

Enhanced power switch

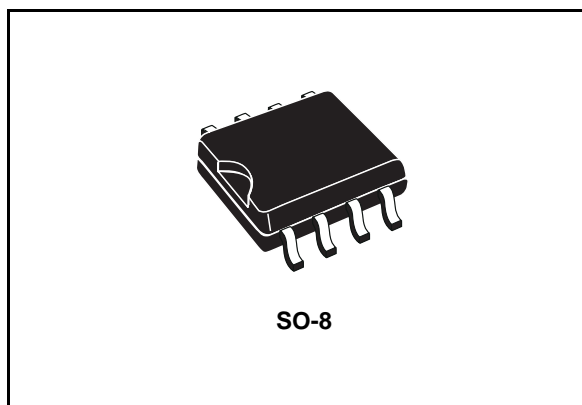
Features

- 90 mΩ high-side MOSFET switch
- 500 mA continuous current per channel
- Thermal and short-circuit protection with overcurrent logic output
- Operating range from 2.7 to 5.5 V
- CMOS- and TTL-compatible enable inputs
- 2.5 ms typical rise time
- Under voltage lock out
- 10 μA maximum standby supply current
- Ambient temperature range, 0 °C to 85 °C
- 2 kV ESD protection
- Fault-blanking

Description

The ST2041 power distribution switch is intended for applications where heavy capacitive loads and short circuits are likely to be encountered. These devices incorporate 90 mΩ N-channel MOSFET high-side power switches for power-distribution. The switch is controlled by a logic enable input. Gate drive is provided by an internal charge pump designed to control the power-switch rise times and fall times to minimize current surges during switching. The charge pump requires no external components and allows operation from supplies as low as 2.7 V.

When the output load exceeds the current-limit threshold or a short is present, the device limits the output current to a safe level by switching into a constant-current mode, pulling the overcurrent logic output low. When continuous heavy



overloads and short circuits increase the power dissipation in the switch, causing the junction temperature to rise, a thermal protection circuit shuts off the switch to prevent damage. Recovery from a thermal shutdown is automatic once the device has cooled sufficiently. Internal circuitry ensures the switch remains off until valid input voltage is present.

Table 1. Device summary

Order code	Package	Packaging
ST2041BDR	SO-8	Tape and reel

1 Schematic diagram and pin connections

Figure 1. Schematic diagram

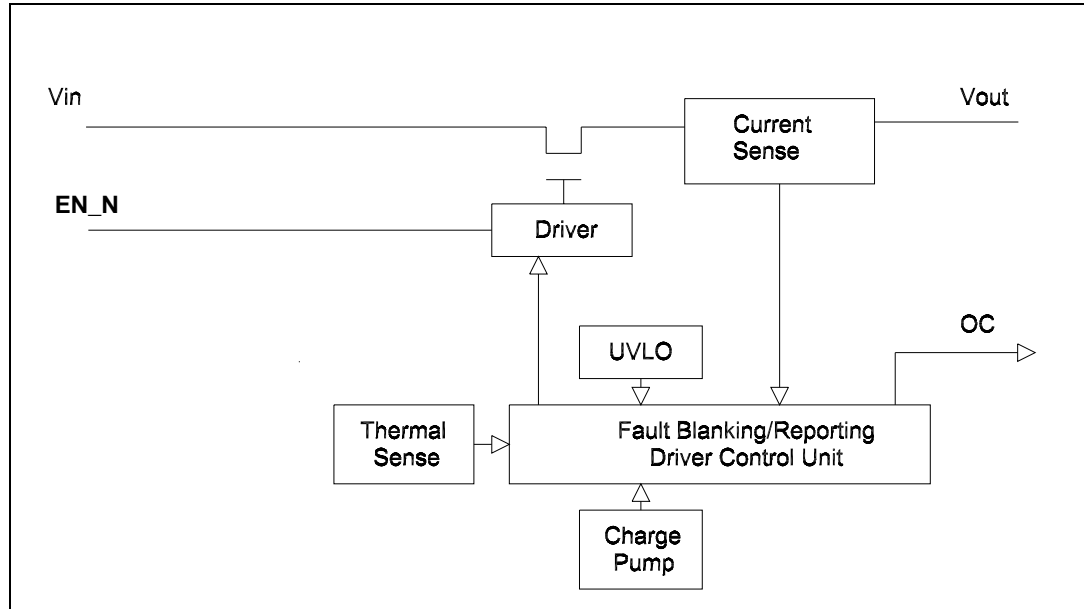


Figure 2. Pin connections (top view)

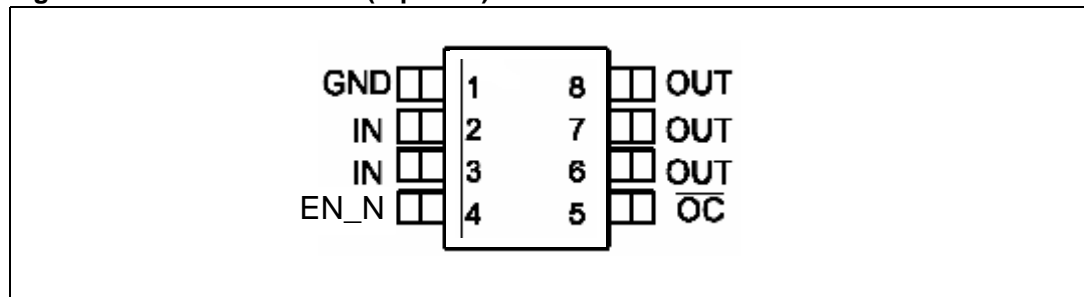


Table 2. Pin functions

Pin	Name	Type	Description
1	GND	-	Ground
2	IN1	-	V _{CC} input, 2.7-5.5V
3	IN2	-	V _{CC} input, 2.7-5.5V
4	EN_N	I	Enable (Active Low)
5	OC	O	Open drain output for fault indication
6	OUT3	-	Output
7	OUT2	-	Output
8	OUT1	-	Output

2 Functional descriptions

2.1 Fault blanking

ST devices feature a 10ms fault blanking. Fault blanking allows current-limit faults, including momentary short-circuit faults that occur when hot-swapping a capacitive load, and also ensures that no fault is issued during power-up. When a load transient causes the device to enter current limit, an internal counter starts. If the load fault persists beyond the 10ms fault-blanking time-out, the FAULT output asserts low. Load-transient faults less than 10ms (typical) will not cause a FAULT output assertion. Only current-limit faults are blanked. Die over-temperature faults and input voltage droops below the Under voltage lock out (UVLO) threshold will cause an immediate fault output.

2.2 Overcurrent/over-temperature protection

In overcurrent or short-circuit condition, the switch limits the current at 500mA. If temperature of die goes above limit value, the switch turns OFF.

2.3 Under voltage lock out (UVLO)

When input voltage drops below critical value, the power switch turns OFF to prevent improper operation due to low voltage.

3 Maximum rating

Stressing the device above the rating listed in the “Absolute maximum ratings” table may cause permanent damage to the device. These are stress ratings only, and operation of the device at these or any other conditions above those indicated in the operating sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Refer also to the STMicroelectronics SURE Program and other relevant quality documents.

Table 3. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_I	Input voltage range	-0.3-6.0	V
V_O	Output voltage range	-0.3-($V_I+0.3$)	V
Vienx	EN input voltage range	-0.3-6.0	V
I_O	Continuous output current	Internally limited	
ESD	ESD protection level	2	kV
T_J	Junction operating temperature	-40 to 125	C
T_{STG}	Storage temperature	-55 to 150	C

3.1 Recommended operating conditions

Table 4. Recommended operating conditions

Symbol	Parameter	Min	Typ	Max	Unit
V_I	Input voltage	2.7	5.0	5.5	V
V_O	Output voltage	0	5.0	5.5	V
I_O	Continuous output current	0	-	500	mA

4 Electrical characteristics

Table 5. Electrical characteristics ($T_J = 25\text{ °C}$, $V_I = 5.0\text{ V}$)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$R_{DS(on)}$	Static drain-source on-state resistance	$V_I = 3.3\text{ V}$ $-40 < T_J < 125\text{ °C}$		100	145	m Ω
		$V_I = 5.0\text{ V}$ $-40 < T_J < 125\text{ °C}$		90	135	
		$V_I = 3.3\text{ V}$ $T_J = 25\text{ °C}$		90	130	
		$V_I = 5.0\text{ V}$ $T_J = 25\text{ °C}$		80	110	
t_r	Output rise time ⁽¹⁾	$V_I = 5.5\text{ V}$ $R_L = 10\ \Omega$ $C_L = 1\ \mu\text{F}$		2.5		ms
		$V_I = 2.7\text{ V}$ $R_L = 10\ \Omega$ $C_L = 1\ \mu\text{F}$		3		ms
t_f	Output fall time ⁽¹⁾	$V_I = 5.5\text{ V}$ $R_L = 10\ \Omega$ $C_L = 1\ \mu\text{F}$		0.3		ms
		$V_I = 2.7\text{ V}$ $R_L = 10\ \Omega$ $C_L = 1\ \mu\text{F}$		0.2		ms
T_{ON}	Turn-on time ⁽¹⁾	$R_L = 10\ \Omega$ $C_L = 100\ \mu\text{F}$			20	ms
T_{OFF}	Turn-off time ⁽¹⁾	$R_L = 10\ \Omega$ $C_L = 100\ \mu\text{F}$			40	ms

1. Not tested in production, specified by design

Table 6. Current limit characteristics ($V_I = 5.5\text{ V}$, $I_O = \text{rated current}$, $T_J = 25\text{ }^\circ\text{C}$, unless otherwise specified.)

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
I_{OS}	Short circuit output current	$V_I = 5\text{ V}$ OUT connected to GND, device enabled into short circuit	0.7	1.0	1.3	A

Table 7. Supply current characteristics ($V_I = 5.5\text{ V}$, $I_O = \text{rated current}$, $T_J = 25\text{ }^\circ\text{C}$, unless otherwise specified.)

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
I_{OFF}	Switch turned OFF	No load		1.0	5.0	μA
		No load; $-40 < T_J < 125^\circ\text{C}$			10	μA
I_{ON}	Switch turned ON	No load		70	90	μA
		No load; $-40 < T_J < 125^\circ\text{C}$			100	μA
$I_{leakage}$	Output leakage current	Output grounded, switch is OFF			10	μA
		Output grounded, switch is OFF; $-40 < T_J < 125^\circ\text{C}$			20	μA

Table 8. Thermal characteristics ($V_I = 5.5\text{ V}$, $I_O = \text{rated current}$, $T_J = 25\text{ }^\circ\text{C}$, unless otherwise specified.)

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
T1	Thermal shutdown threshold		135			$^\circ\text{C}$
T2	Recovery from thermal shutdown		125			$^\circ\text{C}$
Hyst	Hysteresis			10		$^\circ\text{C}$

Table 9. UVLO characteristics ($V_I = 5.5\text{ V}$, $I_O = \text{rated current}$, $T_J = 25\text{ }^\circ\text{C}$, unless otherwise specified.)

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
V_{UVLO}	Undervoltage lockout threshold		2.0		2.5	V
Hyst	Hysteresis			100		mV

Table 10. OC pin characteristics ($V_I = 5.5\text{ V}$, $I_O = \text{rated current}$, $T_J = 25\text{ }^\circ\text{C}$, unless otherwise specified.)

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
OC Blanking	OCx assertion and de-assertion (1)		4	8	15	mS
V_O	Output low voltage				0.4	V
I_{OFF}	OFF current				1.0	μA

1. Not tested in production, specified by design.

Table 11. EN_N pin characteristics ($V_I = 5.5\text{ V}$, $I_O = \text{rated current}$, $T_J = 25\text{ }^\circ\text{C}$, unless otherwise specified.)

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
V_{IH}	High level input voltage	$V_I = 2.7\text{ to }5.5\text{ V}$	2.0			V
V_{IL}	Low level input voltage	$V_I = 4.5\text{ to }5.5\text{ V}$			0.8	V
		$V_I = 2.7\text{ to }4.5\text{ V}$			0.4	V
I_I	Input current	$V_{IENX} = 0\text{ V or }V_I$	-0.5		0.5	μA

5 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com.

Figure 3. SO-8 package outline

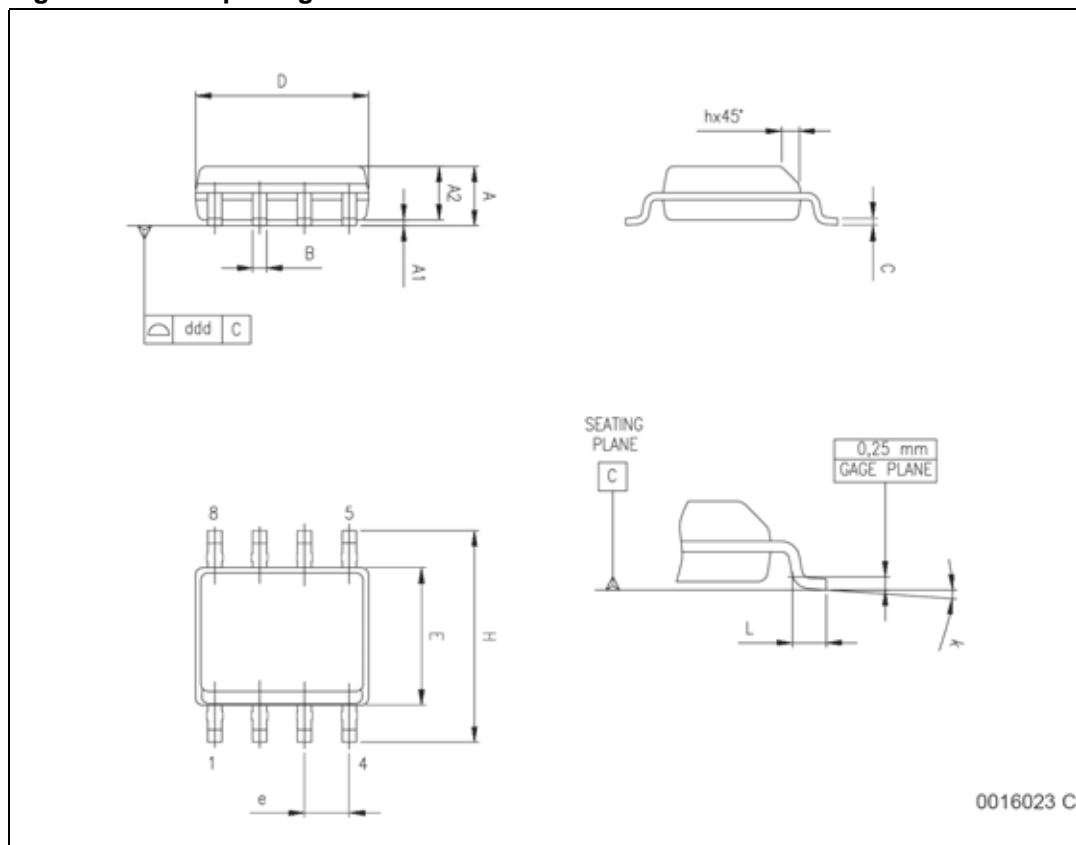


Table 12. SO-8 mechanical data

Symbol	Millimeters			inches		
	Min	Typ	Max	Min	Typ	Max
A	1.35		1.75	0.053		0.069
A1	0.10		0.25	0.004		0.010
A2	1.10		1.65	0.043		0.065
B	0.33		0.51	0.013		0.020
C	0.19		0.25	0.007		0.010
D	4.80		5.00	0.189		0.197
E	3.80		4.00	0.15		0.157
e		1.27			0.050	
H	5.80		6.20	0.228		0.244
h	0.25		0.50	0.010		0.020
L	0.40		1.27	0.016		0.050
k	8° (max.)					
ddd			0.10			0.004

6 Revision history

Table 13. Document revision history

Date	Revision	Changes
05-May-2006	1	Initial release.
20-Feb-2008	2	Document restructured and converted to new ST template, watermark removed.

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