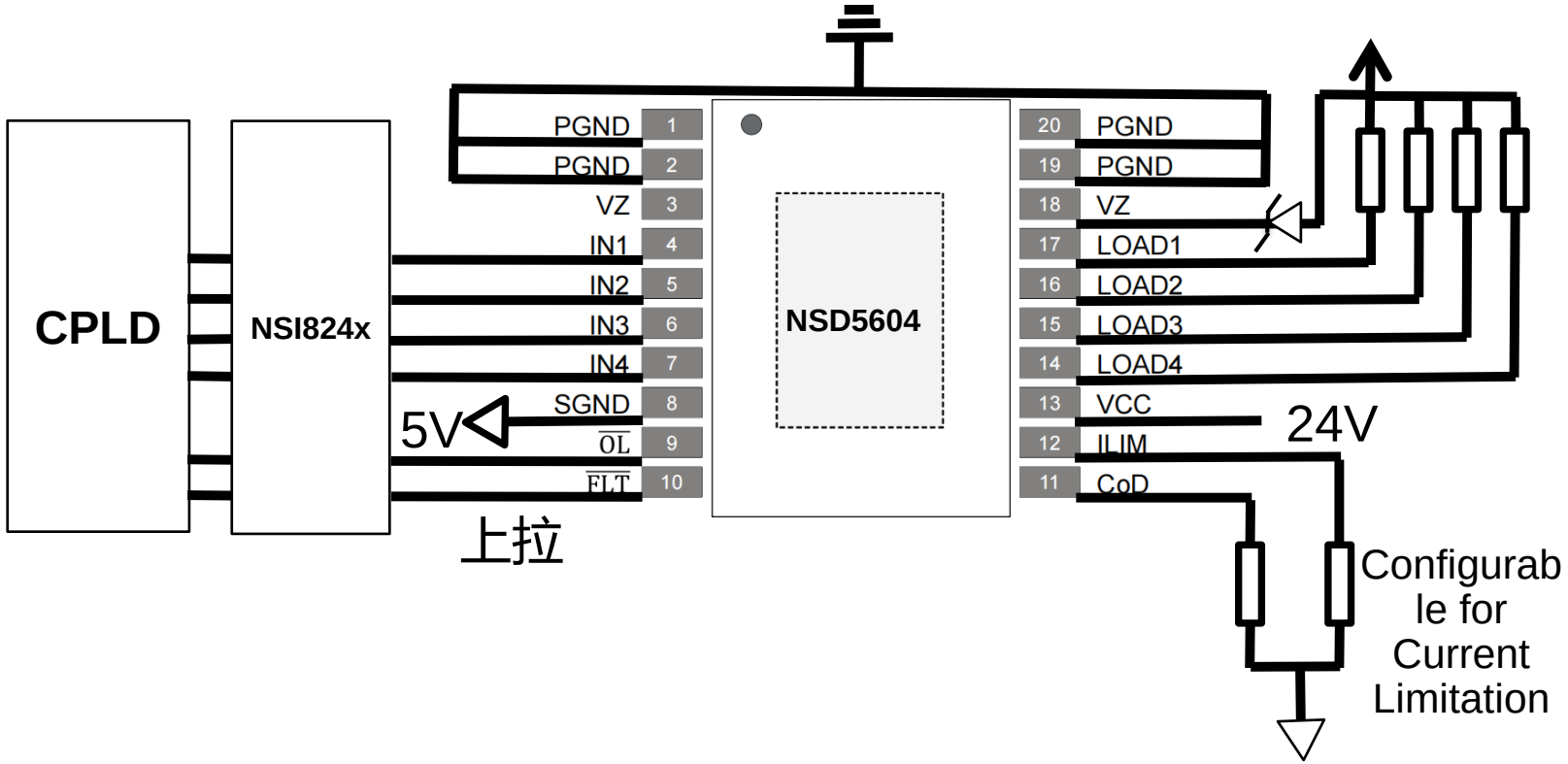


PLC & Motion Control Card:

- Tolerant up to 55V enable margin for 24-30V field supply.
- Low leakage current to avoid miss turn-on for LED/Lamp.
- Support 500mA Sink Current for each channel.

Device Features:

- Support 55V AMR.
- Independent OC and Current Limitation for each channel.
- Internal Clamping for inductive load.



System Requirement:
- 24-30V VDC
- PTO up to 200kHz
- 500mA/Channel; 2A with low side parallel
- Support resistive, capacitive, inductive load
- <10uA leakage @ output pin

NSD5604 Comparison Table

	NSD5604E	NSD5604NE	NSD5604	NSD5604N	DRV8803	DRV8804	DRV8860	IPS4260
NO. of Channel	4	4	4	4	4	4	8	4
Power Supply Min(V)	8	8	8	8	8.2	8.2	8	8
Power Supply Max(V)	50	50	50	50	60	60	36	50
Power Supply ABS(V)	55*	55*	55*	55*	65	65	40	55*
Rate Current(A)	0.5(4 CH), 2A(1 CH)	0.5(4 CH), 2A(1 CH)	0.5(4 CH), 2A(1 CH)	0.5(4 CH), 2A(1 CH)	0.5(4 Ch)	0.5(4 Ch)	0.33(8 Ch)	0.5(4 CH), 2A(1 CH)
Rds(on) Ohm	0.26	0.26	0.26	0.26	0.5	0.5	1.5	0.26
LDO	Y (5V 20mA)	N	Y (5V 20mA)	N	N	N	N	N
Output Parallel	Y	Y	Y	Y	Y	Y	Y	Y
Internal Clamping	Y(55V)	Y(55V)	Y(55V)	Y(55V)	N	N	N	Y(55V)
Output Frequency(kHz)	200	200	200	200	200	N	N	100
Output Leakage(uA)	<10	<10	<10	<10	50	50	30	10
Current Limitation	Y	Y	N	N	N	N	N	Y
Current Limitation Threshold	Configurable	Configurable	N	N	N	N	N	Configurable
Over Current	Y	Y	Y	Y	Y	Y	Y	Y
CH Independent OC Protection	Y	Y	Y	Y	N	N	N	Y
Over Current Threshold(A)	Configurable	Configurable	3.6	3.6	3	3	0.62	Configurable
Serial Communication	N	N	N	N	N	Y	Y	N
Open Load detection	N	N	N	N	N	N	Y	Y
Package	HTSSOP20	HTSSOP20	HTSSOP16	HTSSOP16	SOIC 20 HTSSOP 16	SOIC 20 HTSSOP 16	TSSOP 16 HTSSOP 16	HTSSOP20

60V HALF BRIDGE DRIVER WITH 1/2 FULL BRIDGE CONTROL

Features

- Quad ½-H bridge motor driver
  - Supply voltage: **8 to 60 V (abs max 65 V)**
  - Peak Current: **2.5 A per channel**
  - RDS(ON): **400 mΩ HS + LS (at 24 V, 25°C)**
- Outputs can be paralleled for higher current
- Independent PWM and enable pins per ½ bridge
- On-chip 3.3V 10mA LDO regulator

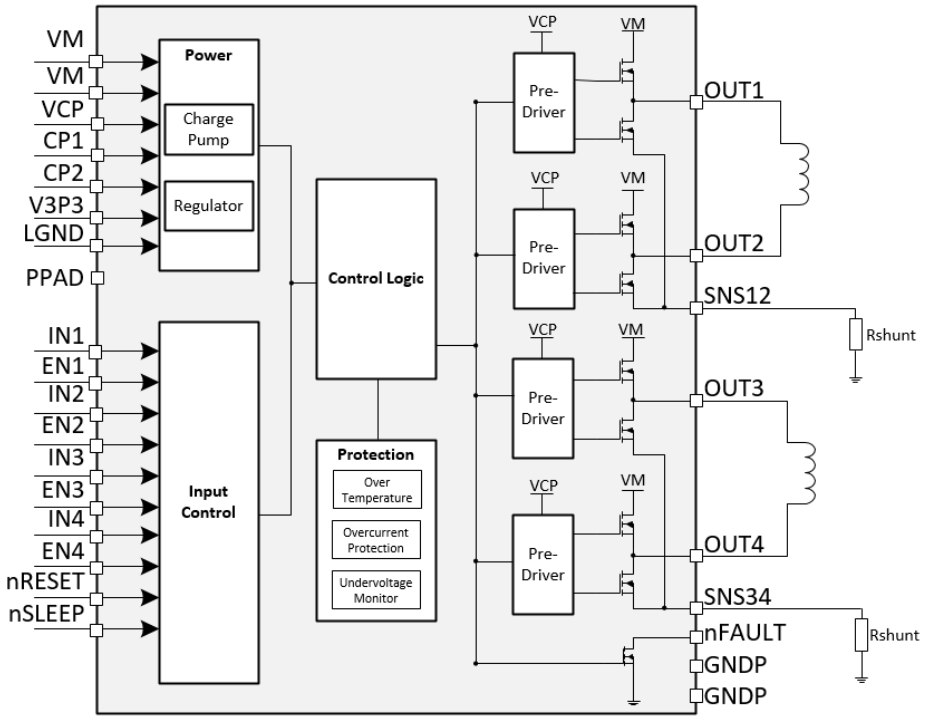
- **Fully Protected:**
  - Supply and charge pump undervoltage
  - Overcurrent protection
  - Thermal shutdown

- **Drop-in replacement of :**
  - DRV8844

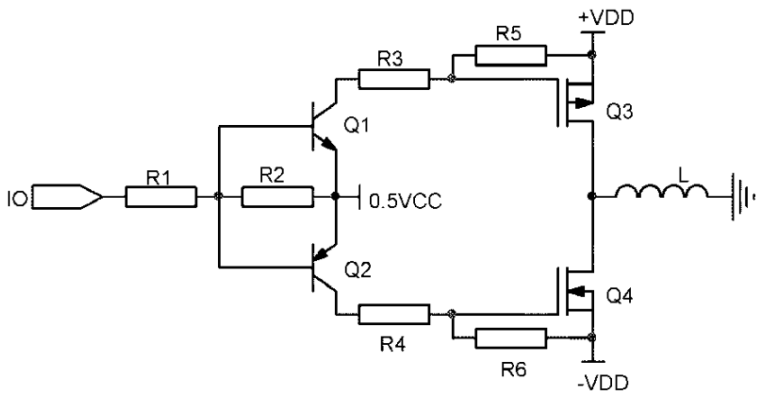
- **Package**
  - HTSSOP-28 9.7mm x 4.4 mm

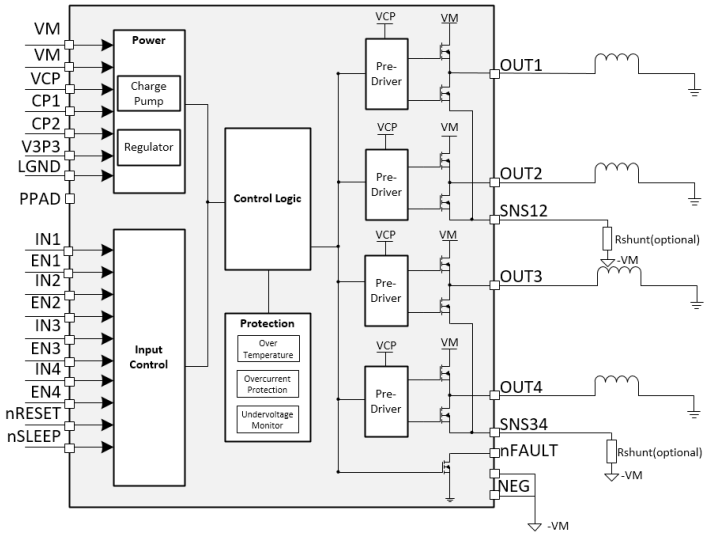
Applications

- HVAC Systems
- Textile & Factory Automation
- Programmable Logic Controller
- Stage Lighting
- ATM, ePOS, Currency Counting



Discrete Solution





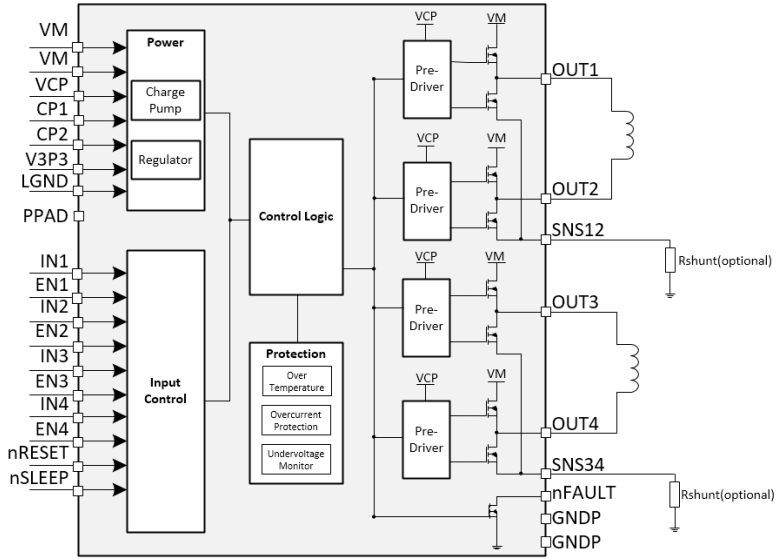
1 unit

NSD8644 Solution：Bipolar supply，Less channel

- Bipolar Power supply +-24V (AMR 65V)
- Support Negative -24V
- Floating logic Input

H Bridge Solution：Unipolar supply，40V，More channel

- Unipolar Power Supply - 24V (AMR 40V)
- Connect to GND
- Logic Input share the GND with power side.



2 units

60V DUAL BRUSHED-DC OR STEPPER DRIVER

Features

- Quad ½-H bridge motor driver
  - Supply voltage: **8 to 60V (abs max 65 V)**
  - Peak Current: **2.5 A per channel**
  - RDS(ON): **400 mΩ HS + LS (at 24 V, 25°C)**
- Outputs can be paralleled for higher current
- Independent PWM and enable pins per ½ bridge
- On-chip 3.3V 10mA LDO regulator

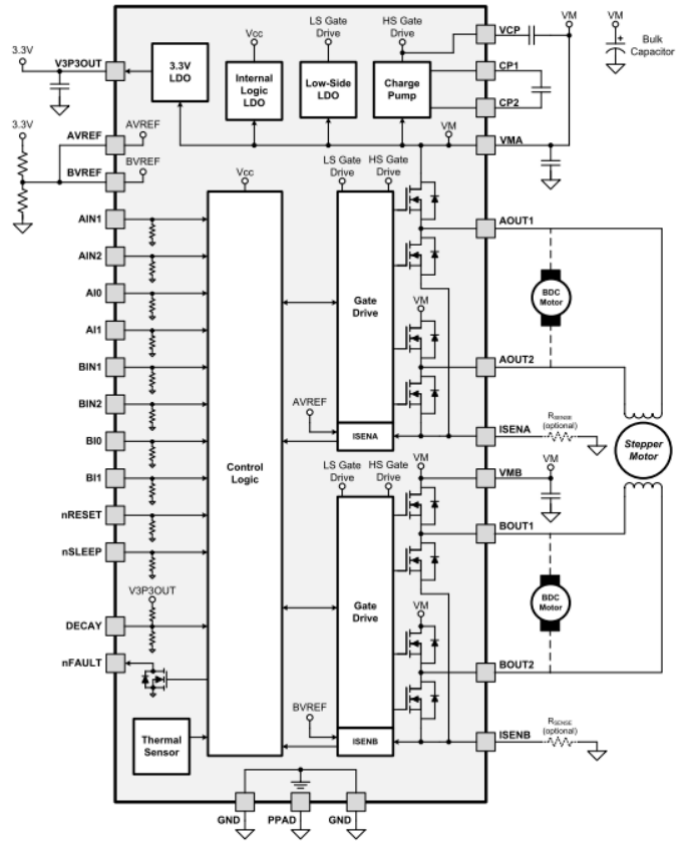
- **Fully Protected:**
  - Supply and charge pump undervoltage
  - Overcurrent protection
  - Thermal shutdown

- **Drop-in replacement of :**
  - DRV8841

- **Package**
  - HTSSOP-28 9.7mm x 4.4 mm

Applications

- Textile & Factory Automation
- Stage Lighting



60V H-BRIDGE DC DRIVER

Features

- Quad ½-H bridge motor driver
  - Supply voltage: **8 to 60 V (abs max 65 V)**
  - Peak Current: **5 A per channel**
  - RDS(ON): **200 mΩ HS + LS (at 24 V, 25°C)**
- **Phase and Enable // IN1 & IN2 Control for DC Motor**
- On-chip 3.3V 10mA LDO regulator

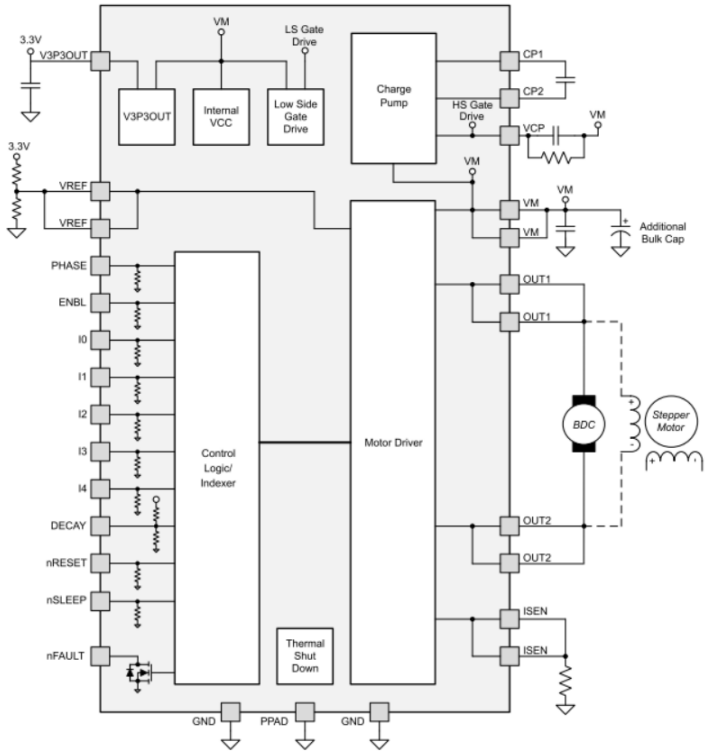
- **Fully Protected:**
  - Supply and charge pump undervoltage
  - Overcurrent protection
  - Thermal shutdown

- **Drop-in replacement of :**
  - DRV8840

- **Package**
  - HTSSOP-28 9.7mm x 4.4 mm

Applications

- Massage Chair
- Stage Lighting
- Lock



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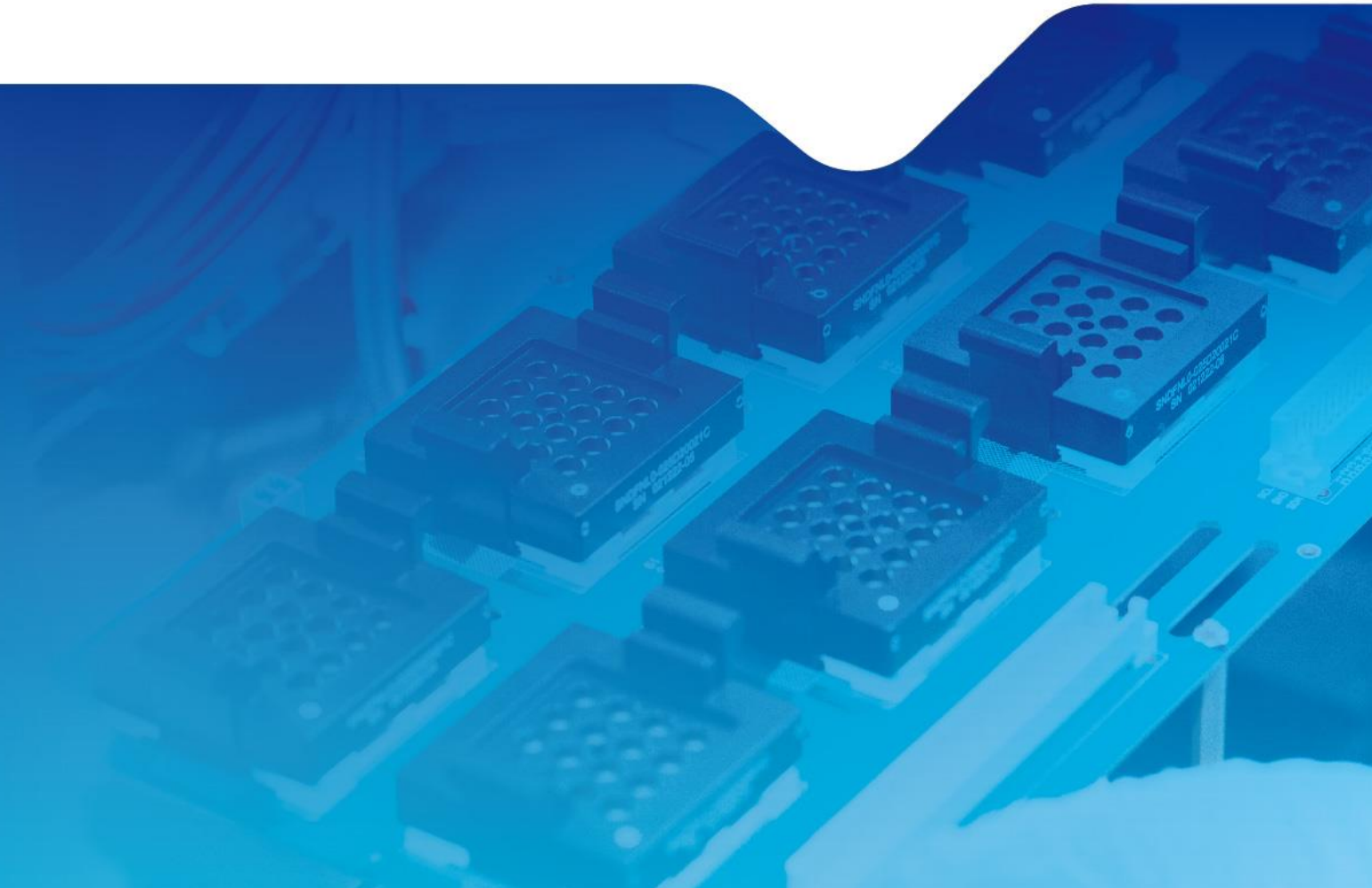
Automotive Motor Driver

Power & Driver Product Line



Automotive Body & ZCU

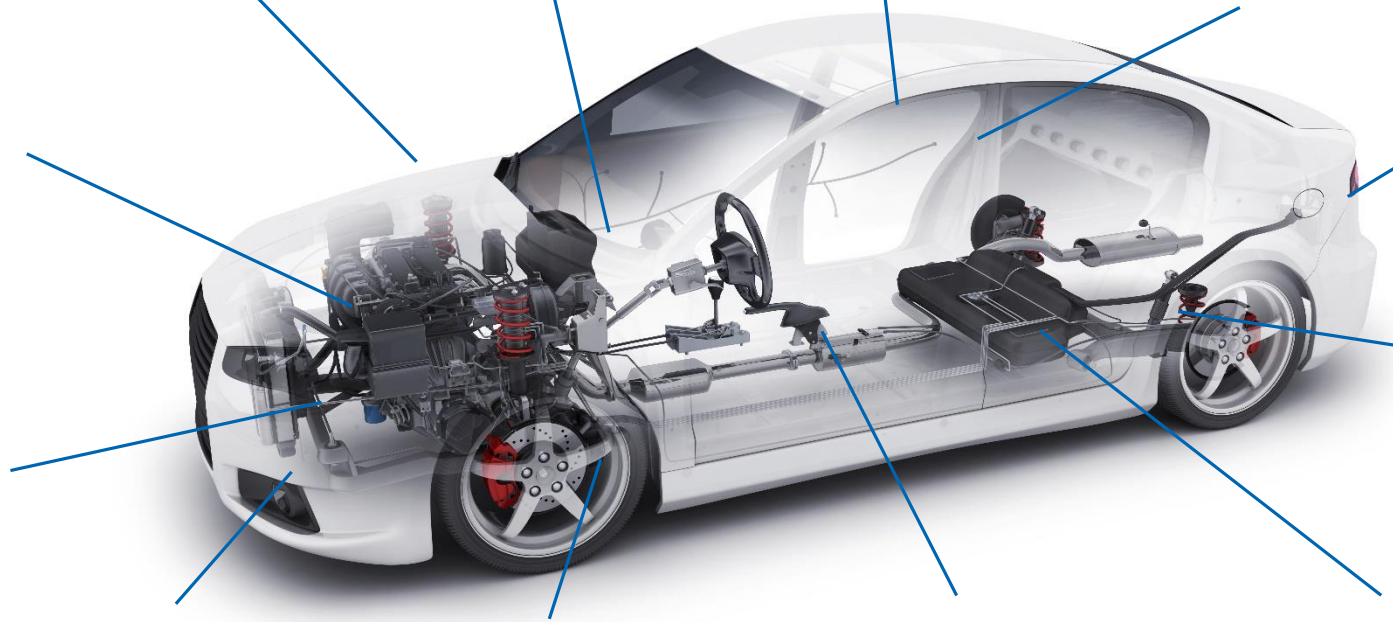
Mirror Fold/X-Y
NSD731x-Q1
NSD8306-Q1

HVAC Flap
NSD8308/12-Q1
NSD8381-Q1

Window Lift
NSD3608-Q1
NSD3604-Q1

Roof/Dome
NSD3604-Q1
NSD3602-Q1

Throttle
NSD7315-Q1



Trunk
NSD3608-Q1
NSD3604-Q1

OBC Lock/Shield
NSD7312-Q1
NSD7314-Q1

BDC/STEPPER Valve
NSD7312-Q1
NSD8381-Q1

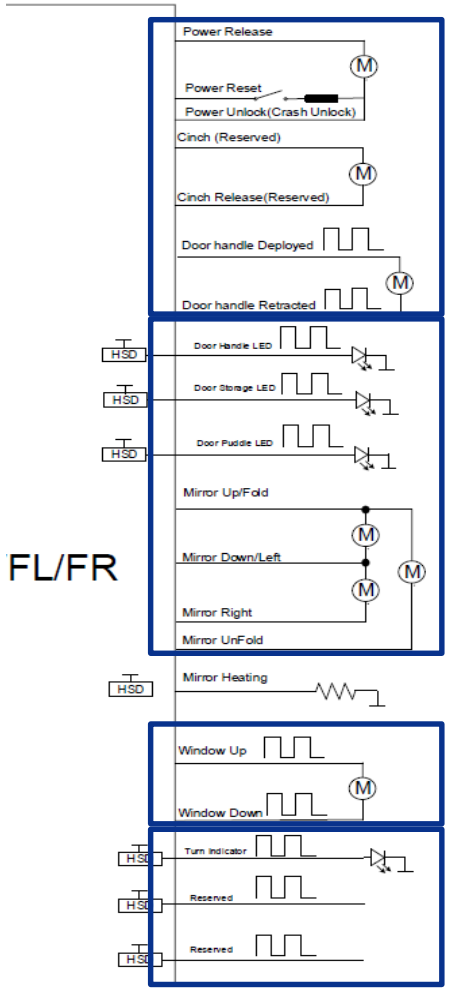
Headlight
NSD8381-Q1

Steering Columns
NSD7315-Q1

Electric Seat
NSD3608 – Q1
NSD3604 – Q1
NSD7315-Q1

Door E-lock/Handle
NSD7314-Q1
NSD7315-Q1

4-7 Motor Driver/Door
20+ Motor/Car

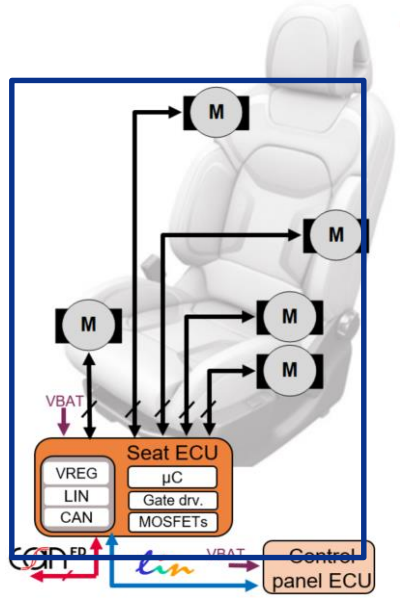


ELock/ELatch/Door Handle
HS + LS(Rds(on))=50-150mΩ
Peak Current：6-20A
NSD7314 (Sampled)
NSD7315 (Design)
NSD7308 (Concept)
NSD3602 (Design)

Rear Mirror Fold/X-Y/LED
Peak Current：1-6A
HS + LS(Rds(on))= 1000mΩ/200mΩ
NSD8308/6 (RTM)
NSD7314 (Sampled)
NSD7312 (RTM)

Window Lift
HS + LS(Rds(on))=MOSFET
NSD3602 (Design)

LED Indicator
HS + LS(Rds(on))= 1000mΩ
NSD8308/6 (RTM)



8 Directional Adjust：
Seat F/R，U/D，
Lumbar F/R，Lumbar U/D

12 Directional Adjust：
Seat F/R，U/D，
Lumbar F/R，Lumbar U/D
Backrest

Other：headrest，Massage

Peak：15-30A

HS + LS(Rds(on))= MOSFET
NSD3608 (Sample 2023 Q2)
NSD3604 (Sample 2023 Q2)

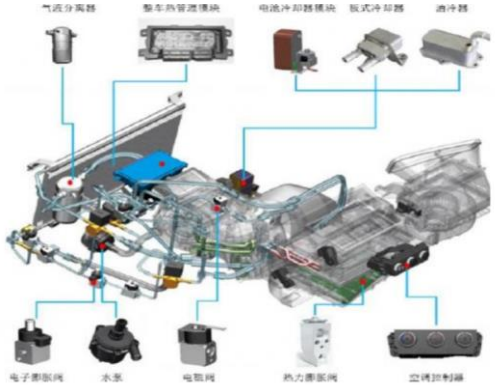
Signal Transmitting/LV Relay
NSD56008(Design)

HV Relay/Valve
NSD12409/121416 (Sampled)

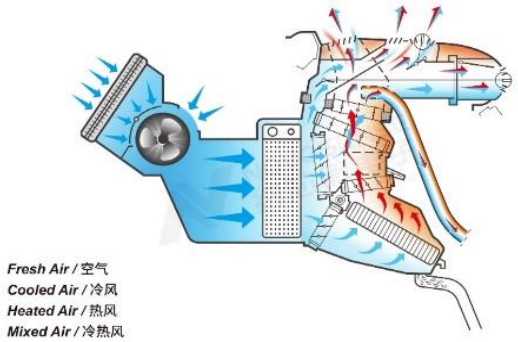
2-4 Multi-Channel Relay Driver/VCU/BCM

Thermal Management & Headlight

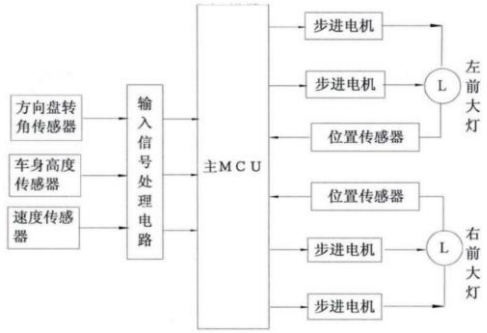
电子膨胀阀



Valve
Peak Current：1A
HS + LS(Rds(on))= 1200mΩ
NSD8381 (Sample 2023 Q2)



Flap/LED
Peak Current：1A
HS + LS(Rds(on))= 1500mΩ
NSD8308/6 (RTM)
NSD8312/10 (Sampled)



Headlight
Peak Current：1A
HS + LS(Rds(on))= 1200mΩ
NSD8381 (Sample 2023 Q3)

40V BRUSHED DC DRIVER WITH INTERNAL CURRENT SENSE

Features

- **Single H-Bridge motor driver**
  - Supply voltage: 4.5 to 36 V (abs max 40 V)
  - Output current: 2.0A RMS
  - Peak current: 3.6A full-scale
  - $R_{DS(ON)}$: 520mΩ HS + LS (at 24 V, 25°C)
- **Inrush current protection**
  - PWM current regulation
- **Fully Protected:**
  - Supply undervoltage UVLO
  - Overcurrent protection
  - Thermal shutdown

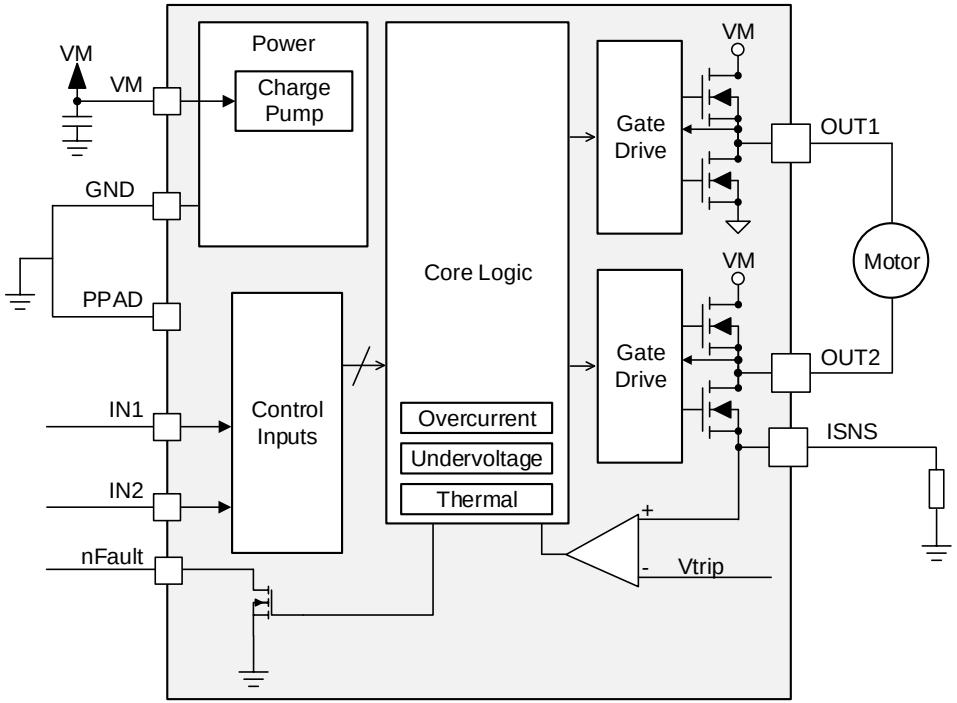
Package:

- Small 8 pin HSOIC package: 4.9mm x 6mm

- **Drop-in replacement of :**
  - DRV8872-Q1

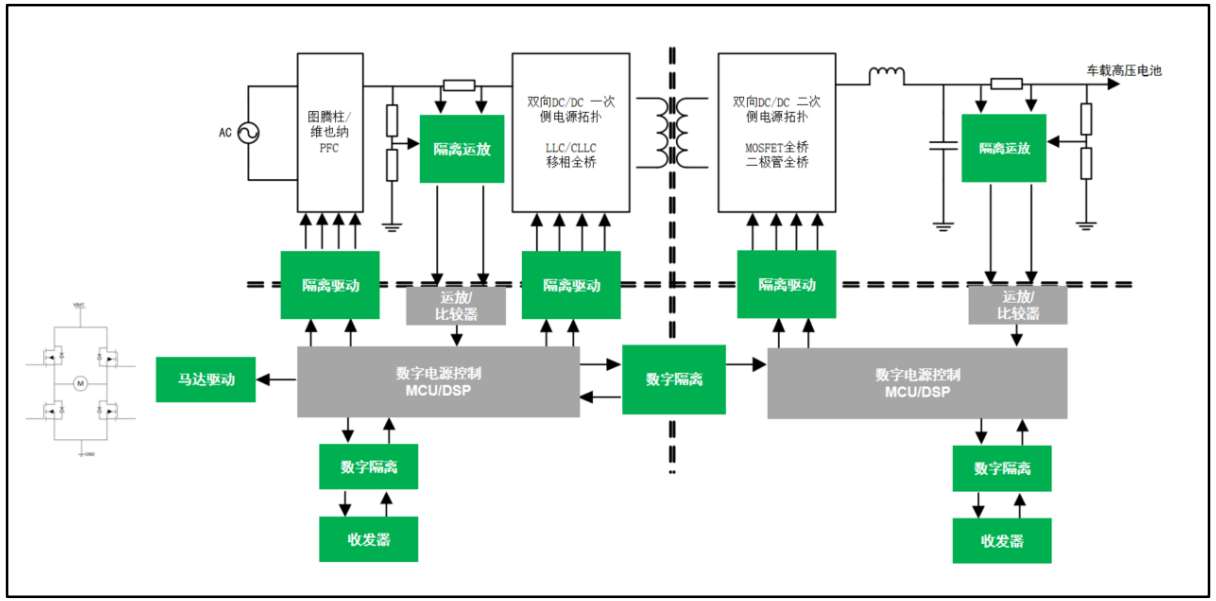
Applications

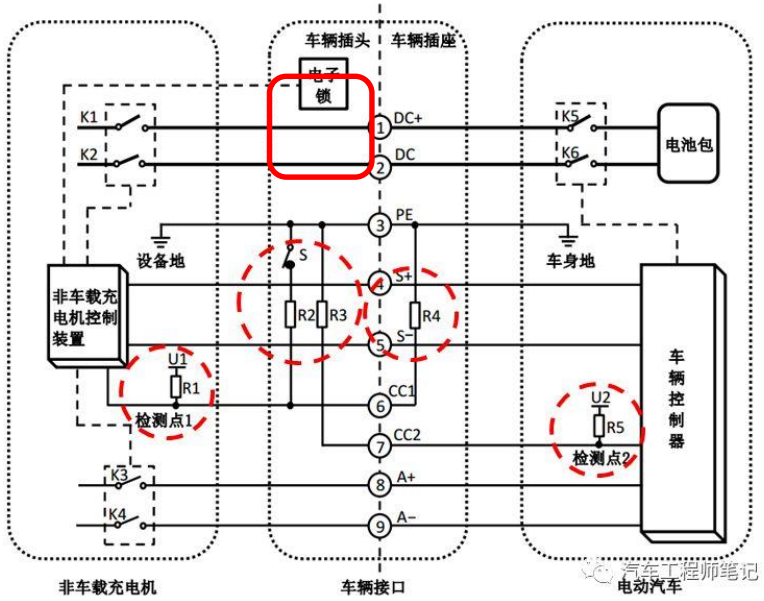
- OBC Elock
- Grill shutters
- Lumbar support



NSD7312-Q Comparison Table

GPN	NSD7310/2-Q1	NSD7312A-Q1	DRV8231A	DRV8870	DRV8872Q1
Number of Full Bridges	1	1	1	1	1
Operating Voltage Min (V)	5	5	4.5	6.5	6.5
Operating Voltage Max (V)	36	36	33	45	45
Abs Max Voltage Support (V)	40	40	35	50	50
Peak Current (A)	3.6	3.6	3.6	3.6	3.6
Typical RDSon (HS+LS) (mOhms)	520	520	600	565	565
Control Mode	PWMS	PWM	PWM	PWM	PWM
Control Interface	Hardware (GPIO)	Hardware (GPIO)	Hardware (GPIO)	Hardware (GPIO)	Hardware (GPIO)
Current Sense Amplifier (Y/N)	N	Y	N/Y	N	N
Typical Current Sense Accuracy (+/-__%)	N/A	1000uA/A	1500uA/A	N/A	N/A
External power sense resistor required (Y/N)	Y	N	N	Y	Y
UVLO, OCP, TSD (Y/N)	Y	Y	Y	Y	Y
nFAULT Pin (Y/N)	Y(12) / N(10)	Y(12) / N(10)	N	N	Y
Integrated Current Sensing	N	Integrated Current Sensing	Intergrated Current Sensing	N	N
Current Regulation	Current Regulation	Current Regulation	Current Regulation	Current Regulation	Current Regulation
Operating Ambient (°C)	-40 to 125	-40 to 125	-40 to 125	-40 to 125	-40 to 125
Max JunctionTemp (°C)	150	150	150	150	150
Package	HSOP-8	HSOP-8	HSOP-8	HSOP-8	HSOP-8





Charger E-Lock :

- For OBC charging current which is higher than16A, E-lock must be used to prevent detaching of charging gun.
- E-lock can be equipped on OBC, BMS or VCU based Vehicle Electrical and Electronic Architecture.

Product Requirement:

- 3.5A Peak current with less than 1A average operating current.
- Low quiescent current 10uA at sleep mode.
- Offer over-temperature, OC protection

40V BRUSHED DC DRIVER WITH DIAGNOSIS

Sample

Features

- H bridge motor driver
  - Supply voltage: 4.5 to 37V (abs max 40 V)
  - Peak Current: 6A
  - RDS(ON): 220 mΩ HS + LS
- Spread spectrum to optimized EMI perfomrance
- PH/EN, PWM, or independent PWM control modes available
- Current mirror for output current sensing (no sense resistor required)
- Current regualtion to limit motor start-up current

Fully Protected:

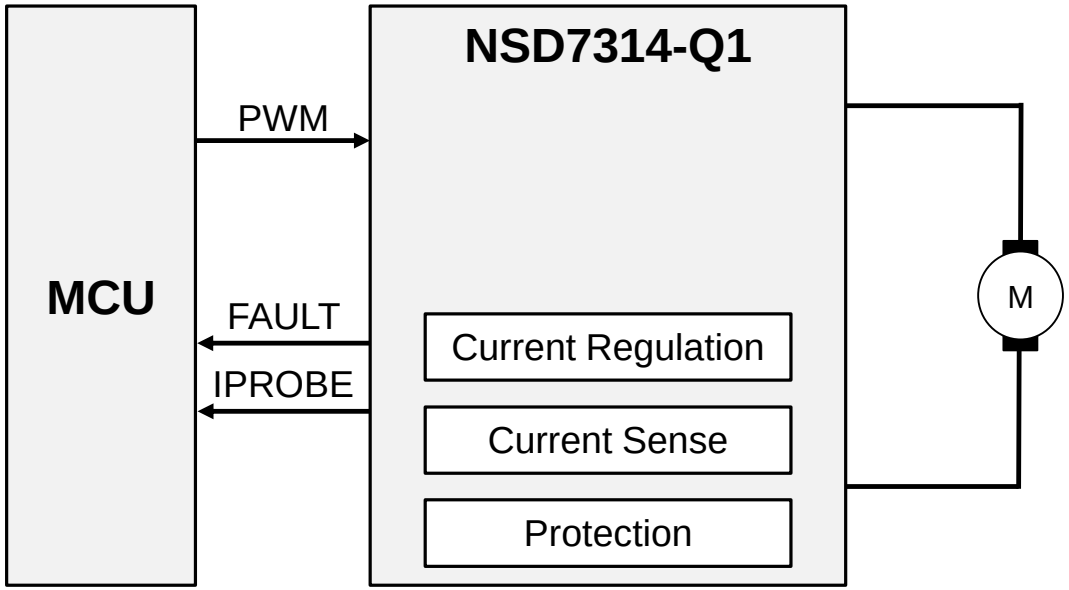
- Overcurrent protection
- Thermal protection
- Vm UVLO protection
- charge pump UVLO

Package:

- HTSSOP-16

Applications

- ePOS & Currency Counting
- ATM Machine
- Multi-Function Printers
- Auto Body Electronics



40V BRUSHED DC DRIVER WITH DIAGNOSIS

Features

- H bridge motor driver
  - Supply voltage: **4.5 to 36 V (abs max 40 V)**
  - Peak Current: **10 A**
  - RDS(ON): **150 mΩ HS + LS** (at 13.5 V, 25°C)
- **Devices in the Family:**
  - NSD7415H: Hardware Interface
  - NSD7415S: SPI Interface
- **Output slew rate control for EMI tuning**
- **PH/EN, PWM, or independent PWM control modes available**
- **Open load diagsnotic for motor disconnected**
- **Current mirror for output current sensing (no sense resistor required)**

Fully Protected:

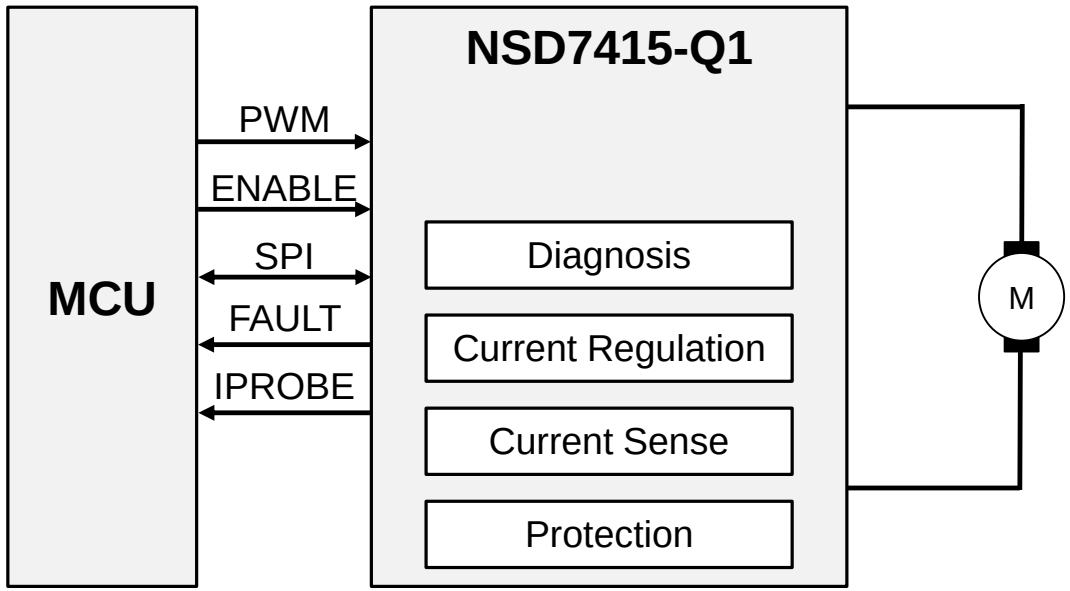
- over-current, thermal, shoot-through, UVLO protection, charge pump faults, open load detection, and overvoltage protection

Package:

- HTSSOP-24

Applications

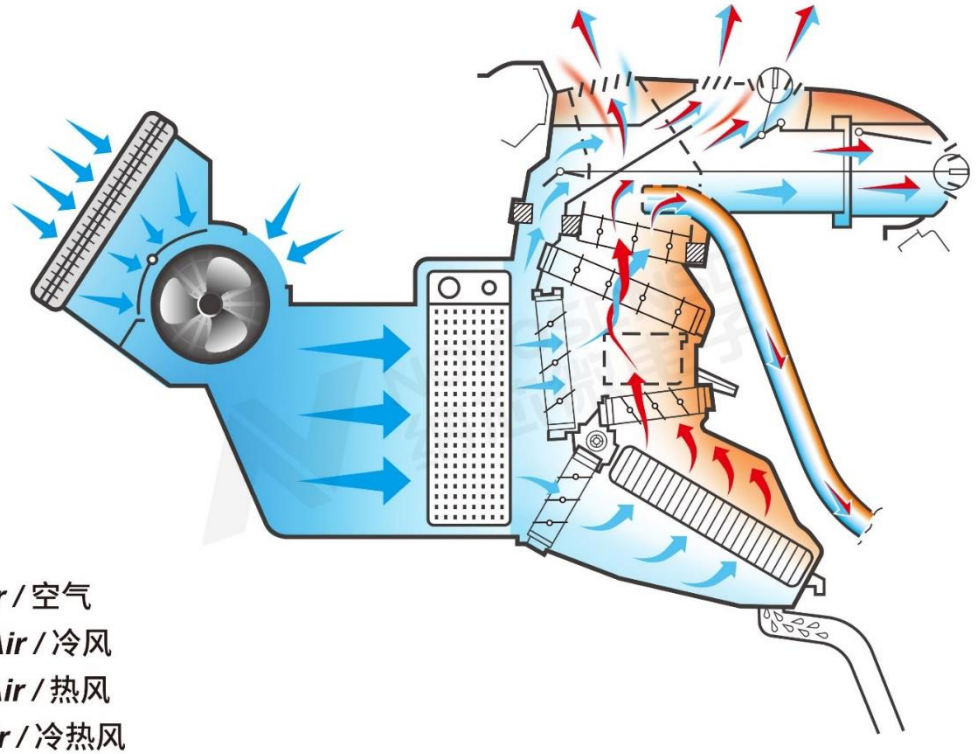
- ePOS & Currency Counting
- ATM Machine
- Multi-Function Printers
- Auto Body Electronics



NSD7315S/H-Q1 Comparison Table

GPN	NSD7312/A	NSD7314	NSD7315	L9960	A4959	VNH7100
Number of Full Bridges	1	1	1	1	1	1
Operating Voltage Min (V)	4.5/6.5	4.5	4.5	4.5	TBD	4
Operating Voltage Max (V)	36	36	36	28	TBD	28
Abs Max Voltage Support (V)	40	40	40	40	50	41
Peak Current (A)	3.6/4.0	6	12	12	6	15
Typical RDSon (HS+LS) (mOhms)	550	220	150	300	180	100
Control Mode	PWM	PWM	PWM/SPI	PWM	PWM	PWM
Control Interface	Hardware (GPIO)	Hardware (GPIO)	Hardware (GPIO) & SPI	Hardware (GPIO)	Hardware (GPIO)	Hardware (GPIO)
Spread Spectrum	N	Y	Y	Y	N	TBD
Independent Half Bridge Mode	N	Y	Y	N	N	Y
SPI	N	N	Y	Y	N	N
Open Load Diagnostic	N	N	Y	Y	N	Y
STG & STB Diagnostic	N	N	N	Y	N	N
Slew Rate	N	N	Y	Y	N	N
UVLO, OCP, TSD (Y/N)	Y	Y	Y	Y	Y	Y
nFAULT Pin (Y/N)	Y	Y	Y	Y	Y	N
Integrated Current Sensing	Y	Y	Y	Y	Y	Y
Current Regulation	Y	Y	Y	Y	Y	N
Operating Ambient (°C)	-40 to 125	-40 to 125	-40 to 125	-40 to 125	-40 to 125	-40 to 125
MaxJunctionTemp (°C)	150	150	150	150	150	150
Package Type Option 1	HSOP-8	HTSSOP-16	HTSSOP-24	PowerSSO-36	HTSSOP-24	SSOP-16

HVAC FIAP CONTROL



Fresh Air / 空气
Cooled Air / 冷风
Heated Air / 热风
Mixed Air / 冷热风

Feature：

- Flap for ventilation/HVAC control system.
- Mixed of Heated air and cooled air.
- Distribute air for driver and passengers.

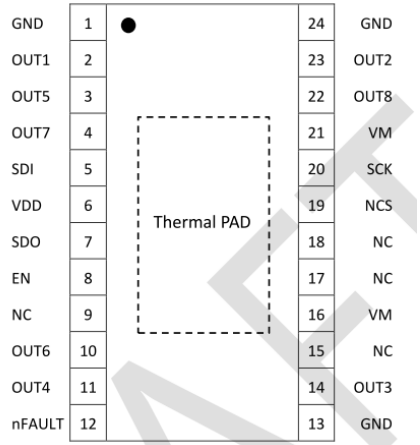
MULTICHANNEL HALF-BRIDGE DRIVERS

Features

- Qualified for Automotive AEC-Q100 (Grade-1)
- Multi-Channel Half Bridge Drivers (6, 8, 10 and 12 Channels)
  - Supply voltage: 4.5-V to 20-V/32-V (EXT_OVP) operating (40 V load dump)
  - Output current: 1.0-A rms per bridge (3.0 A max for all output)
  - $R_{DS(ON)}$: 1.7Ω (HS + LS) @ 13.5 V, 0.5 A, 25° C
- SPI Interface (16-bit, 5 MHz) for configurability with daisy chain support
- Very low power consumption in sleep mode (5 µA)
- PWM mode with internal PWM generation on each channel
  - 4 PWM frequency options: 80-Hz, 100-Hz, 200-Hz, 2kHz
  - 8 bit duty resolution (~0.4 % duty)
  - Slew rate control for supporting 200Hz
- Per Channel SPI diagnosis with the global error flag
  - nFAULT pin for hardware monitoring
  - Supply under-voltage (UVLO) and over-voltage protection (OVP)
  - Logic supply power on reset (POR)
  - Overcurrent protection (OCP) on each HS or LS FET
  - Open Load detection (OLD) on Each HS or LS FETs in active state.
  - Thermal warning and shutdown (OTW / OTSD)

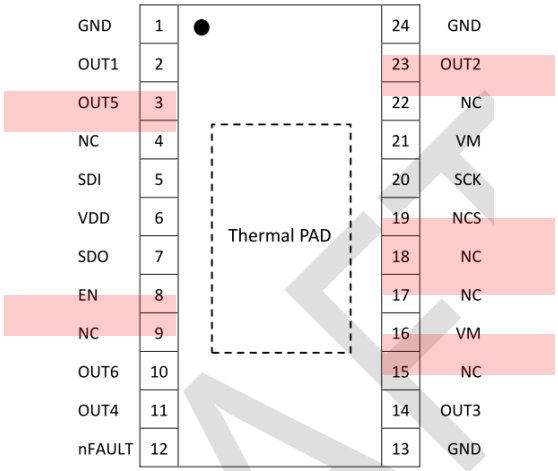
Applications

- HVAC Flap DC motors
- Side mirror x-y adjustment and mirror fold
- LEDs

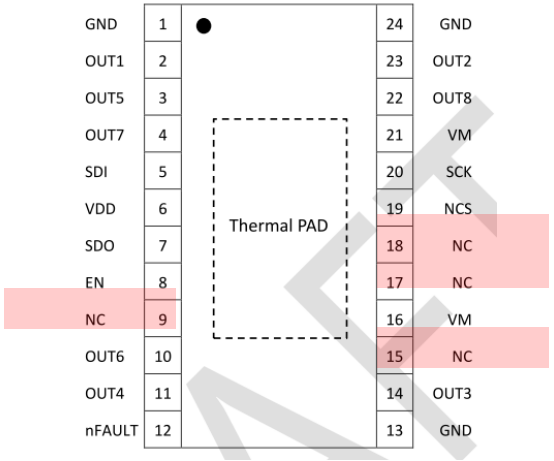


MULTICHANNEL HALF-BRIDGE DRIVERS

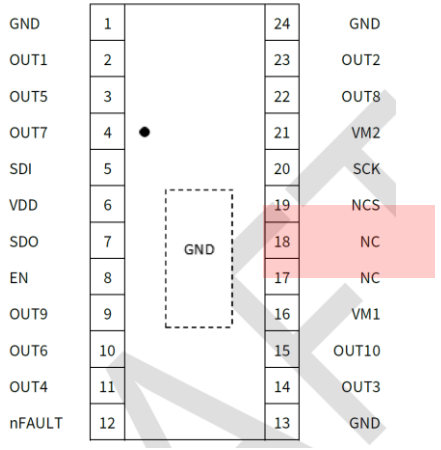
Part #	Channels	# of Motors	Package	I/F	Status
NSD8306-Q1	6	3	24-pin HTSSOP	SPI	RTM
NSD8308-Q1	8	4			RTM
NSD8310-Q1	10	5			Sample
NSD8312-Q1	12	6			Sample



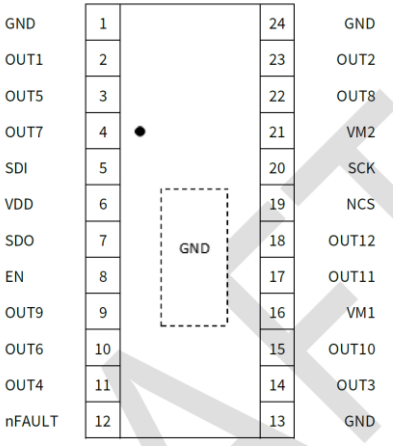
NSD8306-Q1



NSD8308-Q1



NSD8310-Q1

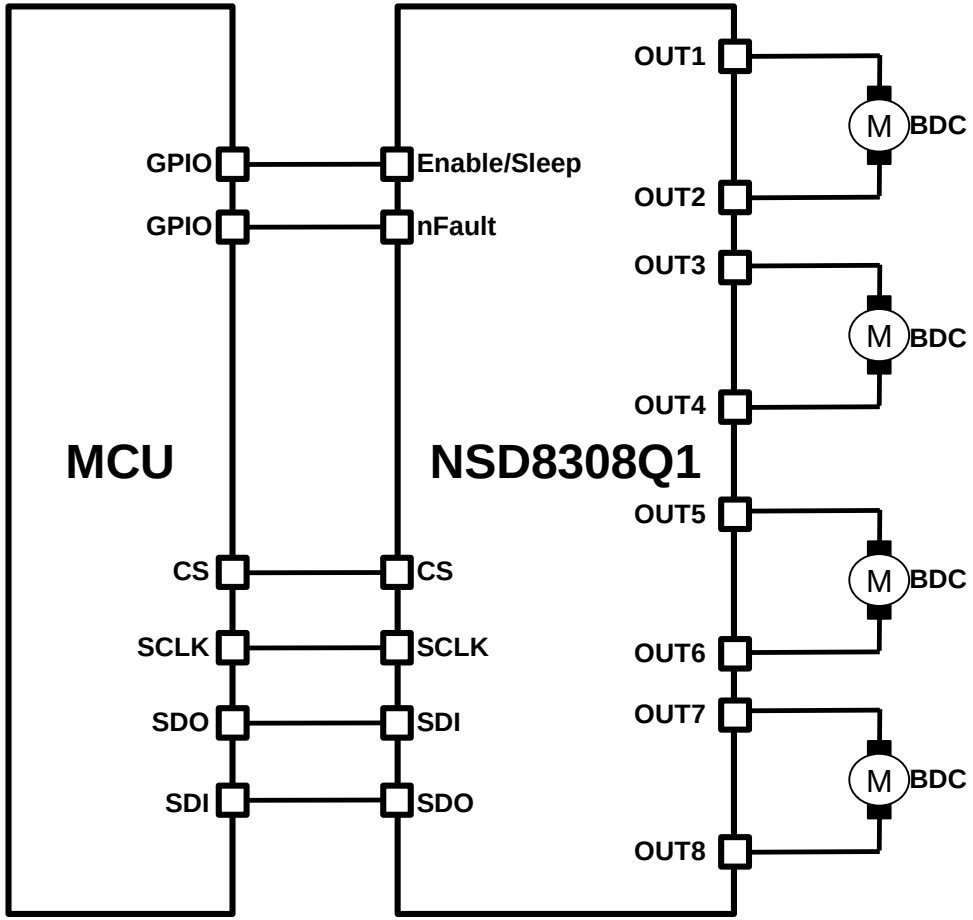


NSD8312-Q1

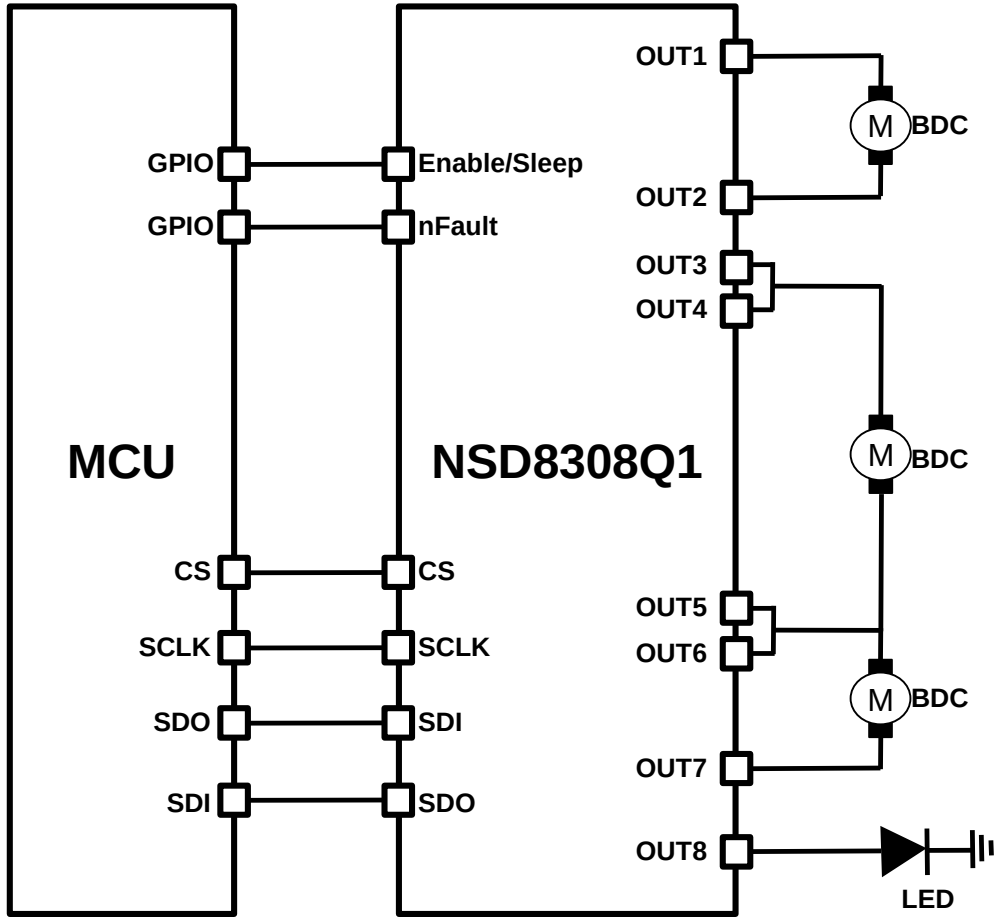
NSD830x-Q1 Comparison Table

Features	TLE94104/6/8/10/12	DRV8906/08/10/12	NCV7723/4	NCV7718/7719	NSD8306/8/10/12	TMP7306/08
# Half Bridges (Family)	3, 4, 6, 8, 10, 12	4, 6, 8, 10, 12	6, 8	6, 8	6, 8,10,12	6, 8
VM Operating Voltage	5.5-18 V	4.5 - 32 V	5.5 - 32 V	5.5 - 28V	4.5 – 36V	5-18V
Load Dump	40V	45 V (500 ms)	45 V (500ms)	40 V	40 V	40 V
VDD voltage	3.0 – 5V	3.0 – 5V	3.15 - 5.25V	3.15 - 5.25V	3.0 – 5V	unkown
Sleep Current	IDDQ + ISQ < 3uA @ -40 to 120C	V_M + V_{DD}: 3 µA, @ -40 to 125 C	V_M + V_{DD}: 5 µA, @ -40 to 125 C	V_M + V_{DD}: 5 µA, @ -40 to 125 C	Target VM+Vdd<5uA @ -40 to 85C	unkown
Peak Current	0.9A(min)	1.3 A (min)	1.1A(min)	0.8A(min)	1A(min)/1.3A(Register option)	unkown
Rdson (HS + LS) Typ @25	1800 mΩ	1500 mΩ	1600 mΩ	2000 mΩ	1700 mΩ	2000 mΩ
Temperature	-40 / 150° C (T_J)	-40 / 150° C (T_J)	-40 / 150° C (T_J)	-40 / 150° C (T_J)	-40 / 150° C (T_J)	-40 / 150° C (T_J)
Control Interface (With Daisy Chain)	SPI, 5 MHz (Yes)	SPI, 5 MHz (Yes)	SPI, 5 MHz (Yes)	SPI, 5 MHz (Yes)	SPI, 5 MHz (Frame Comptable with TI) (Yes)	SPI, 5 MHz (Yes)
PWM Mode	Yes(80, 100, 200Hz)	Yes (80, 100, 200, 2kHz)	No	No	Yes (80, 100, 200, 2kHz)	No
PWM Generator	3 Channel	8/4 Channel	No	No	8 Channel	No
nFAULT Pin	No	Yes & No	No	No	Yes & No	No
Open Load Detect	Active(OUT ON) Yes Passive(OUT OFF) No	Active(OUT ON) Yes Passive(OUT OFF) Yes	Underload Detection Active(OUT ON) Yes Passive(OUT OFF) No	Underload Detection Active(OUT ON) Yes Passive(OUT OFF) No	Active(OUT ON) Yes Passive(OUT OFF) Yes	Underload Detection Active(OUT ON) Yes Passive(OUT OFF) No
Reverse Open Load	No	Yes	No	No	No	No
Short Protect	Yes	Yes	Yes	Yes	Yes	Yes
Passive STG/STB	No	No	No	No	Yes (SW Involved)	No
Other Protection	UVLO, OTW, TSD, OVP, OCP	UVLO, OVP, POR, OTW / TSD, OCP	UVLO, OVP, OTP, OCP	UVLO, OCP, OTP	UVLO, OVP, POR OTW / TSD, OCP	UVLO, OCP, OTP
Packages	TSDSO-24 8.65 x 3.9 mm	HTSSOP-24 7.8 x 4.4mm	EP SSOP-24 8.64 x 3.9 mm	EP SSOP-24 8.64 x 3.9 mm	HTSSOP-24 7.8 x 4.4mm	EP SSOP-24 8.64 x 3.9 mm

Support Independent H-Bridge Control

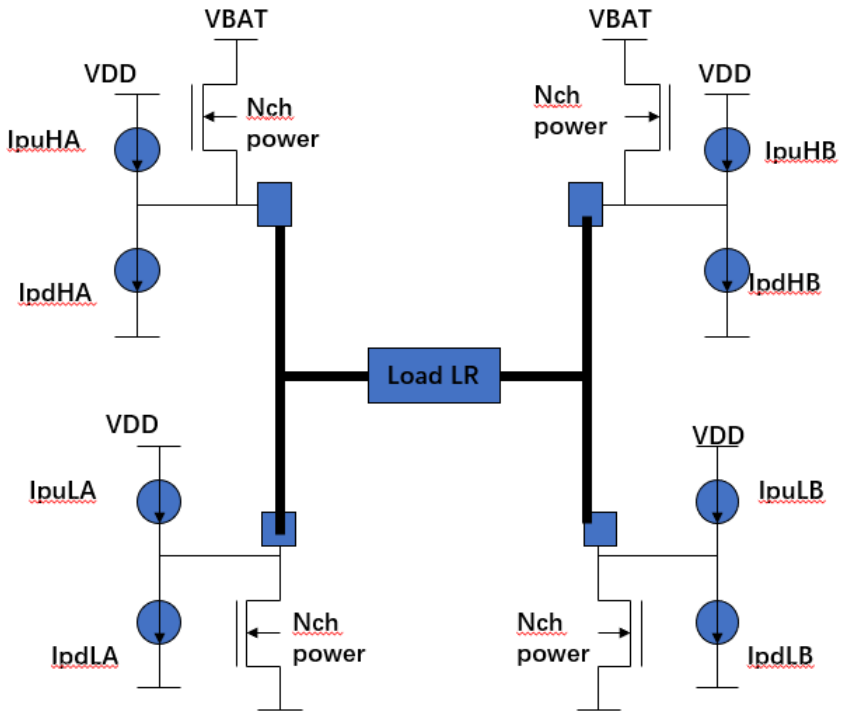


Support ½ Bridge Share and LED Mode



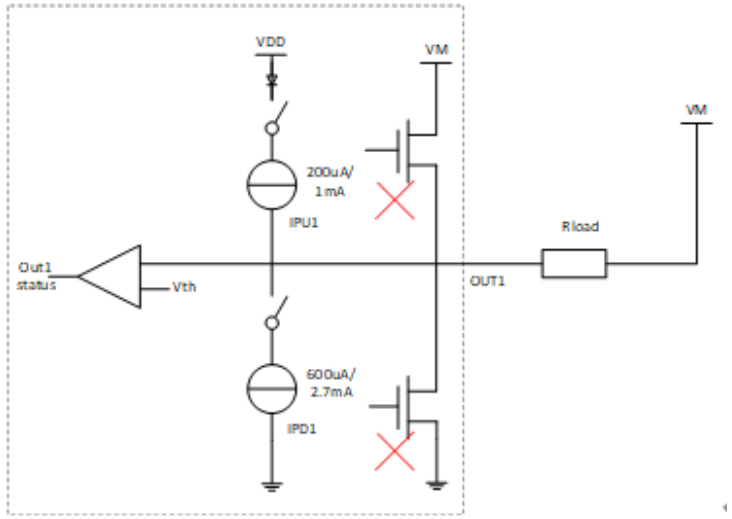
- Two optional open load threshold in active state
  - ✓ Normal ~10mA open load current threshold for motor load
  - ✓ Additional smaller ~1mA open load threshold for low current load ie. LED

- New open load detection in off-state
  - ✓ open load detection before driver turn on
  - ✓ Avoid false diagnosis due to motor operating



Open Load Diagnosis – Low Side

- Low side diagnosis, OFF-STATE



1) Normal load connection

PU1	PD1	Out Status
on	on	H
on	off	H

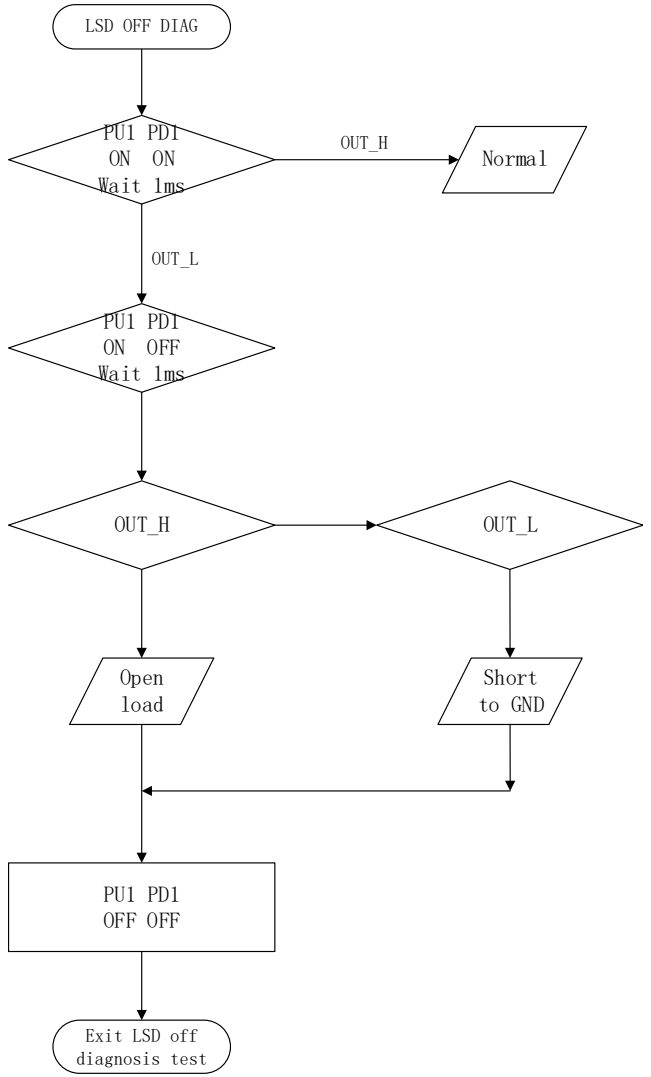
2) Open load connection

PU1	PD1	Out Status
on	on	L
on	off	H

3) Short to GND connection

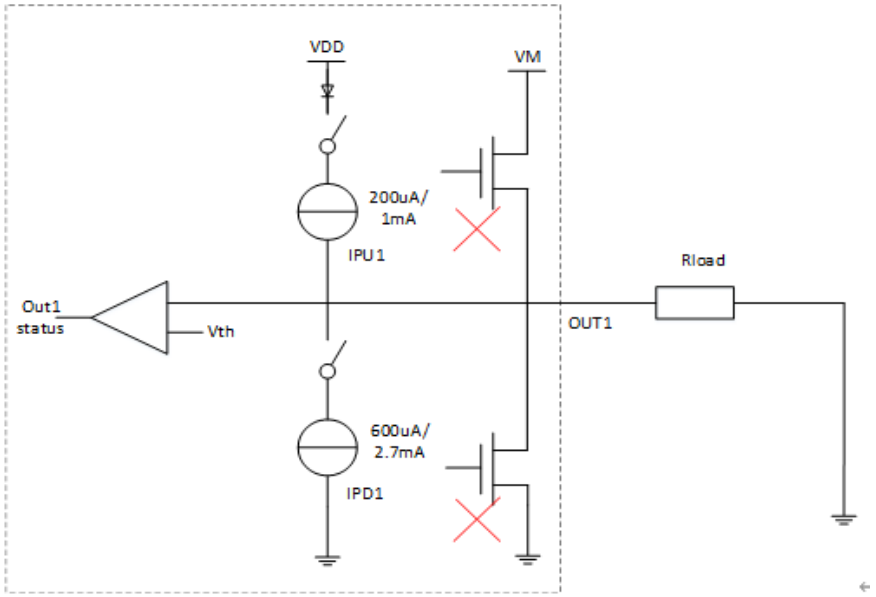
PU1	PD1	Out Status
on	on	L
on	off	L

NSD8308 lowside off state diagnosis example flowchart



Open Load Diagnosis – High Side

- High side diagnosis, OFF-STATE



1) Normal load connection

PU1	PD1	Out Status
on	off	L
on	on	L

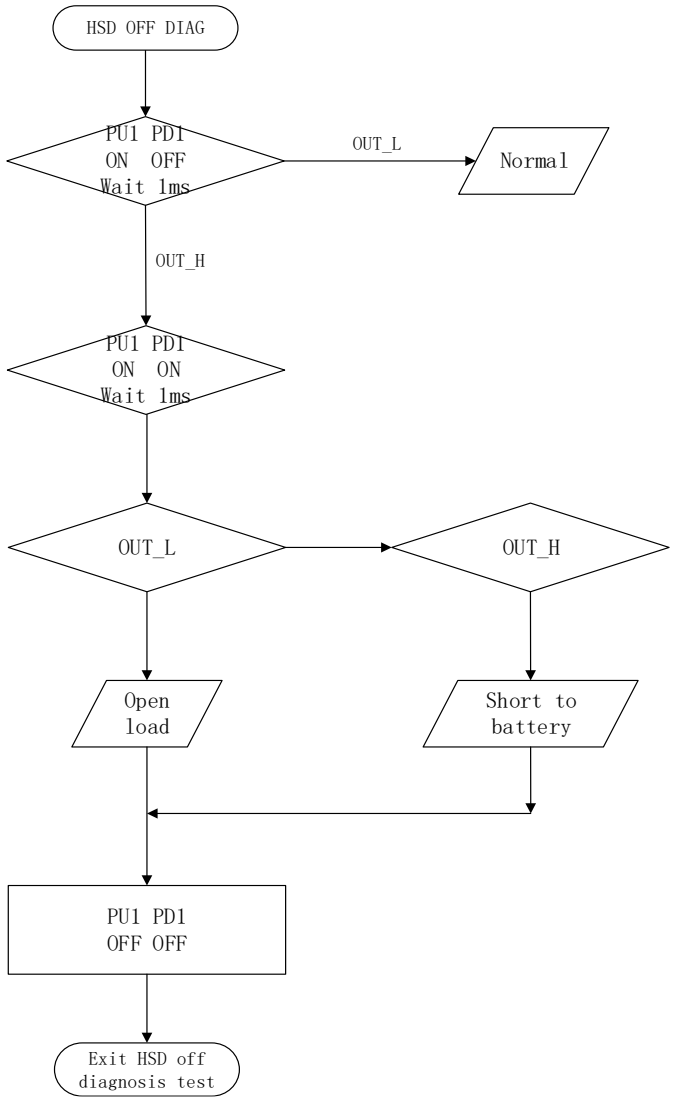
2) Open load connection

PU1	PD1	Out Status
on	off	H
on	on	L

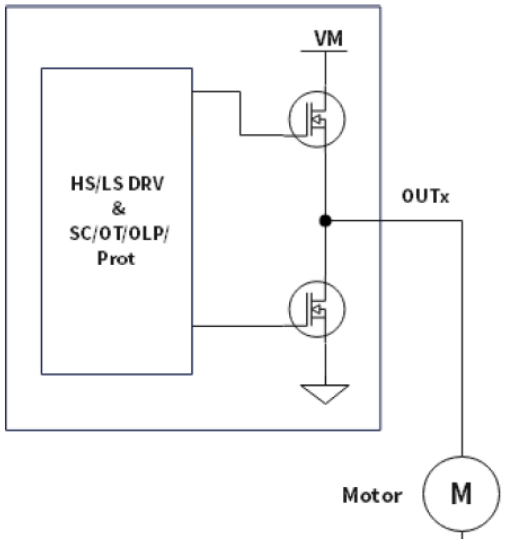
3) Short to battery connection

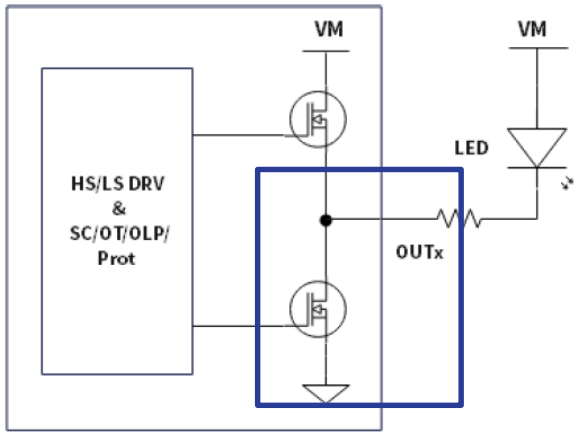
PU1	PD1	Out Status
on	off	H
on	on	H

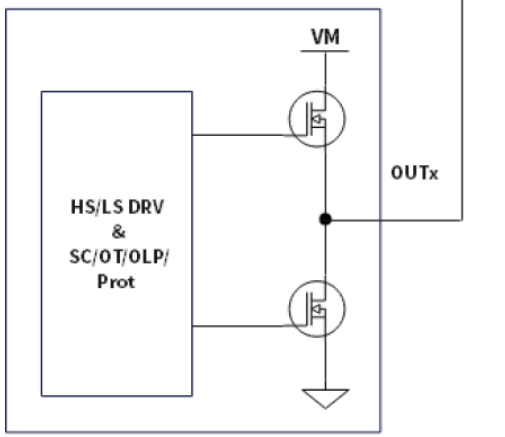
NSD8308 highside off state diagnosis example flowchart

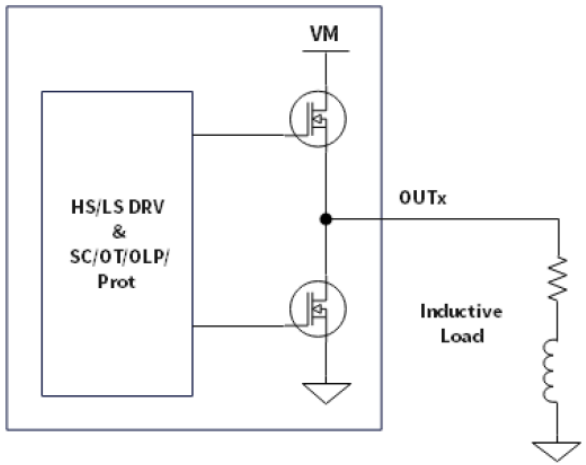


LED Mode Open Load Diagnosis









I_{OL}	Open load threshold	Half bridge low side, HBx_OPL_TH = 0	3	10	25	mA
		Half bridge high side, HBx_OPL_TH = 0	-25	-10	-3	mA
t_{OL}	Open load filter time	HBx_OPL_TH = 0, guarantee by digital scan	2	3	4	ms
I_{OL_LOW}	Low open load threshold	Half bridge low side, HBx_OPL_TH = 1	0.3	1	2	mA
t_{OL_LOW}	Low open load filter time	HBx_OPL_TH = 1, guarantee by digital scan	0.2	0.3	0.4	ms

- Support LED Mode Open Load Diagnosis.
- Typical LED current 5-10mA.
- **Only** Low Side MOS support LED low current mode
- Threshold decreases from **10mA to 1mA.**

ELECTRIC SEAT AND DOOR MODULE

Body Control
NSD8308
NSD3608

Seat ECU：

- Seat – Brushed DC
- Lumbar – Brushed DC
- Backrest – Brushed DC
- Seat Heat – High Side Switch

Door ECU：

- Deploy Handle – Brushed DC
- Window Lift – Brushed DC
- E-Lock – Brushed DC
- LED – High Side/Low Side

Rear Mirror ECU：

- Up/Down – Brushed DC
- Left/Right – Brushed DC
- Mirror Heat – High Side
- Mirror Fold – Brushed DC
- Turn Light - High/Low Side
- Blind Spot Light – High/Low Side

MULTICHANNEL HALF-BRIDGE DRIVERS

Features

Functions:

- 8x ½ bridge gate pre-driver
  - Supply voltage: **5.5 to 36 V (abs max 40 V)**
  - Adjustable slew rate control
  - 0.25mA ~ 64mA configurable source current per channel
  - 0.25mA ~ 64mA configurable sink current per channel
- 2 stage charge pump + spread spectrum
- 2x wide common mode current shunt amplifier
- 16-bit SPI interface
- Low current consumption in sleep mode
- Window watchdog

Fully Protected:

- Supply undervoltage and overvoltage
- VDS overcurrent protection
- Vgs monitoring
- Off-state open load, short to vbat, short to gnd detection
- Thermal warning and shutdown

Package

- VQFN-56

Applications

- Power seat module
- Power trunk and lift gate
- Power sunroof
- Body control module

MULTICHANNEL HALF-BRIDGE DRIVERS

Features

- AEC-Q100 Grade1
- Stepper motor driver up to 1.35A
- Programmable step mode: full step, half step 1/2, mini step 1/4, 1/8 or 1/16 or 1/32 micro step with internal current profile generator
- Current regulation loop:
  - two 4-bit full scale current amplitude, RUN and HOLD
  - 6 bit DAC for reference current
- Support slow / mixed / automatically deacy mode
- STEP & DIR, also HOLD three input pins
- Fault output
- Stall detection output (TBD)
- Programmable slew rate for EMC optimize
- PWM freq spread spectrum
- 16-bit SPI interface

Fully Protected:

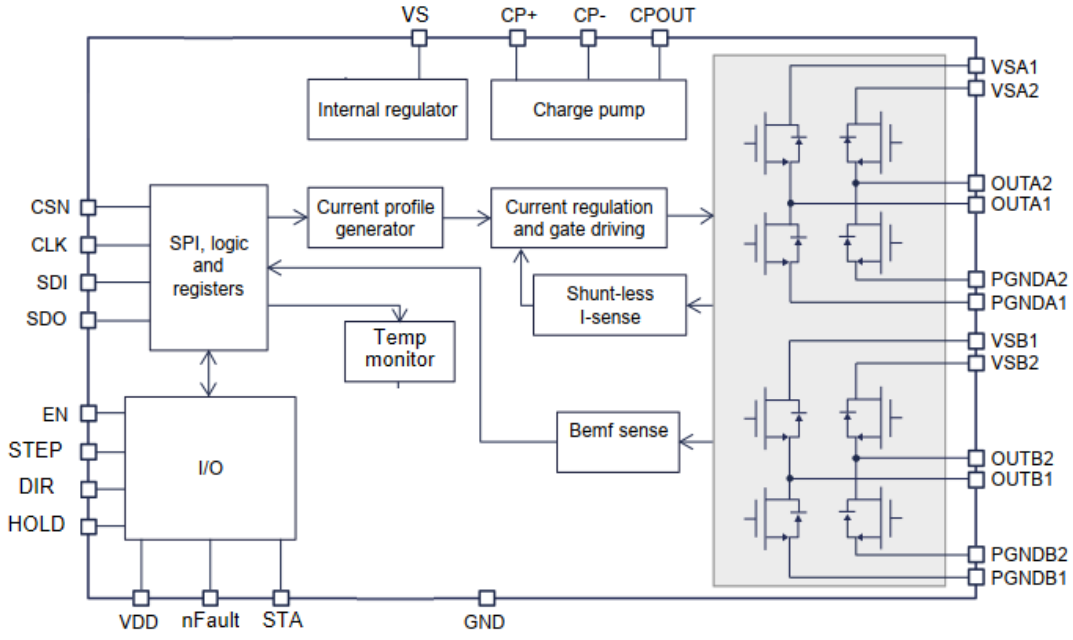
- Off-state open load, short to vbat, short to gnd
- overcurrent protection
- Charge pump undervoltage
- Thermal warning and shutdown

Package

- QFN32

Applications

- Expansion Valve
- Coolant Valve
- HUD
- Printer



8 – CHANNEL LOW SIDE DRIVER WITH DIAGNOSTIC

Features

- 8 Channel low side driver with diagnosis
- Support Vbat as low as 4.5V for cranking
- Internal active clamping for inductive load
- Rds(on) = 1 Ohm @ 25 °C
- 16 bit SPI interface with Daisy Chain capability
- Internal Active Clamping
- 2 dedicated input pins with output mapping functionality/4 dedicated pins
- **Limp home mode**
- Low quiescent current < 5us @ 25 °C

Diagnosis:

- Loss of Battery/Loss of Ground
- Open load detection – power up off to avoid LED unintended illumination
- Short to Ground
- Input and output status monitor

Protection:

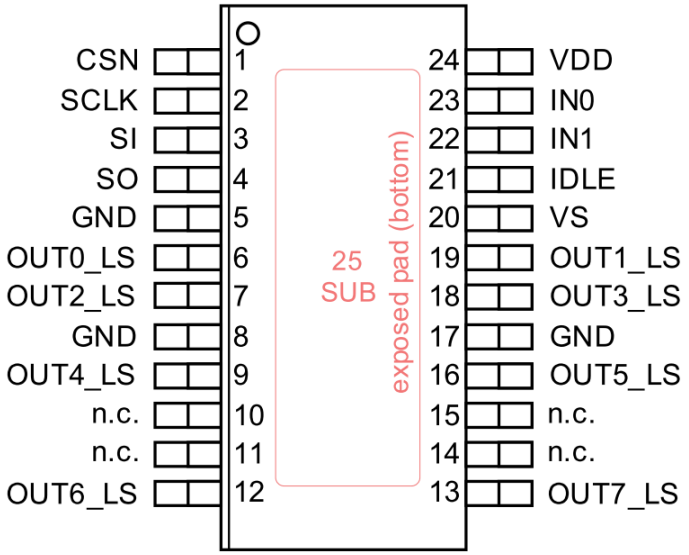
- VBAT Undervoltage protection
- Overload protection
- Over temperature protection

Package:

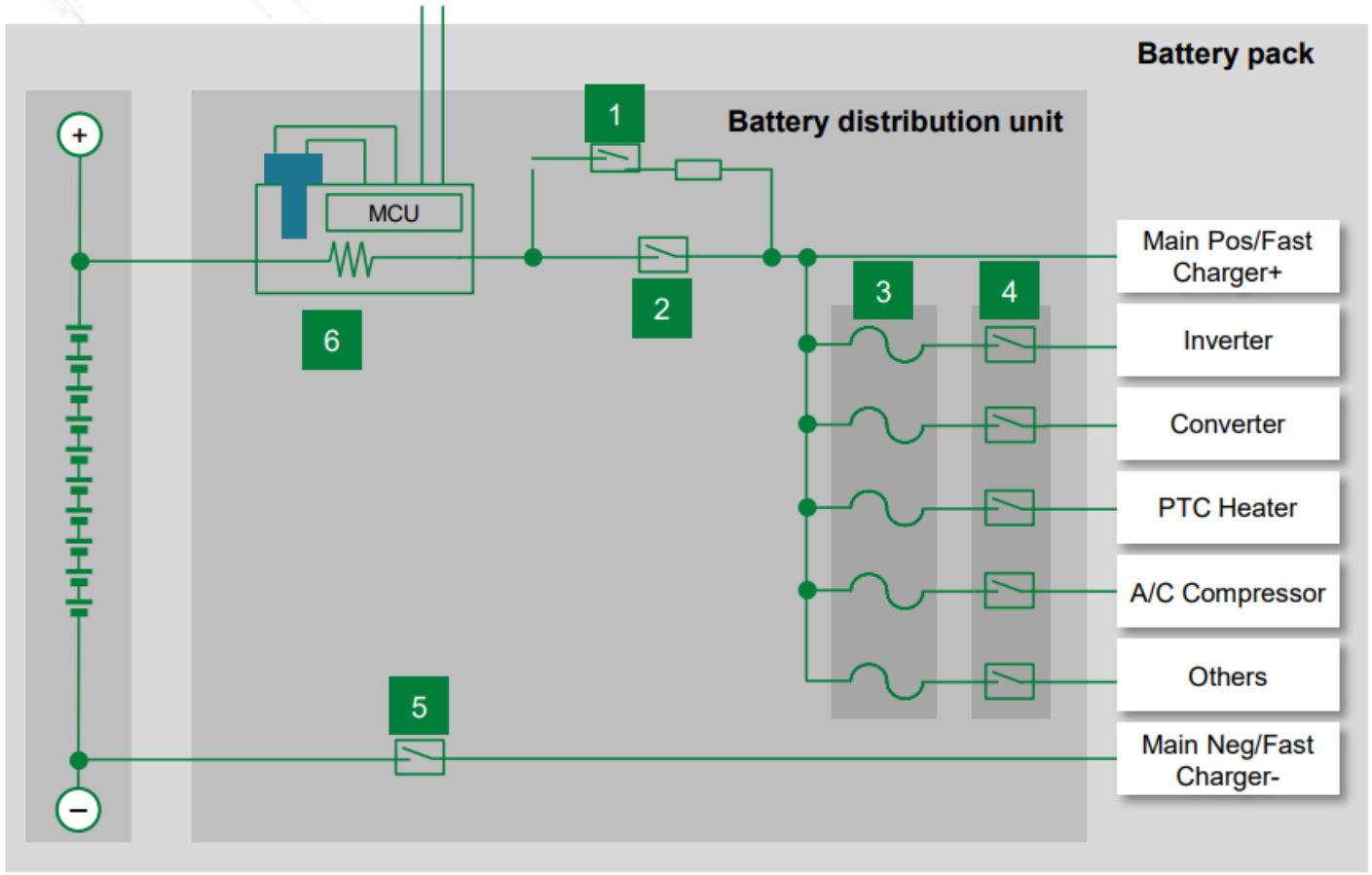
- HTSOP-24 (P2P to TLE75008)
- HTSSOP-24

Applications

- VCU
- Thermal Management System
- Zonal Controller



Address Battery Distribution Box solution



Location	Competitor	Novosns
1 Pre-charge contactor	ST/IFX	NSE11409-Q1 NSD12409-Q1 NSD11416-Q1 NSD12416-Q1 NSD5604-Q1 NSD5604E-Q1
2 Main Relay Pos/ Fast charger Pos	ST/IFX	
4 Power Distribution Relay	ST/IFX	
5 Main Relay Neg/ Fast charger Neg	ST/IFX	

Reference: Littelfuse – Relay used in BMS System

Smart Low Side Driver

	R_{ON} (mΩ)	Single channel	Dual channel
NSD11416 – 1 Channel (Sample) NSD12416 – 2 Channel (Sample)	300	VNL5300S5-E ●	VNLD5300-E ●
	160	VNL5160S5-E ●	VNLD5160-E* ●
		VNL5160N3-E ●	
NSE11409 – 1 Channel (RTM) NSD12409 – 2 Channel (Sample)	90	VNL5090S5-E ●	VNLD5090-E ●
		VNL5090N3-E ●	
NSD11405 – 1 Channel (Concept)	50	VNL5050S5-E ●	
		VNL5050N3-E ●	
	30	VNL5030J-E ●	
		VNL5030S5-E ●	

Note:* in development

● SO-8

● SOT-223

● PowerSSO-12

P/N	Rds(on)	CH	Package	P2P	Similar Function
NSD11416 – Q1SPR	160m	1	SOP8	VNL5160 VNL5300	NCV8402
NSD11416-Q1STBR	160m	1	SOT223	VNL5160 NCV8402	
NSD12416-Q1SPR	160m	2	SOP8	VNLD5160 VNLD5300	NCV8402D
NSD12409-Q1SPR	90m	2	SOP8	VNLD5090	

NOVOSENSE Solution

CAN transceiver
- NSA1042: CAN transceiver

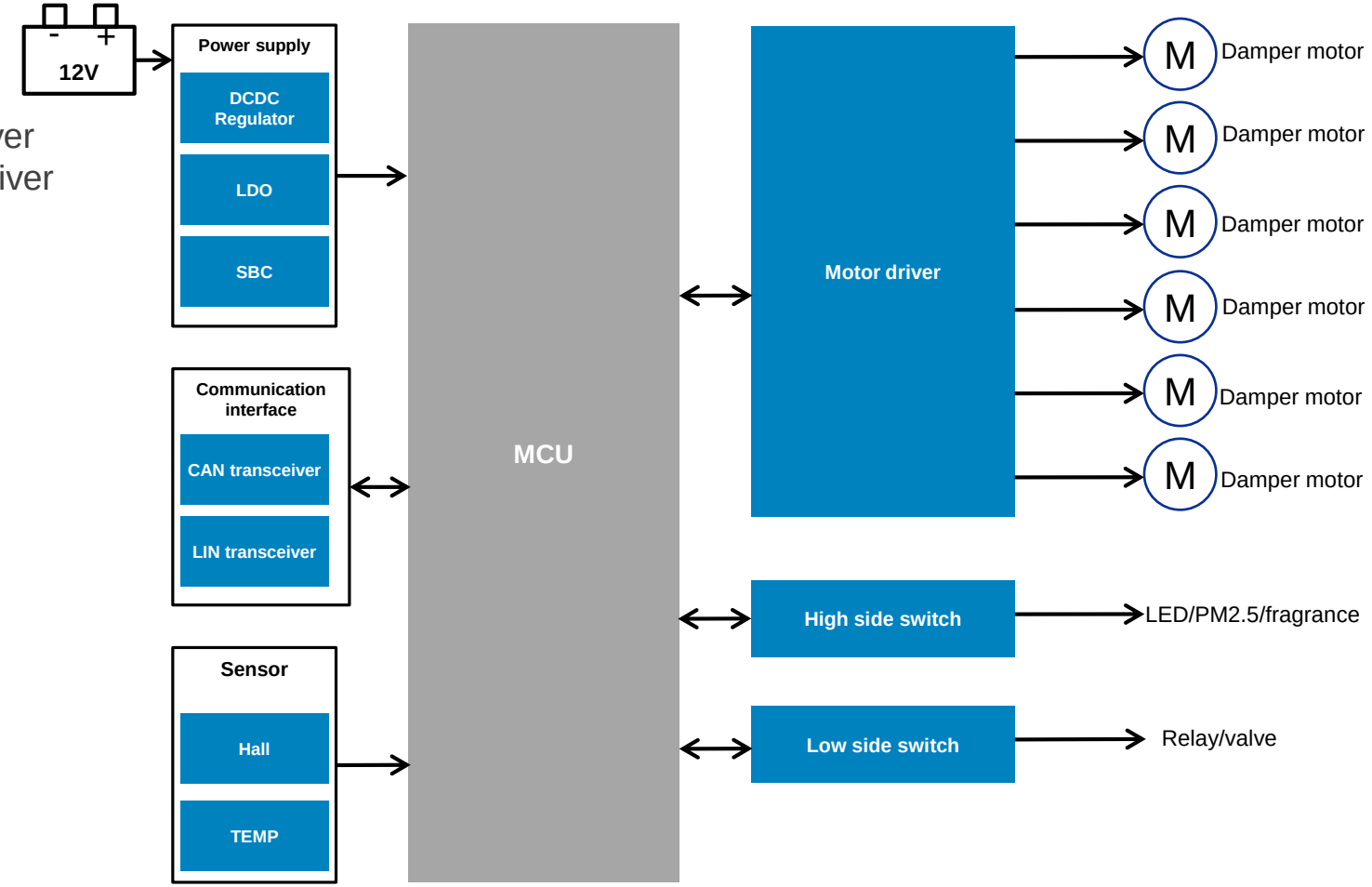
Motor driver
- NSD8308: 8-channel half-bridge integrated driver
- NSD8312: 12-channel half-bridge integrated driver

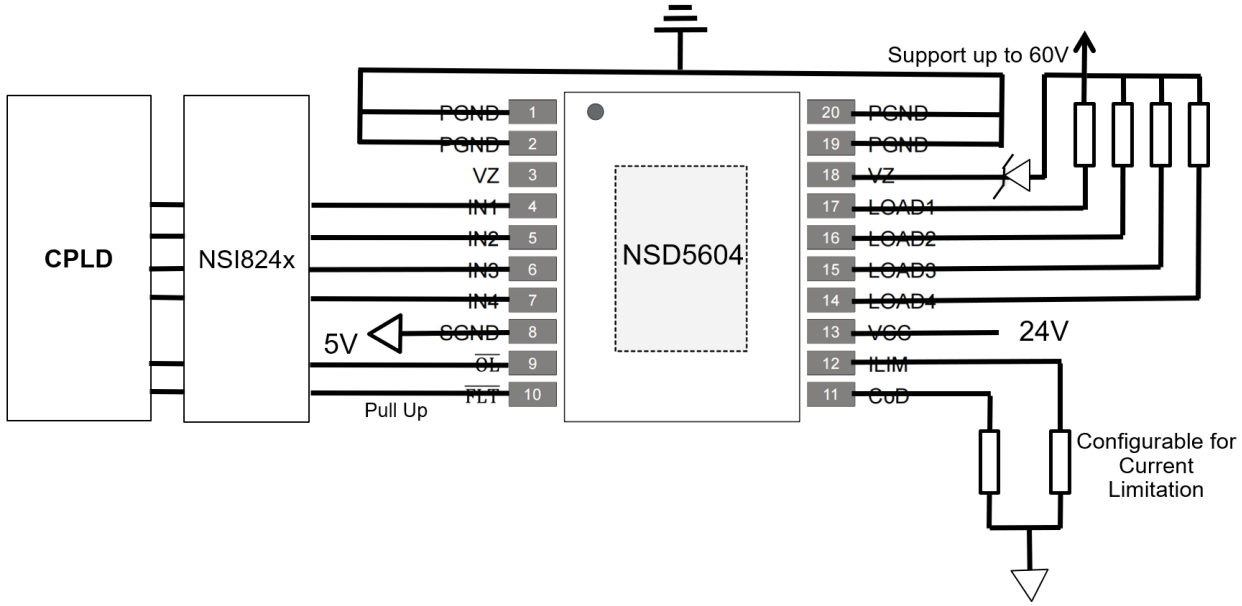
High side switch
- NSE34050Q-Q1

Low side switch
- NSE11409-Q1
- NSD11416-Q1
- NSD12409-Q1/NSD12416-Q1

DCDC
- NSR114xx-Q1

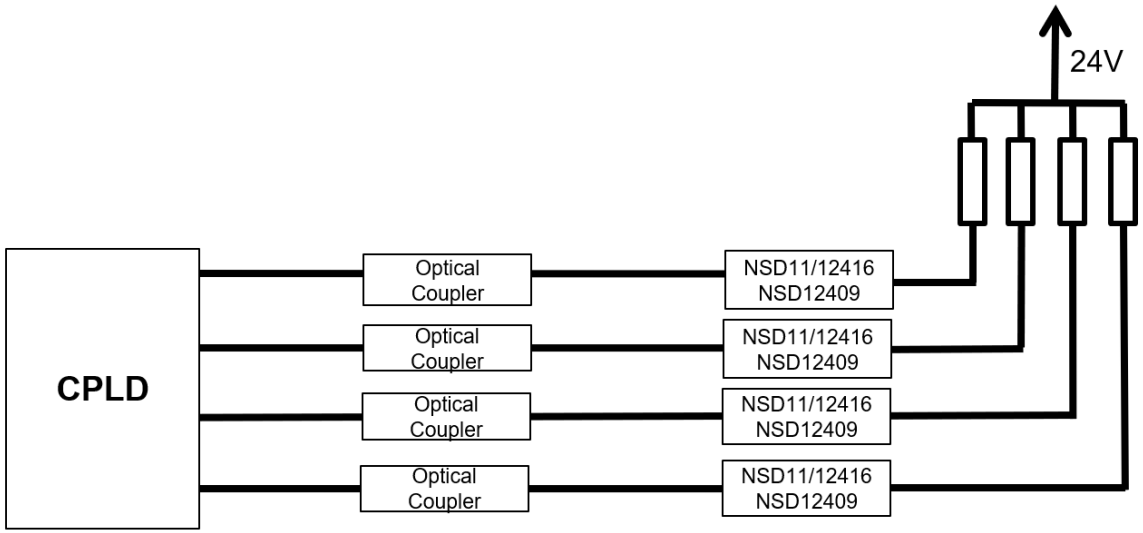
LDO
- NSR35/33/31xxx-Q1





Low Side Digital I/O – NSD5604

- Up to 200kHz
- Compatible for both Low speed and high speed digital I/O
- Integrated solution for size sensitive PCB



Low Side Digital I/O – NSD11/12416

- Low Speed digital I/O
- Lower Rds(on) for better thermal performance
- Channel to Channel Independent

NSD11/12 Replacement Device List

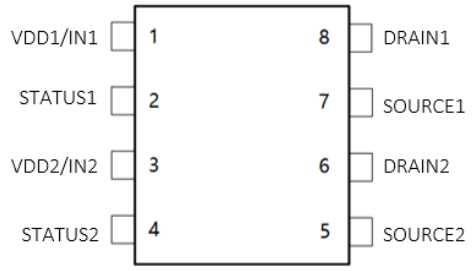
NOVOSENSE P/N	NO. Channel	Rds(on) (mOhm)	Replacement P/N	Competitor Rds(on)(mOhm)	Package	Pin to Pin	Function to Function
NSD12409-Q1SPR	2	90	VNLD5090	90	SOP8	Yes	Yes
NSD12416-Q1SPR	2	160	VNLD5160	160	SOP8	Yes	Yes
NSD11416-Q1STBR	1	160	VNL5160	160	SOT223	Yes	Yes
NSD11416-Q1SPR	1	160	VNL5160	160	SOP8	Yes	Yes
NSD11416-Q1STBR	1	160	VNN1NV04	250	SOT223	Yes	Yes
NSD11416-Q1STBR	1	160	BSP76	200	SOT223	Yes	Yes
NSD11416-Q1STBR	1	160	NCV8412ASTT3	180	SOT223	Yes	Yes
NSD11416-Q1STBR	1	160	NCV8402A	165	SOT223	Yes	Yes
NSD11416-Q1STBR	1	160	VNN3NV04	120	SOT223	Yes	Yes
NSD12416-Q1SPR	2	160	BTS3410G	200	SOP8	No	Yes
NSD12416-Q1SPR	2	160	NCV8402ADDR2G	165	SOP8	No	Yes
NSD12416-Q1SPR	2	160	NCV8402DDR2G	165	SOP8	No	Yes
NSD12416-Q1SPR	2	160	VNS1NV04D	250	SOP8	No	Yes
NSD12416-Q1SPR	2	160	VNS3NV04D	120	SOP8	No	Yes
NSD11416-Q1SPR	1	160	NCV8412ADDR	145	SOP8	No	Yes
NSD11416-QSTBR	1	160	BSP75N	490	SOT223	No	Yes

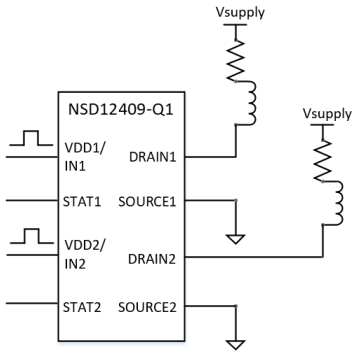
40V 90MOHM 2CH LOW SIDE SWITCH

P2P with VNLD5090

Features

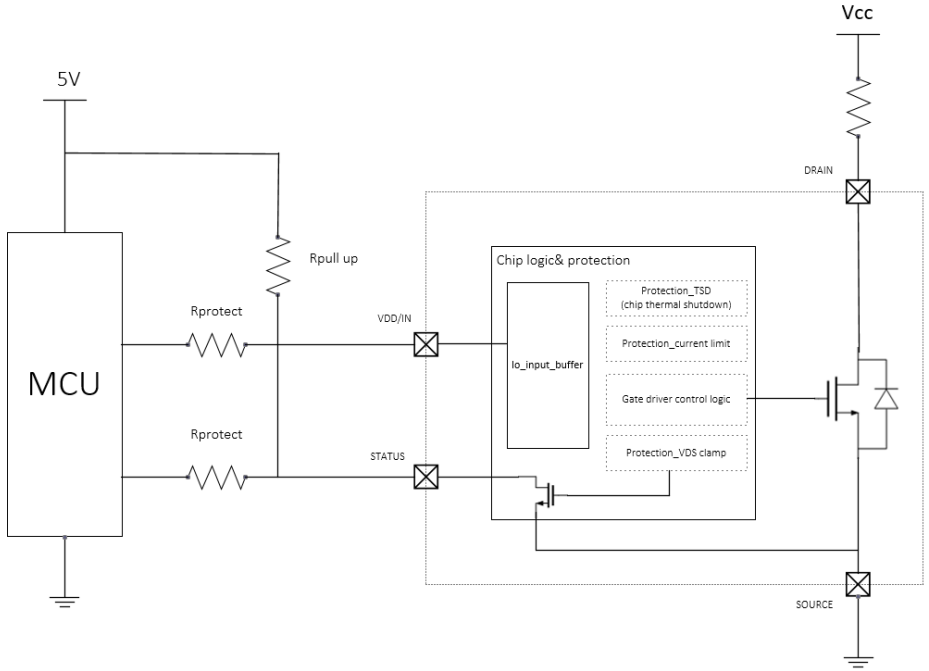
- Qualified for Automotive Grade 1 Application : Tj from -40℃ to 150℃
- 2 channel，Rdson:90mohm
- Support >20khz switching frequency
- Low standby current < 10uA
- Diagnosis & protection
  - Current limitation: 5.5A(min.)
  - Drain source clamp voltage: 46V to 56V
  - Off-stage open load detection
  - Thermal shutdown and thermal swing
- Package : SO-8 (4.9mm*3.9mm)
- The difference between NSD12409& VNLD5090： there are 2 current limitation (typical 8A and 13A)in VNLD5090, NSD12409 only has the low current(typical 8A) limitation





Applications

- Automotive Relays
- Solenoids
- Valves
- Lighting

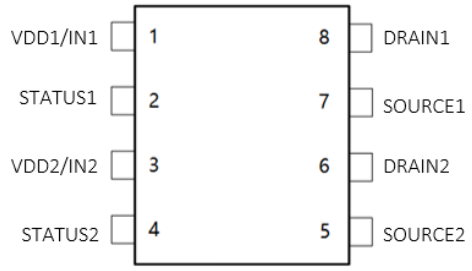


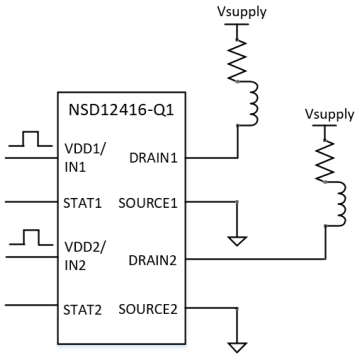
40V 160MOHM 2CH LOW SIDE SWITCH

P2P with VNLD5160

Features

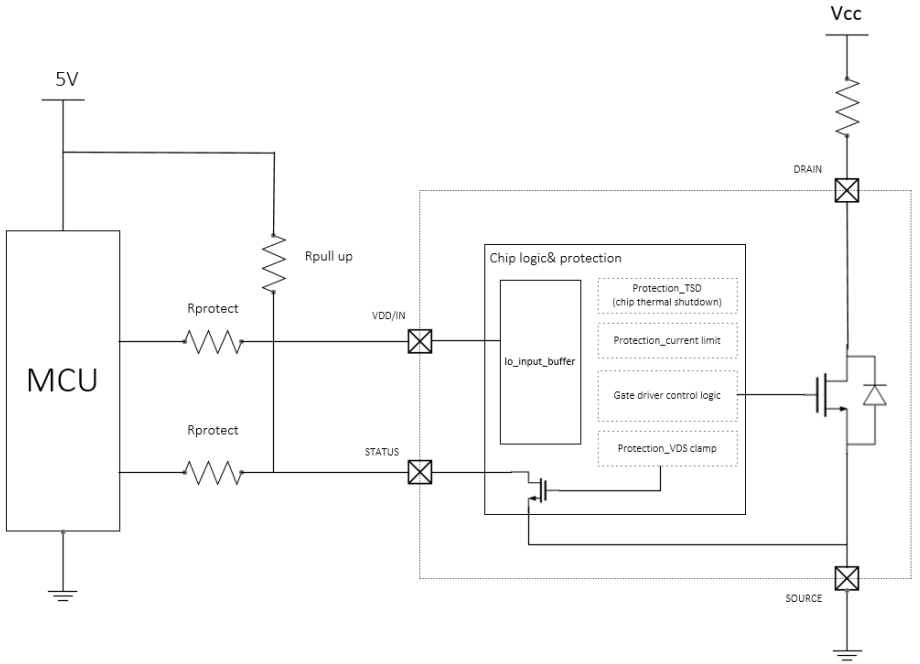
- Qualified for Automotive Grade 1 Application : Tj from -40℃ to 150℃
- 2 channel，Rdson:160mohm
- Support >20khz switching frequency
- Low standby current < 10uA
- Diagnosis & protection
  - Current limitation: 2.5A(typ.)
  - Drain source clamp voltage: 46V to 56V
  - Off-stage open load detection
  - Thermal shutdown and thermal swing
- Package : SO-8 (4.9mm*3.9mm)
- The difference between NSD12416& VNLD5160： there are 2 current limitation (typical 2.5A and 5A)in VNLD5160, NSD12416 only has the low current(typical 2.5A) limitation





Applications

- Automotive Relays
- Solenoids
- Valves
- Lighting



40V 160MOHM 1CH LOW SIDE SWITCH

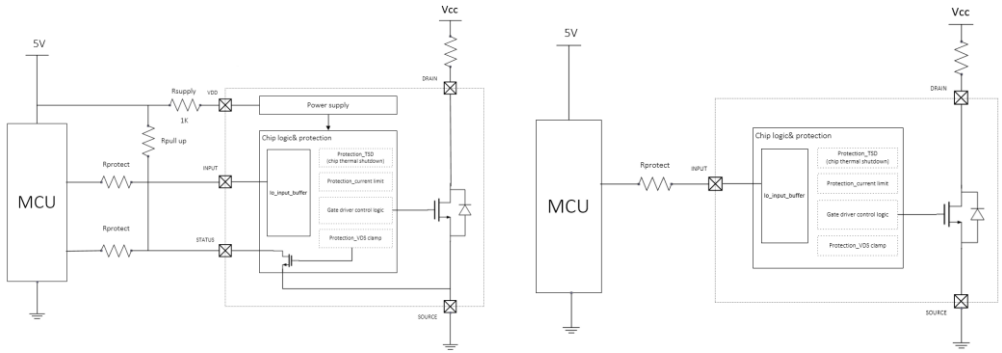
P2P with VNL5160

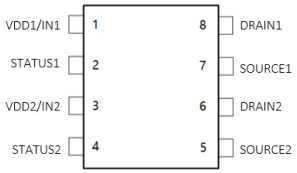
Features

- Qualified for Automotive Grade 1 Application : Tj from -40℃ to 150℃
- 1 channel，Rdson:160mohm
- Support >20khz switching frequency
- Low standby current < 10uA
- Diagnosis & protection
  - Current limitation: 2.5A(typ.)
  - Drain source clamp voltage: 46V to 56V
  - Off-stage open load detection
  - Thermal shutdown and thermal swing
- Package : SO-8 (4.9mm*3.9mm)&SOT223(6.48mm*3.38mm)
- The difference between NSD11416& VNL5160： there are 2 current limitation (typical 2.5A and 5A)in VNL5160, NSD11416 only has the low current(typical 2.5A) limitation

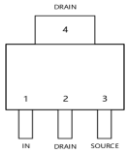
Applications

- Automotive Relays
- Solenoids
- Valves
- Lighting

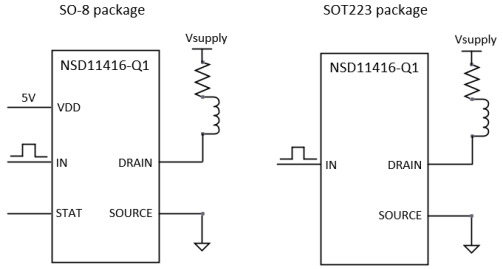




SO-8



SOT223



NSD11/12409/16 Comparison Table

	NSD11416	NSD12416	NSD12409	NCV8402	NCV8402D	VNL5160	VNLD5160	VNL5090	VNLD5090
NO. of Channel	1	2	2	1	2	1	2	1	2
Configurable HS/LS	0	0	0	0	0	0	0	0	0
High side	0	0	0	0	0	0	0	0	0
Low side	1	2	2	1	2	1	2	1	2
Power Supply Min(V)	2.1(SOP8) 3.5(SOT223)	3.5	3.5	VGS +-14V	VGS +-14V	3.5	3.5	3.5	3.5
Power Supply Max(V)	7	7	7	VGS +-14V	VGS +-14V	7	7	7	7
Quiescent Current	30	30	30	-	-	30	30	30	30
Output Clamp Min(V)	41	41	41	42	42	41	41	41	41
Logic Supply(V)	Y	Y	Y	N	N	Y	Y	Y	Y
Rds(on) Ohm	0.16	0.16	0.09	0.165	0.165	0.16	0.16	0.09	0.09
Internal Clamping	Y	Y	Y	Y	Y	Y	Y	Y	Y
Limp Home Mode	N	N	N	N	N	N	N	N	N
Current Limitation	Y	Y	Y	Y	Y	Y	Y	Y	Y
Current Limitation Threshold	2.5	2.5	Min 5.5, Typ 8	4.2-5.4 @ 25	4.2-5.4 @ 25	3.5/2.5	3.5/2.5	13/8	13/8
Open Load Diagnosis	Y	Y	Y	N	N	Y	N	Y	N
Short to GND Protection	Y	Y	Y	Y	Y	Y	Y	Y	Y
Package	SOT223/SOP8	SOP8	SOP8	SOT223	SOP8	SOP8	SOP8	SOT223/SOP8	SOP8