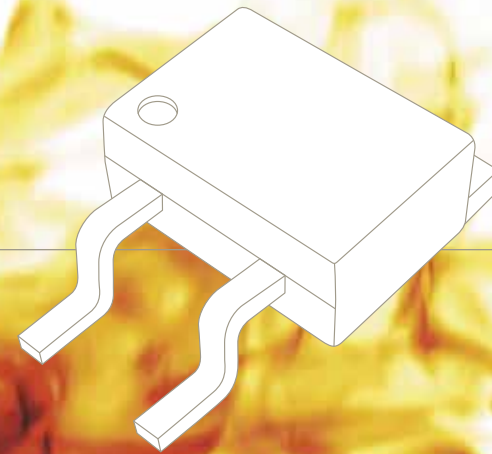




HIGH-TEMPERATURE
& EXTENDED LIFETIME SEMICONDUCTORS

AUTOMOTIVE SOLUTION GUIDE



START-STOP & MICRO HYBRID



HIGH VOLTAGE POWER
CONVERSION IN MILD / FULL
HYBRID & ELECTRIC VEHICLES



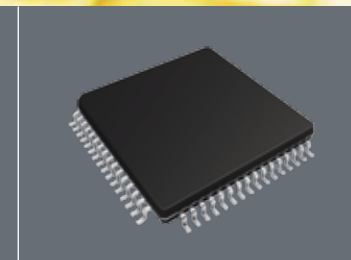
LIGHTING & LOW VOLTAGE
ACTUATION



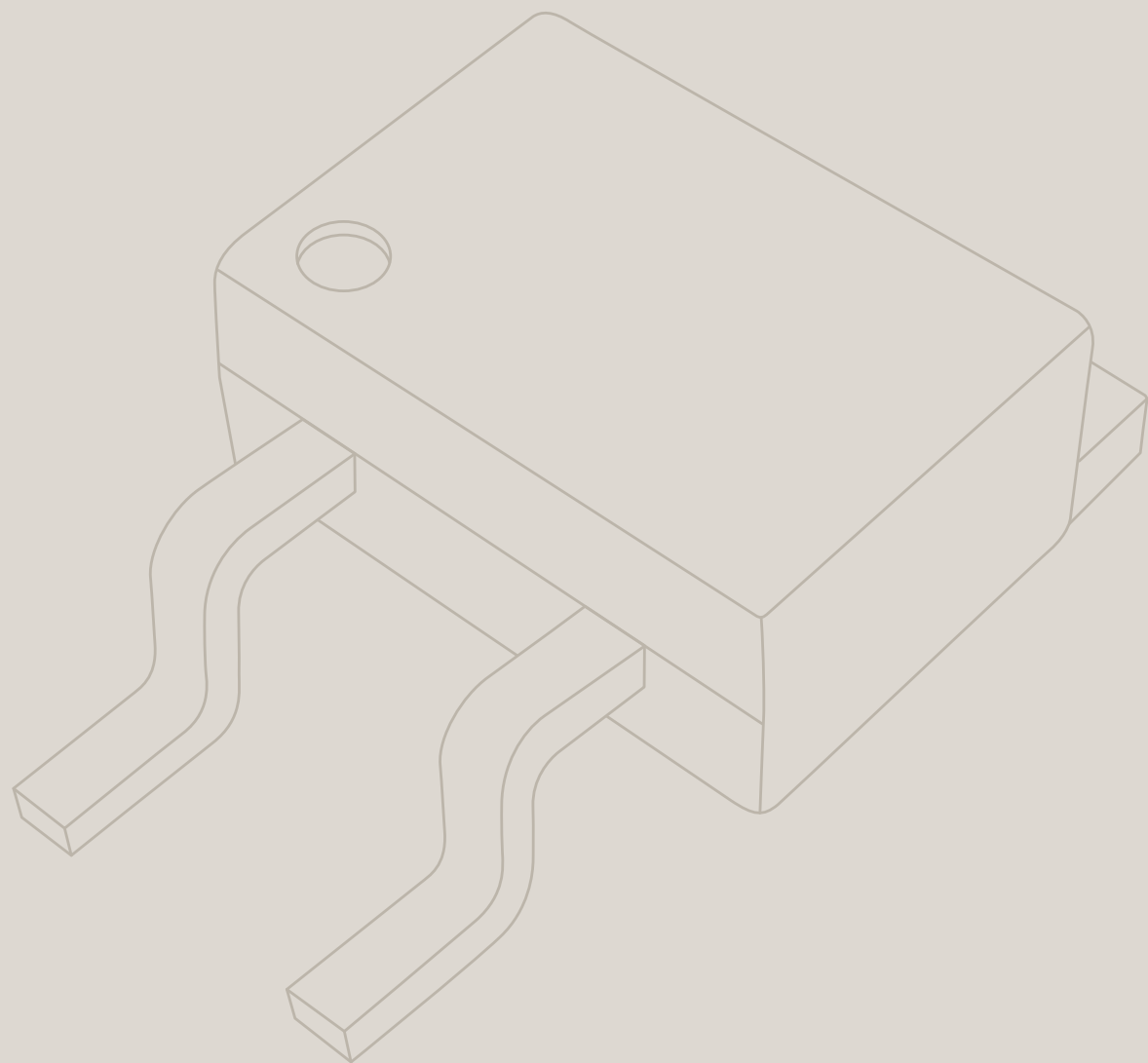
VOLTAGE REGULATORS, DC-DC &
POWER MANAGEMENT



EGR VALVES ELECTRONICS,
ACTUATION & SENSORS



ASSPS



WHY CISSOID?

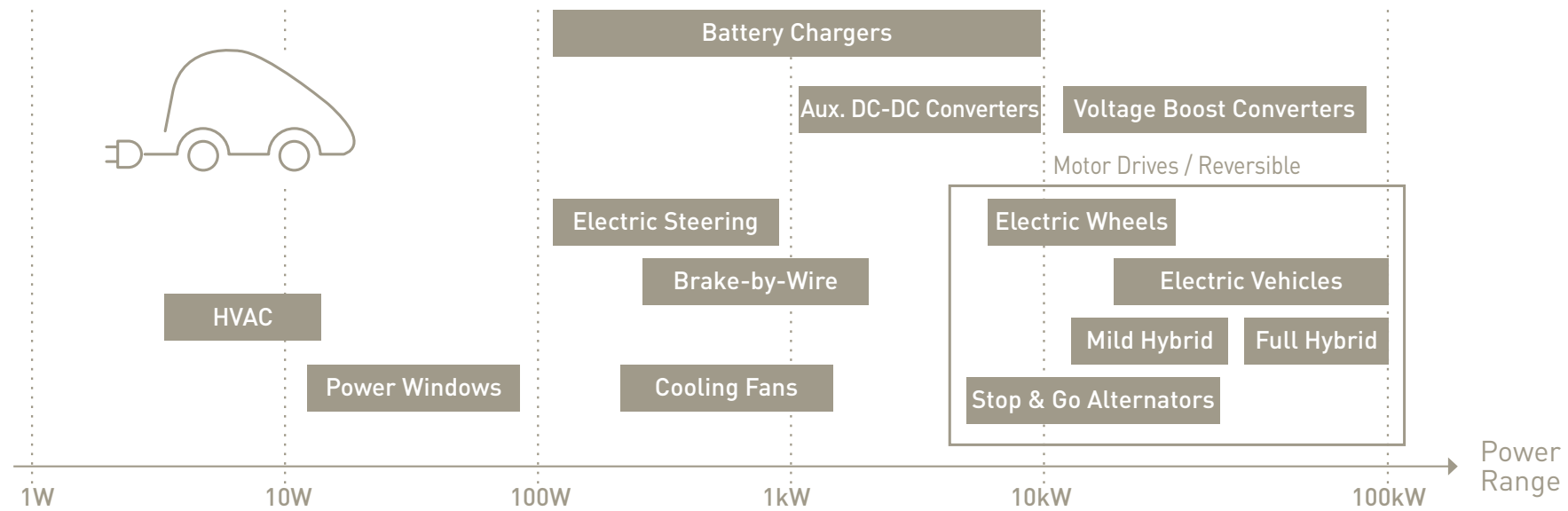
Since 2000, CISSOID is the supplier of choice for high-temperature & extended lifetime semiconductors. CISSOID accumulated know-how and technologies outperform standard semiconductors commonly used in automotive:

- **Temperature ratings are increased up to 175°C, 225°C and above,**
- **Lifetime is increased by more than a decade.**

Where the ambient temperature is low but the power dissipation heats up the chips (e.g. linear voltage regulator & power management ICs), or in high temperature environments (e.g. in the engine compartment or in the exhaust pipe system), CISSOID products enable simpler electronics, with reliable solutions for power supply, power conversion, actuation control and sensors. CISSOID provides cost-effective solutions; AEC-Q10x qualification and PPAP approval as required.



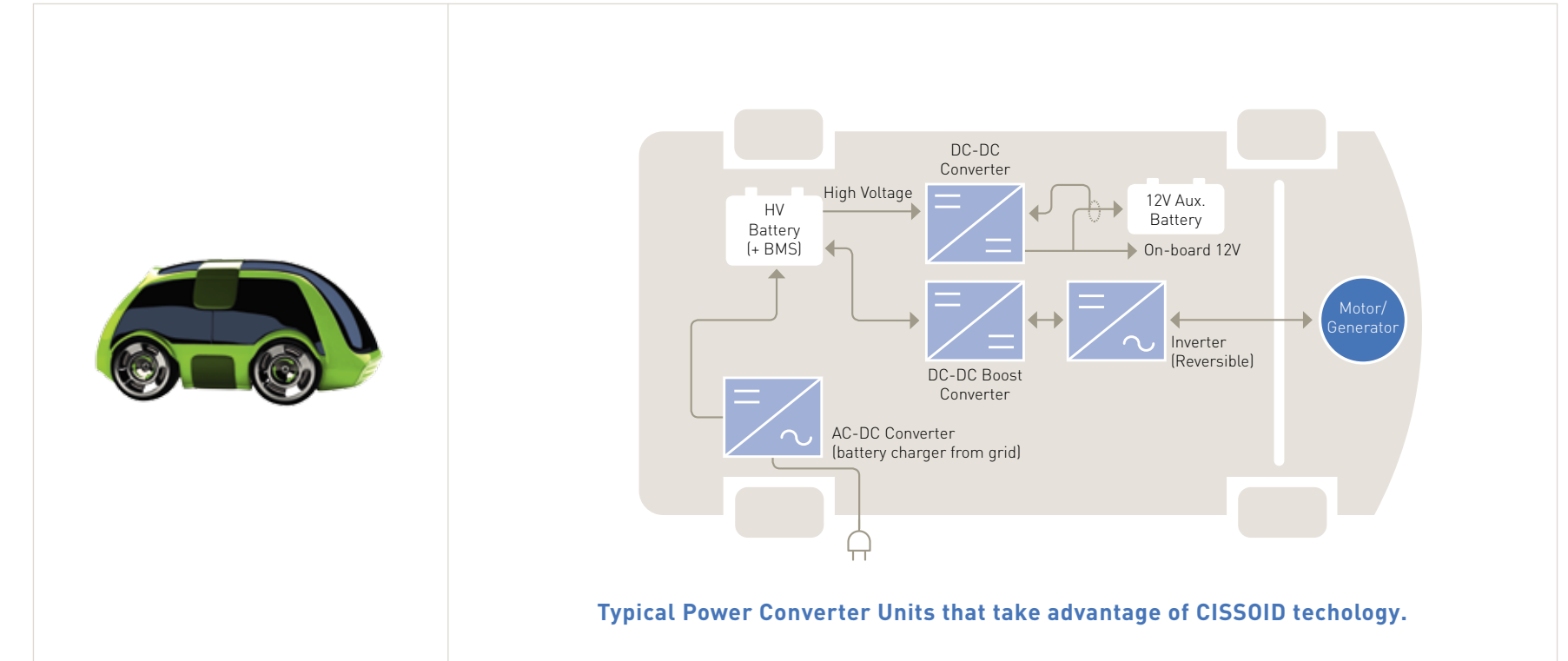
CISSOID enables compact & cooling-free power converters in traditional automotive, EV and HEV



Switching electrical power in automotive requires power components and power electronic sub-systems or modules ranging from a few Watts in small actuators, to kWatt and 100's of kWatt for powertrains in the newest generation of hybrid and electric vehicles.

Thermal management is a major challenge for these converters. CISSOID brings disruptive solutions that make possible the shrinking of the electronics, combined with the possibility to remove the dedicated fluid cooling that currently equip EVs and more especially HEV's.

Typical EV / P-HEV Architecture



CISSOID technology bricks & achievements:

- Complete high-voltage isolated gate driver solutions, 175°C and 225°C for SiC and GaN,
- Silicon Carbide Power MOSFETs,
- Intelligent Power modules.

Start-Stop & Micro Hybrid:



Low & medium voltage power inverters use power switches that operate with junction temperatures largely above 150°C today. The newest generation of SiC and upcoming GaN switches are poised to replace

traditional IGBTs and MOSFETs, leading toward even higher operating temperatures.

CISSOID solutions for gate drivers (Table 1) can be placed close to the power switch; they have been designed to take full advantage of SiC & GaN, bringing power density, compactness and reliability to a new standard level.

Mild / Full Hybrid & Electric Vehicles:



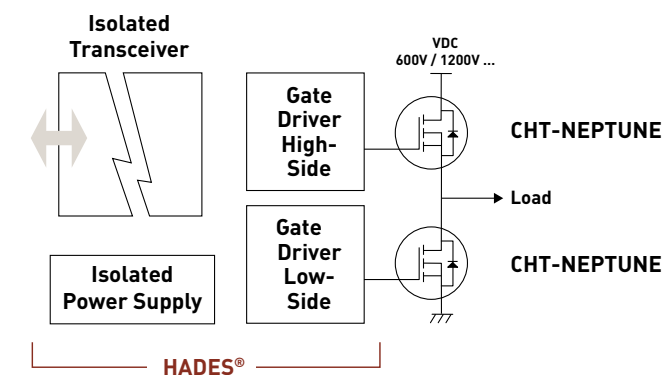
CISSOID has developed HADES®, a turnkey half-bridge gate driver chipset dedicated to high voltage power conversion for EV & HEVs. The highly integrated solution is suitable for power ranging from a few kW to

several 100's of kW. CISSOID also offers advanced SiC power switches and modules (Table 2) for advanced developments and demonstrators, performing very high temperature operation (225°C), high power density and cooling-free systems.

TABLE 1 TITAN: Gate driver, power driver and DC motor driver ICs & Eval Kits

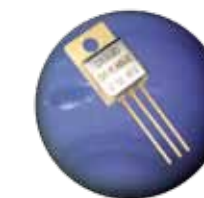
| | CMT / CHT-PALLAS | CMT / CHT-HYPERION | CMT / CHT-ATLAS | HADES® (EVK-HADES: Eval. Kit) | DC & STEPPER MOTOR COMING SOON |
|--|--|---|---|---|---|
| Description | Full-Bridge N-channel MOSFET driver IC | Half-Bridge N-channel MOSFET driver IC | Dual Channel Power Driver IC | Half-Bridge Isolated Gate-Driver chipset & Eval Kit | ATLAS-based H-Bridge - Application Note (Eval Kit: Contact CISSOID) |
| Max bus voltage | 50V DC | 52V | 30V DC | 1200V DC | 30V DC |
| Gate output current | 20/80mA | 1A | 2 x ±2A | ±4A | ±600mA |
| Operating tempertaure (TJ) | -55° to +175°C / +225°C | -55° to +175°C / +225°C | -55° to +175°C / +225°C | -55° to +175°C / +225°C | -55° to +175°C / +225°C |
| Package | Depends on temperature rating: Contact CISSOID | | | Eval Board | CxT-ATLAS-Based Eval board |
| Isolation (primary – secondary) | N/A | N/A | N/A | 2,500VAC @50Hz (for 1mn) | N/A |
| Common mode transient immunity | N/A | N/A | N/A | >100MQ @ 500VDC | N/A |
| Gate voltage (customizable) | 0 / 10V | | | 30-50 kV/µs | N/A |
| Power supply | +5V ±5% & +8V-10V | +5V ±10% & +4V-50V | +5V ±5% & +5V-30V | MOSFET support: 20V / -5V Other devices: Contact CISSOID | N/A |
| Other features | | UVLO; output enable control; adaptive non-overlap circuit; integrated High-Side Bootstrap Diode | 2 channels with separate logic level control inputs; soft-shut down & High Impedance mode | UVLO; Active Miller clamping; Desaturation protection; Isolated fault outputs ... | Soft-shut down; high-impedance mode... |

HIGHLIGHT: HADES® and CHT-NEPTUNE, a complete 1200V / 10A half-bridge IPM solution kit for advanced R&D of high voltage power converters:



TABLES 2: SiC Power MOSFET & modules

| | CHT-NEPTUNE | POWER MODULES |
|---------------------|--|-----------------|
| VDS Max | -55°C ~ +225°C High Voltage, Silicon Carbide MOSFET | 1200V |
| IDS Max (DC) | 10A | Contact CISSOID |
| RDSon | 90 mΩ @ 25°C ; 150 mΩ @ 225°C | Contact CISSOID |
| VGS | -2V / +20V | Contact CISSOID |
| Package | T0257 | Contact CISSOID |



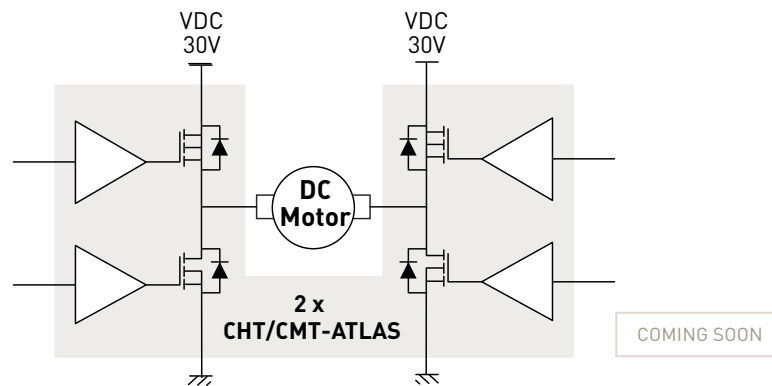
Lighting & Low Voltage Actuation:



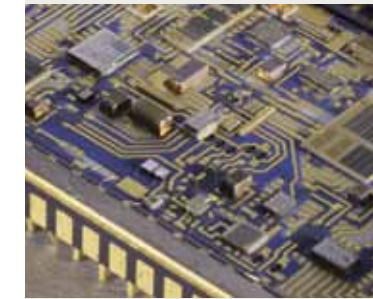
CISSOID provides advanced solutions of low voltage, medium power converter : Either as standalone ICs for low power applications, or combined with newest generation of GaN transistors, CISSOID gate drivers

enable the highest power density with reduced cooling without impacting the reliability. For medium power applications, CISSOID single chip power driver CHT/CMT-ATLAS can be used for DC motor drive (Contact CISSOID for dedicated Application Notes).

HIGHLIGHT: Stepper and DC Motor Drive Application Note (30V / 600mA) using CISSOID ATLAS integrated circuit:



Voltage Regulators, DC-DC & Power Management:



Under the hood electronics commonly implement hybrid and compact PCB modules attached to the engine block or to the gear box, that see the operating temperature commonly going up to 150°C / 170°C. As a result, the reliability of their power supply

circuits is often an issue: In particular linear voltage regulators see their junction temperature increasing above the rest of the module because of the self dissipation within the components. With its STAR family of products (Table 3) CISSOID brings solutions of choice with

no risk of untimely thermal shutdown (most of the standard silicon devices have thermal shutdown active above 150°C) and with lifetime that outperforms any standard bulk silicon solution in the market. Moreover, they advantageously replace switched mode power supplies in a number of applications, reducing the component count, the complexity of the circuitry and the noise, whilst keeping a safety margin with regard to the junction temperature with up to 175°C / 225°C.

CISSOID linear voltage regulators are the only devices in the market with a temperature rating of 175°C and 225°C suitable for automotive applications.

TABLE 3 STAR: Linear Voltage Regulator ICs

| Product-Name | Description | V _{OUT} | V _{IN} Max | I _{OUT} Max | Total Accuracy | Package | P _{max} @ 150°C Ambient * | Temperature Range |
|-----------------------|--|---|---------------------|----------------------|----------------|---------|------------------------------------|-------------------|
| CHT-BG3M | | 6 values from +2.5V to +12V | 25V | 3mA | ±2% | T039 | N/A | -55° to +225°C |
| CHT-LDOS CHT-LDOP | Positive, fixed voltage - Linear regulator | 9 values from +2.5V to +15V | 30V | 1A | ±4% | T0254 | ~10W | -55° to +225°C |
| CHT-LDNS-xxx | Negative, fixed voltage - Linear regulator | 9 values from -2.5V to -15V | -30V | 1A | ±5% | | | |
| CHT-VEGA CHT-RIGEL | Adjustable voltage - Linear regulator | +1.2V to +3.3V (Adjustable) +1.8V to +28V (Adjustable) | 5.5V 30V | 500mA 100mA | ±5% | TDFP16 | ~1W | -55° to +225°C |
| CMT / CHT-ANTARES | Positive, fixed voltage - Linear regulator | 7 values from +1.2V to +15V | 30V | 200mA | ±5% | | | |

[*]: Estimated typical power dissipation figures assuming T0254/257 are equipped with suitable heatsinks and TDFP / T0263 are soldered on PCB with copper thermal pad.

TABLE 4 PLANET - Discrete

| Product Name | Description | V _{DS} Max | I _{DS} Max | R _{DS(ON)} | | Package |
|-----------------------|-------------------------------------|---------------------|---------------------|---------------------|---------|------------|
| | | | | @ 25°C | @ 225°C | |
| EARTH / CHT-NMOS8001 | NMOS Medium Power Transistor | 80V | 1A (3A pulse) | 0.76Ω | 1.56Ω | TDFP16 |
| EARTH / CHT-NMOS8005 | NMOS Medium Power Transistor | 80V | 5A | 0.48Ω | 0.99Ω | TO254 |
| EARTH / CHT-NMOS8010 | NMOS Medium Power Transistor | 80V | 10A | 0.24Ω | 0.46Ω | TO254 |
| SATURN / CHT-NMOS4005 | NMOS Medium Power Transistor | 40V | 5A | 0.38Ω | 0.65Ω | TO254 |
| SATURN / CHT-NMOS4010 | NMOS Medium Power Transistor | 40V | 10A | 0.2Ω | 0.36Ω | TO254 |
| SATURN / CHT-NMOS4020 | NMOS Medium Power Transistor | 40V | 20A | 0.12Ω | 0.25Ω | TO254 |
| MERCURY / CHT-SNMOS80 | NMOS Small Signal Transistor | 80V | 300mA | 7.5Ω | 15Ω | TO39; TO18 |
| CHT-MOON | Dual NMOS Medium Power Transistor | 40V | 4A | 0.38Ω | 0.65Ω | CSOIC16 |
| VENUS / CHT-PMOS3002 | PMOS Medium Power Transistor | 30V | 2A | 2.3Ω | 3.9Ω | TO254 |
| VENUS / CHT-PMOS3004 | PMOS Medium Power Transistor | 30V | 4A | 1.1Ω | 2.0Ω | TO254 |
| VENUS / CHT-PMOS3008 | PMOS Medium Power Transistor | 30V | 8A | 0.6Ω | 1.0Ω | TO254 |
| MARS / CHT-SPMOS30 | PMOS Small Signal Transistor | 30V | 310mA | 15Ω | 26Ω | TO39; TO18 |
| CHT-NEPTUNE | High Voltage Silicon Carbide MOSFET | 1200V | 10A | 0.09Ω | 0.15Ω | TO257 |

| Product Name | Description | V _R | I _F | V _F @ I _F Max |
|--------------|---|---|--|-------------------------------------|
| CHT-GANYMEDE | Dual Series Small Signal Diode | 80V | 280mA | 1.5V |
| CHT-CALLISTO | Dual Small Signal Diode (Common Anode) | 80V | 280mA | 1.5V |
| CHT-AMALTHEA | Dual Diode (Dual Series, Common Anode & Common Cathode) | 80V | 3A | 1.8V |
| CHT-CERES | Transient Voltage Suppressor | 13.4V (break-down voltage; bidirectional) | FEATURES & AVAILABILITY: CONTACT CISSOID | |

TABLE 5 GALAXY: Logic

| Product Name | Description | Power Supply | Temperature Range | Packages |
|-----------------|--------------------------------|--------------|-------------------------|---------------------|
| CHT/CMT-7400 | Quad 2-input NAND | 3.0V to 5.5V | -55° to +175°C / +225°C | CDIL 14/16, CSOIC16 |
| CHT/CMT-7404 | Hex inverter | | | |
| CHT/CMT-7408 | Quad 2-Input AND | | | |
| CHT/CMT-74021 | Quad 2-Input NOR | | | |
| CHT/CMT-7432 | Quad 2-Input OR | | | |
| CHT/CMT-7474 | Dual D-type flip-flop | | | |
| CHT/CMT-7486 | Quad 2-Input XOR | | | |
| CHT/CMT-74132 | Quad NAND Schmitt Trigger | | | |
| CHT/CMT-74-4040 | 12-stage binary ripple counter | | | |
| CHT/CMT-7400 | Quad- 2-input NAND | | | |

Packages: PSOIC / CSOIC;
other packages: Contact CISSOID

EGR Valves Actuation & Sensors:



Applications such as EGR valve actuation, low & medium power actuation (e.g. solenoid control, DC motor control etc.) and sensors (e.g. exhaust gas; oil pressure; position sensors...) are implemented in hot locations, where traditionally the electronic circuitry must be remote due to the local temperature of the

sensing element. With CISSOID, it is now possible to implement part or the full electronic circuitry together with the sensing element in the hot area.

Standard integrated circuits include discrete, logic devices, amplifiers and mixed signal (Tables 4 to 6).

HIGHLIGHT: Analog front end amplification in sensors

Typical sensing applications require an instrumentation amplifier stage together with a voltage or current reference for bridge excitation. CISSOID CHT-RUBY combines these functions in a single chip and meet the toughest temperature and lifetime requirements.

Other function blocks such as multiplexing, A-D conversion, isolated transmission can also be fulfilled by other dedicated CISSOID devices (e.g. CHT-AMAZON or CHT-RHEA), or combined in an ASSP.

CHT-RUBY :
Instrumentation amplifier and bridge excitation in a single IC.

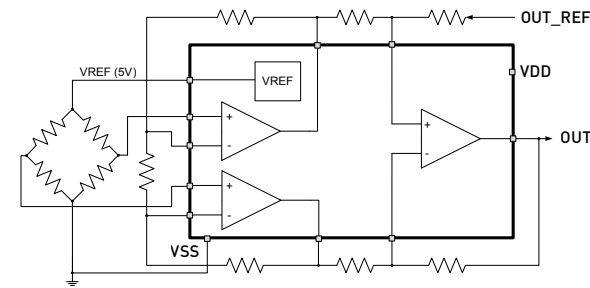




TABLE 6 GEMSTONE: Amplifiers

| Product Name | Description | Power Supply | Max. Current Consumption [1] | Output Voltage Swing | Input Offset Voltage | GBW (Typ.) | Slew Rate [1] | Temperature Range | Packages |
|--|-----------------------------------|--------------|------------------------------|-------------------------|----------------------|------------|--------------------------------------|-------------------------|---------------------------|
|  CMT / CHT-OPA (TURQUOISE) | Quad Op Amp | 4.5V -20V | 2 / 2.2mA | VDD-0.18V; VSS+0.18V | ±8mV | 1.5MHz | 1.6 / 1.7V/μs | -55° to +175°C / +225°C | PSOIC16 / CSOIC16/ CDIL14 |
| CHT-RUBY | Triple Op Amp + Voltage Reference | 6.0V to 20V | 1.6mA + 0.7mA (Vref) | VDD-0.18V VSS +0.18V | ±8mV | 1.3MHz | 1.6V / s | -55°C/+225°C | CSOIC16 |
|  CHT-OPAL | Dual Precision Op Amp | 4.5V to 5.5V | 2.8mA | VDD - 0.1V VSS+0.1V | <50μV | 2.8MHz | 2.7V/μs (@25°C); 3.2V/μs (@225°C) | -55°C/+225°C | TDFP16 |

[1] Load conditions: RL=2KΩ, CL=30pF and Tj=225°C max

Application Specific Standard Products (ASSPs):

When our standard products do not match the exact customer's requirements, CISSOID can tailor its offering, design and deliver ASSPs that match specific needs.

Contact CISSOID for more information.

Customer Requirements:

- Power supply: linear regulator or SMPS
- Instrumentation
- Power drivers
- Discrete
- Logic

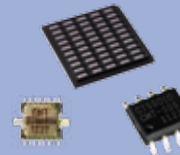
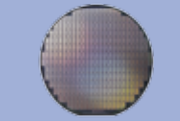
Integration in an ASSP

Chip Design & Simulation
-55°C~175°C / 225°C

Fabrication & test; delivery of engineering samples

AECQ100 Qual

Delivery





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