

iC-DP

HIGHSIDE SWITCH



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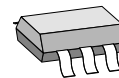
FEATURES

- 36 V highside switch/level shifter
- p-channel output driver without charge pump for short activation time
- Decoupling of input and output reference voltages (SOT23-6L) permits control by 5V logic
- 200 mA of output current
- Short-circuit protected
- Output with an active freewheeling circuit
- On-chip overtemperature protection with hysteresis
- 4 to 36 V input voltage range
- Input with hysteresis
- 3-pin configuration possible
- Wide temperature range of -40 to 120 °C

APPLICATIONS

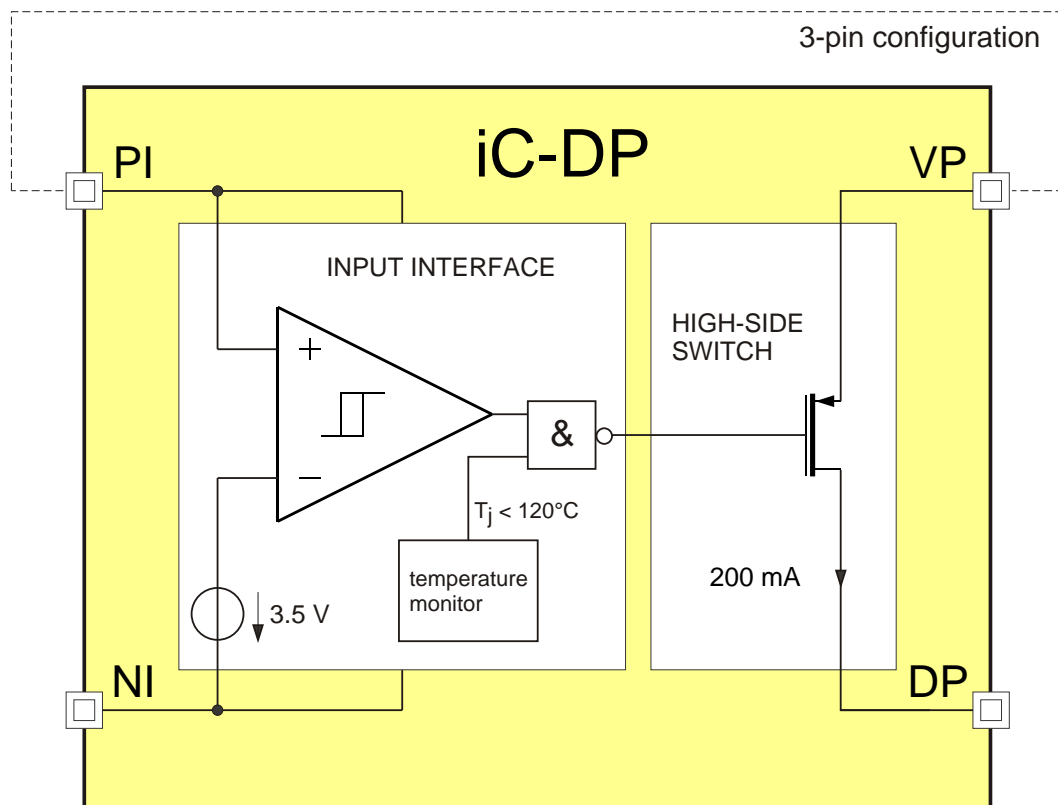
Highside switch for industrial applications, such as relays, inductive proximity sensors and light barriers

PACKAGES



SOT23-6L

BLOCK DIAGRAM



iC-DP

HIGHSIDE SWITCH



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DESCRIPTION

iC-DP is a monolithic highside switch for ohmic, inductive and capacitive loads.

Designed for a wide input voltage range of 4 to 36 V, it is capable of supplying a minimum output current of 200 mA. The output acts as a current source with a low saturation voltage; protection against short-circuiting is provided by the device shutting down with

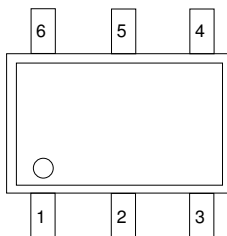
excessive temperature. The chip is activated when the input voltage threshold $V(PI)-V(NI)$ of typically 3.5 V is exceeded.

When used as a 4-pin element, the input (PI, NI) and output (DP, VP) reference voltages are decoupled. The maximum permissible voltage difference between VP and PI is 36 V.

PACKAGES SOT23-6L (JEDEC)

PIN CONFIGURATION

SOT23-6L (JEDEC), 1.6 mm



PIN FUNCTIONS

No. Name Function

| | | |
|---|------|----------------|
| 1 | NI | Negative Input |
| 2 | PI | Positive Input |
| 3 | DP | Output |
| 4 | VP | Supply |
| 5 | n.c. | |
| 6 | n.c. | |

ABSOLUTE MAXIMUM RATINGS

Beyond these values damage may occur; device operation is not guaranteed. Absolute Maximum Ratings are no Operating Conditions. Integrated circuits with system interfaces, e.g. via cable accessible pins (I/O pins, line drivers) are per principle endangered by injected interferences, which may compromise the function or durability. The robustness of the devices has to be verified by the user during system development with regards to applying standards and ensured where necessary by additional protective circuitry. By the manufacturer suggested protective circuitry is for information only and given without responsibility and has to be verified within the actual system with respect to actual interferences.

| Item No. | Symbol | Parameter | Conditions | Min. | | Max. | | Unit |
|----------|--------|---|--|------|--|------|--|------|
| | | | | | | | | |
| G001 | V() | VP, PI Input Voltage with reference to NI | $V()=V(VP)-V(NI)$ bzw. $V()=V(PI)-V(NI)$ | -0.3 | | 40 | | V |
| G002 | V(DP) | DP Output Voltage with reference to VP | no free wheeling | -40 | | 0.3 | | V |
| G003 | I(DP) | DP Output Current | | -300 | | | | mA |
| G004 | I(PI) | PI Input Current | | | | 10 | | mA |
| G005 | I(NI) | NI Input Current | | -10 | | | | mA |
| G006 | Vd() | ESD Susceptibility, all pins with reference to VP, DP | HBM, 100 pF discharged through 1.5 kΩ | | | 2 | | kV |
| G007 | Tj | Max. Junction Temperature | | -40 | | 150 | | °C |
| G008 | Ts | Storage Temperature Range | | -40 | | 150 | | °C |
| G009 | Eas | Inductive load switch-off energy dissipation | temperature monitor not active, $T_j < T_{on}$ | | | 5 | | mJ |

THERMAL DATA

Operating Conditions: $V(PI) = 4...36V$, unless otherwise stated

| Item No. | Symbol | Parameter | Conditions | Min. | | | Max. | | | Unit |
|----------|--------|---------------------------|------------|------|------|--|------|-----|--|------|
| | | | | | Typ. | | | | | |
| T01 | Ta | Ambient Temperature Range | | -40 | | | | 120 | | °C |

All voltages are referenced to ground (NI) unless otherwise stated.

All currents flowing into the device pins are positive; all currents flowing out of the device pins are negative.

ELECTRICAL CHARACTERISTICS

 Operating Conditions: $V(PI) = 0 \dots 36 \text{ V}$, $T_j = -40 \dots 120 \text{ }^\circ\text{C}$, unless otherwise stated

| Item No. | Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|----------------------------|-----------------------------------|------------------------------|---|----------------|------|----------------------|--------------------------------|
| | | | | | | | |
| Total Device | | | | | | | |
| 001 | V() | VP, PI Supply Voltage | $V() = V(VP) - V(NI)$ bzw. $V() = V(PI) - V(NI)$ | 4 | | 36 | V |
| 002 | I(PI) | PI Supply Current | No load; $V(PI) - V(NI) > V(PI)_{on}$ $V(PI) - V(NI) < V(PI)_{off}$ | 0 0 | | 1000 250 | μA μA |
| 003 | I(VP) | VP Supply Current | No load; $V(PI) - V(NI) > V(PI)_{on}$ $V(PI) - V(NI) < V(PI)_{off}$ | 80 0 | | 680 2000 | μA μA |
| 004 | I(NI) | NI Input Current | No load; $V(PI) - V(NI) > V(PI)_{on}$ $V(PI) - V(NI) < V(PI)_{off}$ | -1000 -2000 | | -130 0 | μA μA |
| 005 | I _{lk} (DP) | DP Output Leakage Current | $V(PI) - V(NI) < V(PI)_{off}$, $V(DP) = 0 \dots V(VP)$ | -100 | | 100 | μA |
| 006 | V _c (DP) _{lo} | DP Clamp Voltage low | $V_c(DP)_{lo} = V(DP) - V(VP)$, $I(DP) = -10 \text{ mA}$ | -70 | -45 | -40 | V |
| 007 | V _c (DP) _{hi} | DP Clamp Voltage high | $V_c(DP)_{hi} = V(DP) - V(VP)$, $I(DP) = 10 \text{ mA}$ | 0.3 | | 1 | V |
| 008 | V _c (_{hi}) | PI, VP Clamp Voltage high | $V_c(\text{hi}) = V() - V(NI)$, $I() = 4 \text{ mA}$ | 37 | 40 | | V |
| 009 | tpio _{hi} | Activation Delay NI → DP | $V(PI)_{on} < V(PI) - V(NI) < 48 \text{ V}$, $V(Rload) = 48 \text{ V}$, $Rload = 360 \Omega$, $I(DP) = 0 \rightarrow -90 \text{ mA}$, $ Input \text{ slew rate} > 10 \text{ V}/\mu\text{s}$ | 1 | | 25 | μs |
| 010 | tpio _{lo} | Deactivation Delay NI → DP | $V(PI) - V(NI) < V(PI)_{off}$, $V(Rload) = 36 \text{ V}$, $Rload = 360 \Omega$, $I(DP) = -100 \rightarrow -10 \text{ mA}$, $ Input \text{ slew rate} > 10 \text{ V}/\mu\text{s}$ | 1 | | 15 | μs |
| Highside Output DP | | | | | | | |
| 101 | V _s (DP) | Output Saturation Voltage | DP = hi, with reference to VP $I(DP) = -200 \text{ mA}$, $I(DP) = -50 \text{ mA}$ | -800 -200 | | | mV mV |
| 102 | I _{sc} (DP) | Output Short-Circuit Current | $V(VP) - V(DP) = 1 \text{ V} \dots V_B$, DP = hi $T_j = -40 \text{ }^\circ\text{C}$ $T_j = 27 \text{ }^\circ\text{C}$ $T_j = 120 \text{ }^\circ\text{C}$ | -800 | -400 | -200 -200 -200 | mA mA mA |
| 103 | SR(DP) _{on} | Slew Rate, V(DP) → VP | $V(PI) - V(NI) > V(PI)_{on}$, $V(Rload) = 36 \text{ V}$, $Rload = 360 \Omega$, $V(VP) - V(DP) = 32.4 \rightarrow 3.6 \text{ V}$ | | 50 | | V/ μs |
| 104 | SR(DP) _{off} | Slew Rate, V(DP) → V(NI) | $V(PI) - V(NI) < V(PI)_{off}$, $V(Rload) = 36 \text{ V}$, $Rload = 360 \Omega$, $V(VP) - V(DP) = 3.6 \rightarrow 32.4 \text{ V}$ | | 20 | | V/ μs |
| 105 | V _{fw} (DP) | Freewheeling Voltage | $I(DP) = -200 \text{ mA}$, with reference to VP, including Zener noise voltage | -60 | -45 | -40 | V |
| Temperature Monitor | | | | | | | |
| 201 | Toff | Thermal Shutdown Threshold | | 120 | | 150 | $^\circ\text{C}$ |
| 202 | Ton | Thermal Release Threshold | Decreasing temperature | 110 | | 135 | $^\circ\text{C}$ |
| 203 | Thys | Thermal Shutdown Hysteresis | $Thys = Toff - Ton$ | | 15 | | $^\circ\text{C}$ |
| Input Threshold | | | | | | | |
| 301 | V(PI) _{on} | Power-On Threshold Voltage | $V(PI) - V(NI)$ | 2.7 | | 4.1 | V |
| 302 | V(PI) _{off} | Power-Off Threshold Voltage | $V(PI) - V(NI)$, decreasing voltage | 2.3 | | 3.7 | V |
| 303 | V(PI) _{hys} | Hysteresis | $V(PI)_{hys} = V(PI)_{on} - V(PI)_{off}$ | 170 | 380 | 590 | mV |

ELECTRICAL CHARACTERISTIC: DIAGRAMS

Simulation Data

(current consumption without load; leakage currents not included)

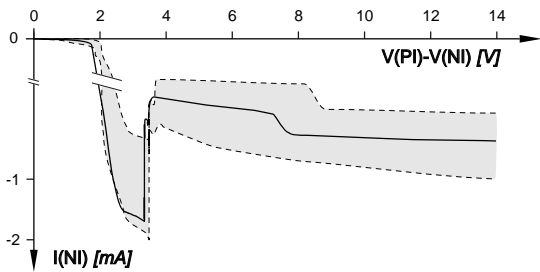


Figure 1: NI input current, no load

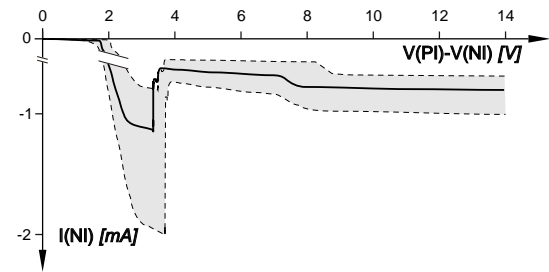


Figure 2: NI input current, $I(DP) = -5\text{ mA}$

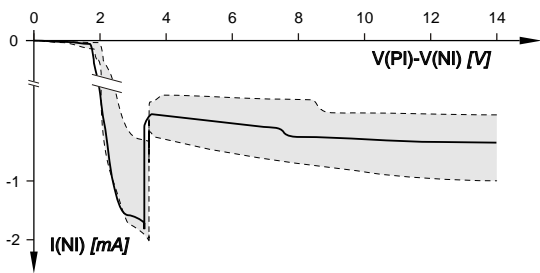


Figure 3: NI input current, $I(DP) = -100\text{ mA}$

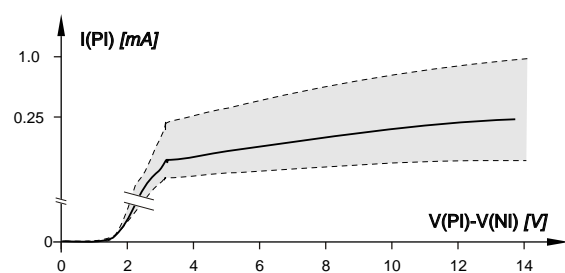


Figure 4: PI input current, load independent

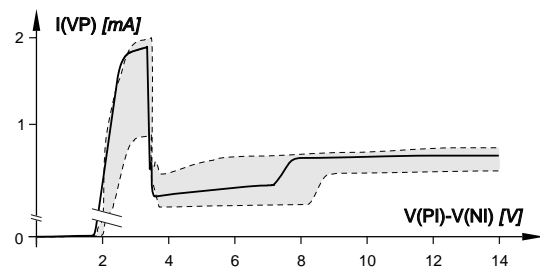


Figure 5: VP supply current, no load

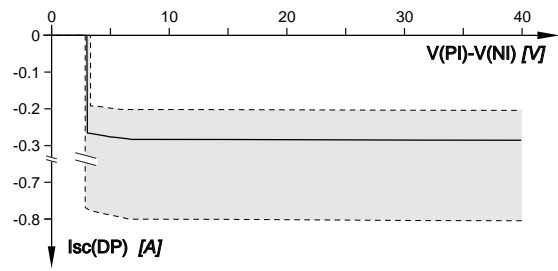


Figure 6: DP short-circuit output current

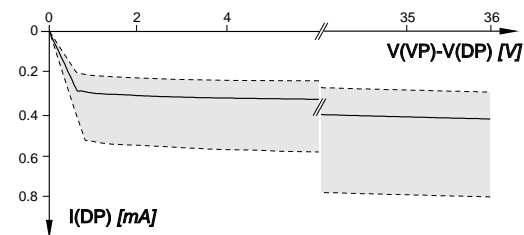


Figure 7: DP output characteristic

APPLICATION NOTES

Example application circuits for SOT23-6L package

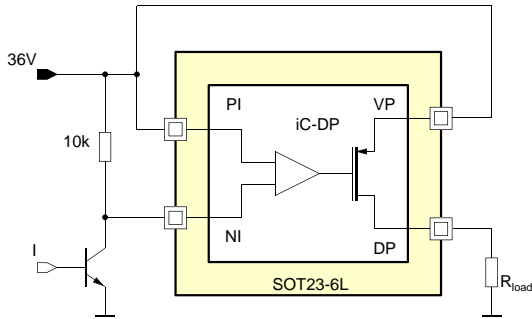


Figure 8: 36 V supply, NPN input control

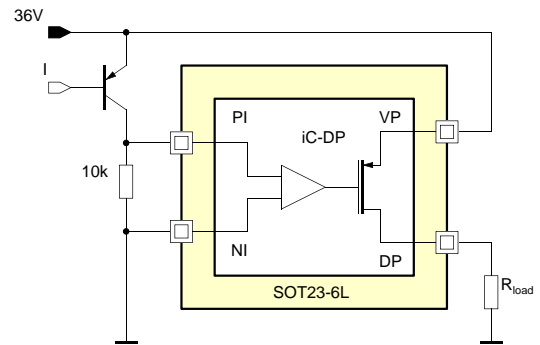


Figure 9: 36 V supply, PNP input control

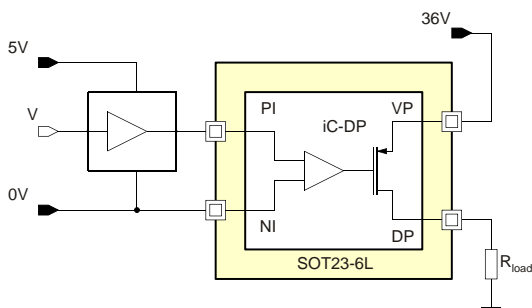


Figure 10: 5 V μ C operating at 5 to 0 V input control, 36 V output supply

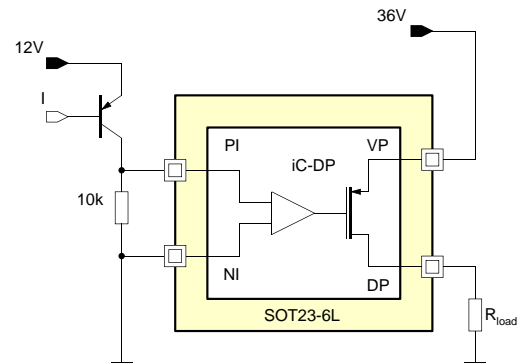


Figure 11: 12 V PNP input control, 36 V output supply

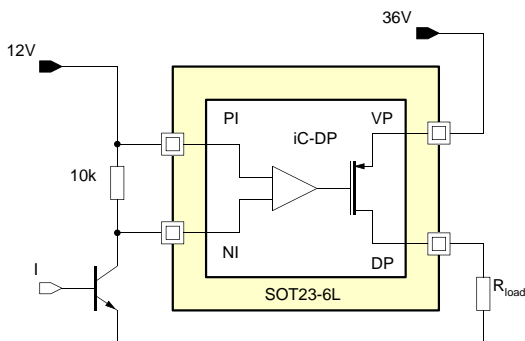


Figure 12: 12 V NPN input control, 36 V output supply

iC-DP

HIGHSIDE SWITCH



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We understand suitable application of our published designs to be state-of-the-art technology which can no longer be classed as inventive under the stipulations of patent law. Our explicit application notes are to be treated only as mere examples of the many possible and extremely advantageous uses our products can be put to.

ORDERING INFORMATION

| Type | Package | Order Designation |
|-------|------------------|-------------------|
| iC-DP | SOT23-6L (JEDEC) | iC-DP SOT23-6L |

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