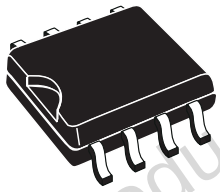
ST2041

Enhanced power switch

Not recommended for new design

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
- Undervoltage lock out
- 10 µA maximum standby supply current
- Ambient temperature range, 0 °C to 85 °C
- 2 kV ESD protection
- Fault-blanking



SO-8

Table 1. Device summary

Order code	Package	Packaging
ST2041BDR(1)	SO-8	Tape and reel

1. Not recommended for new design (refer to STMPS2141MTR). Contact ST sales office for availability.

Contents

1 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.

2 Schematic diagram and pin connections

Figure 1. Schematic diagram

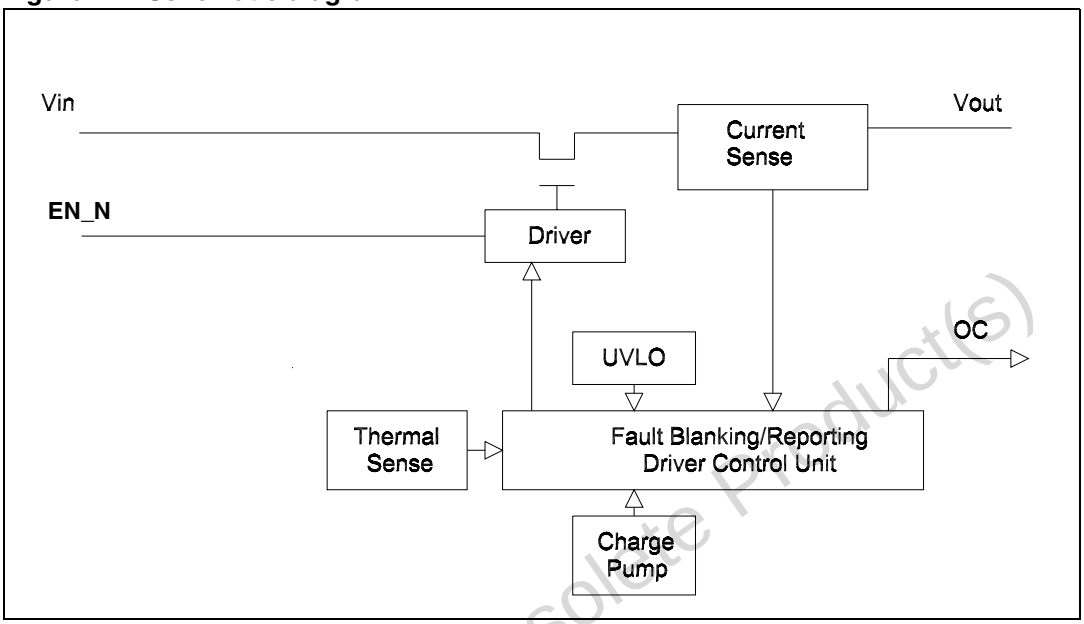


Figure 2. Pin connections (top view)

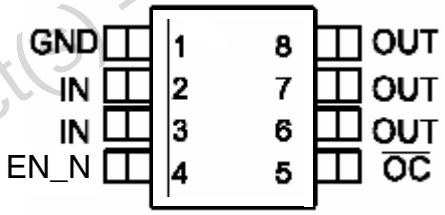


Table 2. Pin functions

Pin	Name	Type	Description
1	GND	-	Ground
2	IN1	-	V_{CC} input, 2.7-5.5 V
3	IN2	-	V_{CC} input, 2.7-5.5 V
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

3 Functional descriptions

3.1 Fault-blanking

ST devices feature a 10 ms 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 10 ms fault-blanking timeout, the FAULT output asserts low. Load-transient faults less than 10 ms (typical) will not cause a FAULT output assertion. Only current-limit faults are blanked. Die overtemperature faults and input voltage drops below the undervoltage lock out (UVLO) threshold will cause an immediate fault output.

3.2 Overcurrent/overtemperature protection

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

3.3 Undervoltage lock out (UVLO)

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

4 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-(Vi+0.3)	V
V_{IENX}	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

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

5 Electrical characteristics

Table 5. Electrical characteristics (T_J = 25 °C, V_I = 5.0 V)

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

1. Not tested in production, specified by design.

Table 6. Current limit characteristics (V_I = 5.5 V, I_O = rated current, T_J = 25 °C, unless otherwise specified)

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
I_{OS}	Short-circuit output current	V_I = 5 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 V, I_O = rated current, T_J = 25 °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 °C			10	µA
I_{ON}	Switch turned ON	No load		70	90	µA
		No load; -40 < T_J < 125 °C			100	µA
$I_{leakage}$	Output leakage current	Output grounded, switch is OFF			10	µA
		Output grounded, switch is OFF; -40 < T_J < 125 °C			20	µA

Table 8. Thermal characteristics (V_I = 5.5 V, I_O = rated current, T_J = 25 °C, unless otherwise specified)

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
T1	Thermal shutdown threshold		135			°C
T2	Recovery from thermal shutdown		125			°C
Hyst	Hysteresis			10		°C

Table 9. UVLO characteristics (V_I = 5.5 V, I_O = rated current, T_J = 25 °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 V, I_O = rated current, T_J = 25 °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 V, I_O = rated current, T_J = 25 °C, unless otherwise specified)

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

6 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: *www.st.com*. ECOPACK® is an ST trademark.

Figure 3. SO-8 package outline

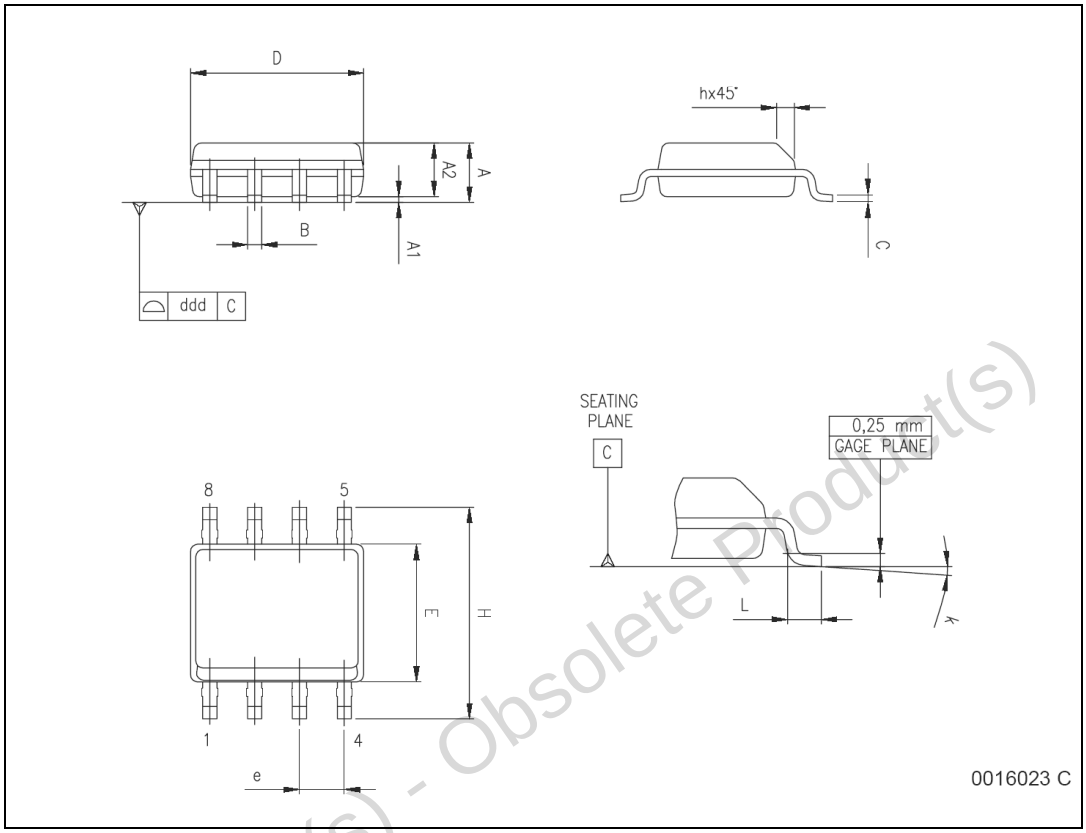


Table 12. SO-8 mechanical data

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

7 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.
24-Nov-2010	3	Document reformatted, added “Not Recommended for New Design” and *Note 1* below *Table 1*, updated ECOPACK® text in *Section 6*, corrected typo in *Features*, *Section 1*, *Table 2*, *Section 3*, *Section 4*, *Table 3*, *Table 5* to *Table 11*.

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