

# iC-DP

## HIGHSIDE SWITCH



Rev C3, Page 1/8

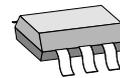
### FEATURES

- 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

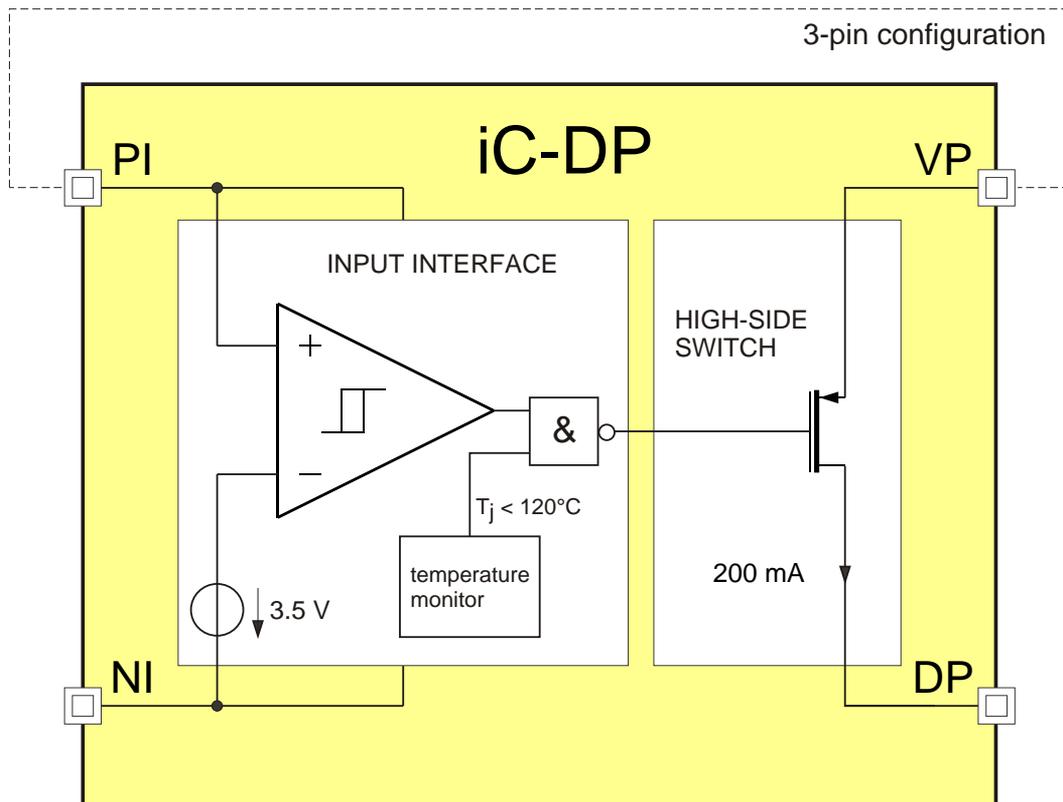
Highside switch for industrial applications, such as relays, inductive proximity sensors and light barriers

### PACKAGES



SOT23-6L

### BLOCK DIAGRAM



# iC-DP

## HIGHSIDE SWITCH



Rev C3, Page 2/8

### 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

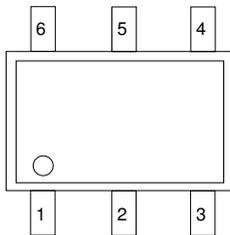
excessive temperature. The chip is activated when the input voltage threshold  $V(PI)-V(NI)$  of typically 3.5 V is exceeded.

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	Limits		Unit
				Min.	Max.	
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	Limits			Unit
				Min.	Typ.	Max.	
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:  $V(PI) = 0...36\text{ V}$ ,  $T_j = -40...120\text{ °C}$ , unless otherwise stated

Item No.	Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
<b>Total Device</b>							
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	$\mu\text{A}$ $\mu\text{A}$
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	$\mu\text{A}$ $\mu\text{A}$
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	$\mu\text{A}$ $\mu\text{A}$
005	I <sub>lk</sub> (DP)	DP Output Leakage Current	$V(PI) - V(NI) < V(PI)_{off}$ , $V(DP) = 0...V(VP)$	-100		100	$\mu\text{A}$
006	V <sub>c</sub> (DP) <sub>lo</sub>	DP Clamp Voltage low	$V_c(DP)_{lo} = V(DP) - V(VP)$ , $I(DP) = -10\text{ mA}$	-70	-45	-40	V
007	V <sub>c</sub> (DP) <sub>hi</sub>	DP Clamp Voltage high	$V_c(DP)_{hi} = V(DP) - V(VP)$ , $I(DP) = 10\text{ mA}$	0.3		1	V
008	V <sub>c</sub> ( <sub>hi</sub> )	PI, VP Clamp Voltage high	$V_c(\text{hi}) = V() - V(NI)$ , $I() = 4\text{ mA}$	37	40		V
009	tpio <sub>hi</sub>	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\ slew\ rate  > 10\text{ V}/\mu\text{s}$	1		25	$\mu\text{s}$
010	tpio <sub>lo</sub>	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\ slew\ rate  > 10\text{ V}/\mu\text{s}$	1		15	$\mu\text{s}$
<b>Highside Output DP</b>							
101	V <sub>s</sub> (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 <sub>sc</sub> (DP)	Output Short-Circuit Current	$V(VP) - V(DP) = 1\text{ V}...V_B$ , DP = hi $T_j = -40\text{ °C}$ $T_j = 27\text{ °C}$ $T_j = 120\text{ °C}$	-800	-400	-200 -200 -200	mA mA mA
103	SR(DP) <sub>on</sub>	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/ $\mu\text{s}$
104	SR(DP) <sub>off</sub>	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/ $\mu\text{s}$
105	V <sub>fw</sub> (DP)	Freewheeling Voltage	$I(DP) = -200\text{ mA}$ , with reference to VP, including Zener noise voltage	-60	-45	-40	V
<b>Temperature Monitor</b>							
201	T <sub>off</sub>	Thermal Shutdown Threshold		120		150	°C
202	T <sub>on</sub>	Thermal Release Threshold	Decreasing temperature	110		135	°C
203	Thys	Thermal Shutdown Hysteresis	$Thys = T_{off} - T_{on}$		15		°C
<b>Input Threshold</b>							
301	V(PI) <sub>on</sub>	Power-On Threshold Voltage	$V(PI) - V(NI)$	2.7		4.1	V
302	V(PI) <sub>off</sub>	Power-Off Threshold Voltage	$V(PI) - V(NI)$ , decreasing voltage	2.3		3.7	V
303	V(PI) <sub>hys</sub>	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)

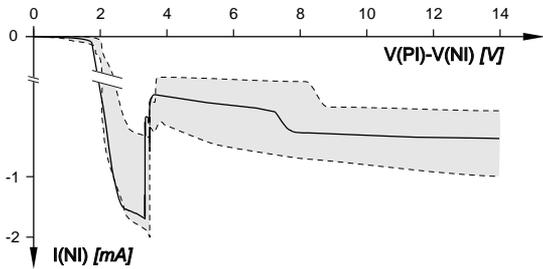


Figure 1: NI input current, no load

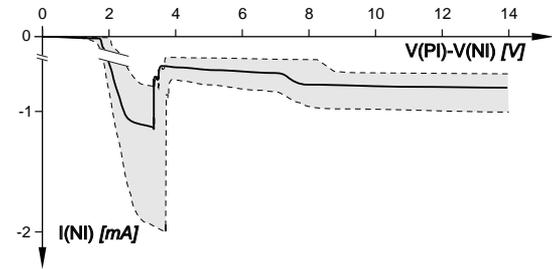


Figure 2: NI input current,  $I(DP) = -5\text{ mA}$

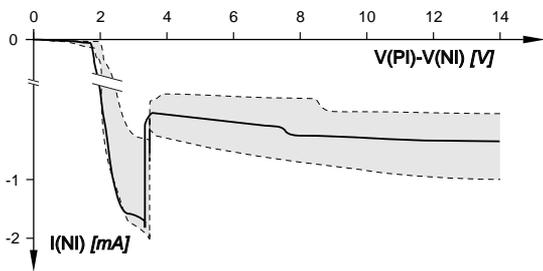


Figure 3: NI input current,  $I(DP) = -100\text{ mA}$

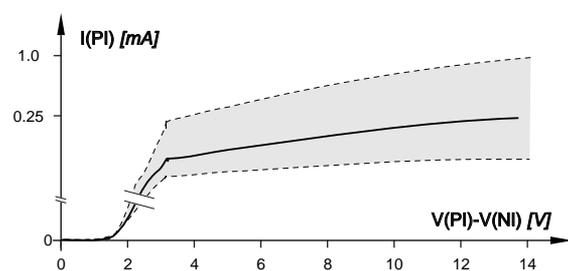


Figure 4: PI input current, load independent

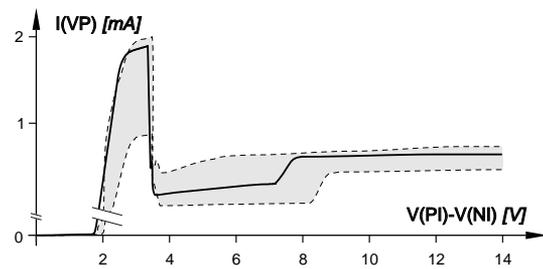


Figure 5: VP supply current, no load

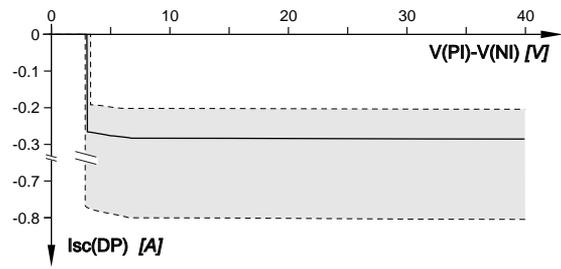


Figure 6: DP short-circuit output current

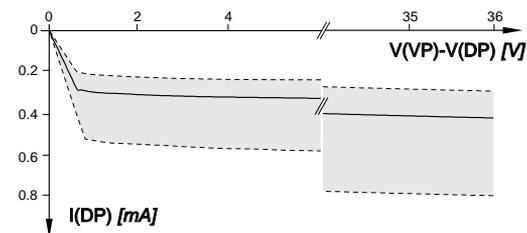


Figure 7: DP output characteristic

### APPLICATION NOTES

#### Example application circuits for SOT23-6L package

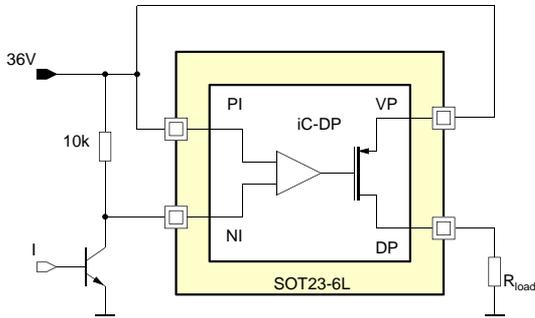


Figure 8: 36 V supply, NPN input control

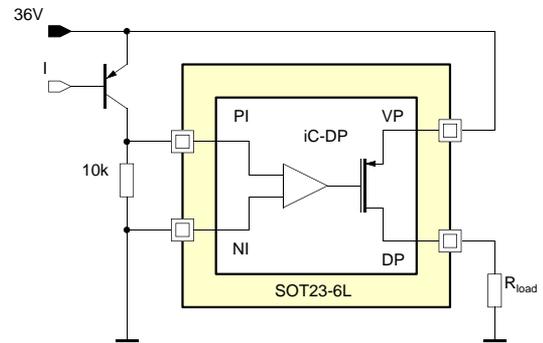


Figure 9: 36 V supply, PNP input control

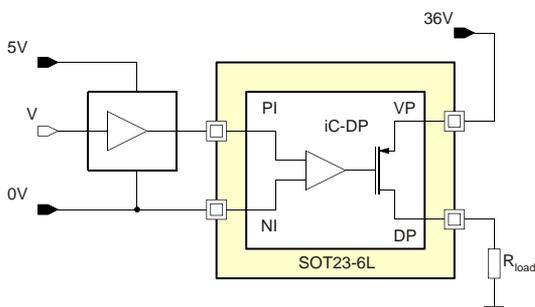


Figure 10: 5 V  $\mu$ C operating at 5 to 0 V input control, 36 V output supply

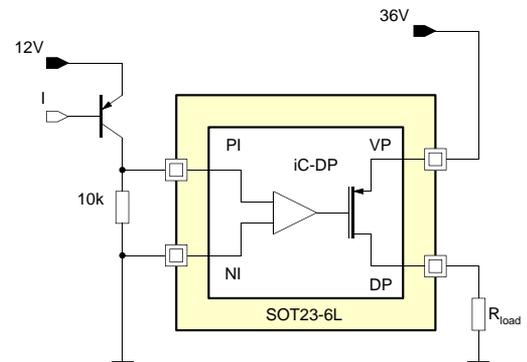


Figure 11: 12 V PNP input control, 36 V output supply

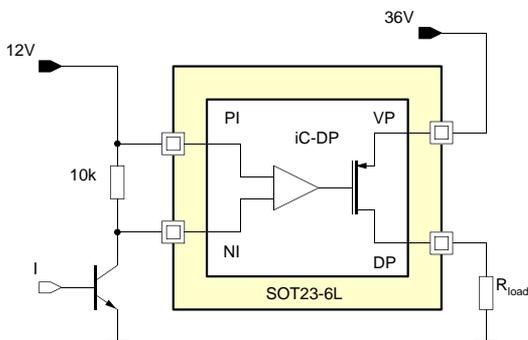


Figure 12: 12 V NPN input control, 36 V output supply

# iC-DP

## HIGHSIDE SWITCH



Rev C3, Page 7/8

iC-Haus expressly reserves the right to change its products and/or specifications. An info letter gives details as to any amendments and additions made to the relevant current specifications on our internet website [www.ichaus.de/infoletter](http://www.ichaus.de/infoletter); this letter is generated automatically and shall be sent to registered users by email.

Copying – even as an excerpt – is only permitted with iC-Haus' approval in writing and precise reference to source.

iC-Haus does not warrant the accuracy, completeness or timeliness of the specification and does not assume liability for any errors or omissions in these materials.

The data specified is intended solely for the purpose of product description. No representations or warranties, either express or implied, of merchantability, fitness for a particular purpose or of any other nature are made hereunder with respect to information/specification or the products to which information refers and no guarantee with respect to compliance to the intended use is given. In particular, this also applies to the stated possible applications or areas of applications of the product.

iC-Haus conveys no patent, copyright, mask work right or other trade mark right to this product. iC-Haus assumes no liability for any patent and/or other trade mark rights of a third party resulting from processing or handling of the product and/or any other use of the product.

As a general rule our developments, IPs, principle circuitry and range of Integrated Circuits are suitable and specifically designed for appropriate use in technical applications, such as in devices, systems and any kind of technical equipment, in so far as they do not infringe existing patent rights. In principle the range of use is limitless in a technical sense and refers to the products listed in the inventory of goods compiled for the 2008 and following export trade statistics issued annually by the Bureau of Statistics in Wiesbaden, for example, or to any product in the product catalogue published for the 2007 and following exhibitions in Hanover (Hannover-Messe).

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

For technical support, information about prices and terms of delivery please contact:

**iC-Haus GmbH**  
Am Kuemmerling 18  
D-55294 Bodenheim  
GERMANY

**Tel.: +49 (61 35) 92 92-0**  
**Fax: +49 (61 35) 92 92-192**  
**Web: <http://www.ichaus.com>**  
**E-Mail: [sales@ichaus.com](mailto:sales@ichaus.com)**

**Appointed local distributors: [http://www.ichaus.com/sales\\_partners](http://www.ichaus.com/sales_partners)**