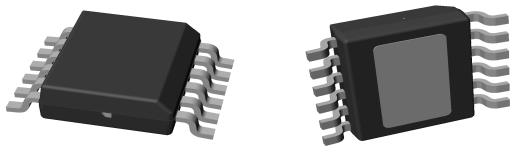
VNQ500PEP

QUAD CHANNEL HIGH SIDE DRIVER

TARGET SPECIFICATION

TYPE	$R_{DS(on)}$	I_{OUT}	V_{CC}
VNQ500PEP	500 mΩ	0.35 A	36V

- CMOS COMPATIBLE I/O's
- CHIP ENABLE
- JUNCTION OVERTEMPERATURE PROTECTION
- CURRENT LIMITATION
- SHORTED LOAD PROTECTION
- UNDERVOLTAGE SHUTDOWN
- PROTECTION AGAINST LOSS OF GROUND
- VERY LOW STAND-BY CURRENT



PowerSSO-12

ORDER CODES		
PACKAGE	**TUBE**	**T&R**
PowerSSO-12	VNQ500PEP	VNQ500PEP13TR

DESCRIPTION

The VNQ500PEP is a monolithic device designed in STMicroelectronics VIPower M0-3 Technology, intended for driving any kind of load with one side connected to ground.
Active current limitation combined with latched thermal shutdown, protect the device against overload.

Device automatically turns off in case of ground pin disconnection.

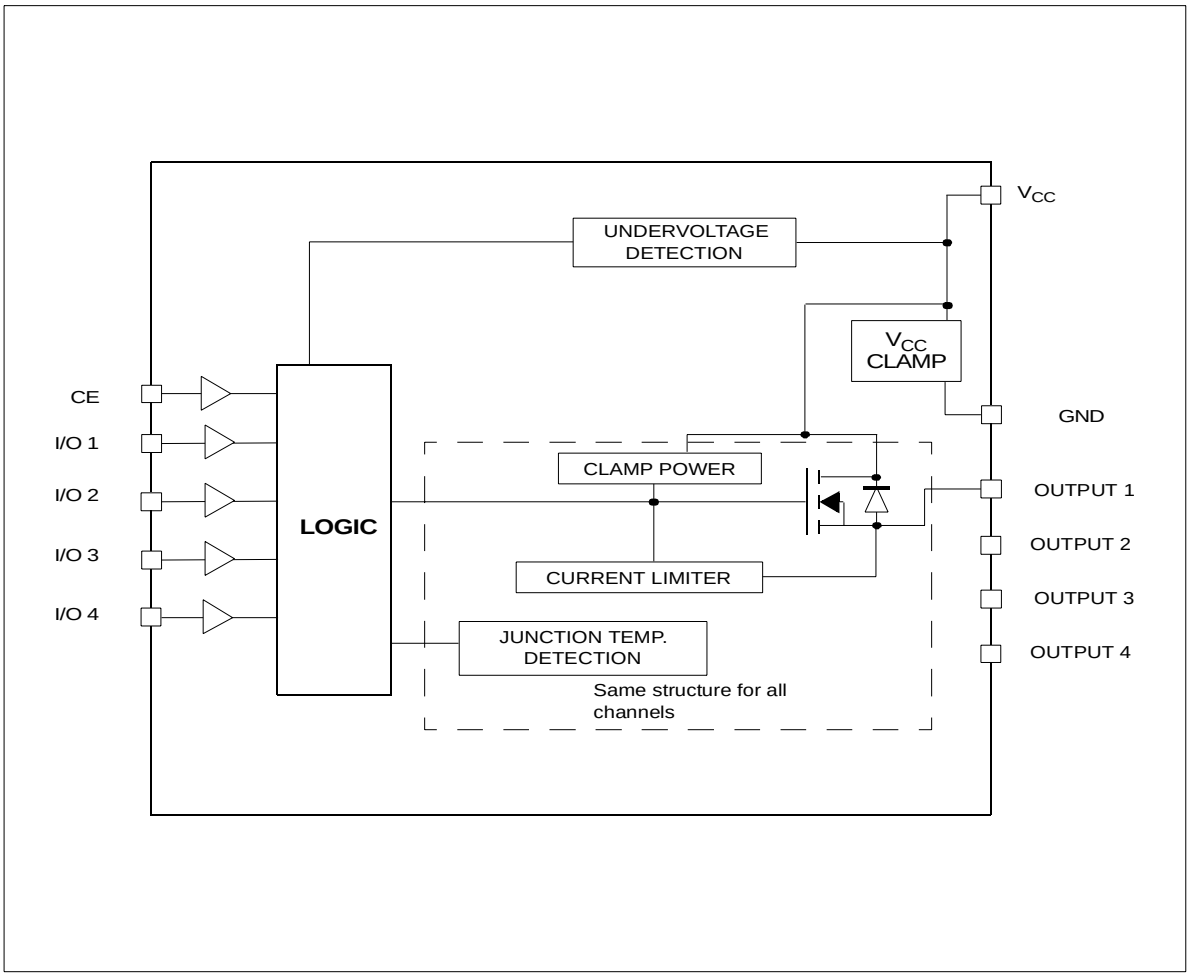
APPLICATION

- Relay Driver
- LED Driver

ABSOLUTE MAXIMUM RATING

Symbol	Parameter	Value	Unit
V_{CC}	DC Supply voltage	41	V
$-V_{CC}$	Reverse supply voltage	-0.3	V
$-I_{GND}$	DC Ground pin reverse current	- 250	mA
I_{OUT}	DC Output current	Internally Limited	A
$-I_{OUT}$	Reverse DC output current	-1	A
I_{IN}	DC Input current	+/- 10	mA
V_{ESD}	Electrostatic discharge (R=1.5KΩ; C=100pF) - I/On - OUTn & Vcc	 4000 5000	 V V
T_j	Junction operating temperature	Internally Limited	°C
T_{stg}	Storage temperature	- 55 to 150	°C

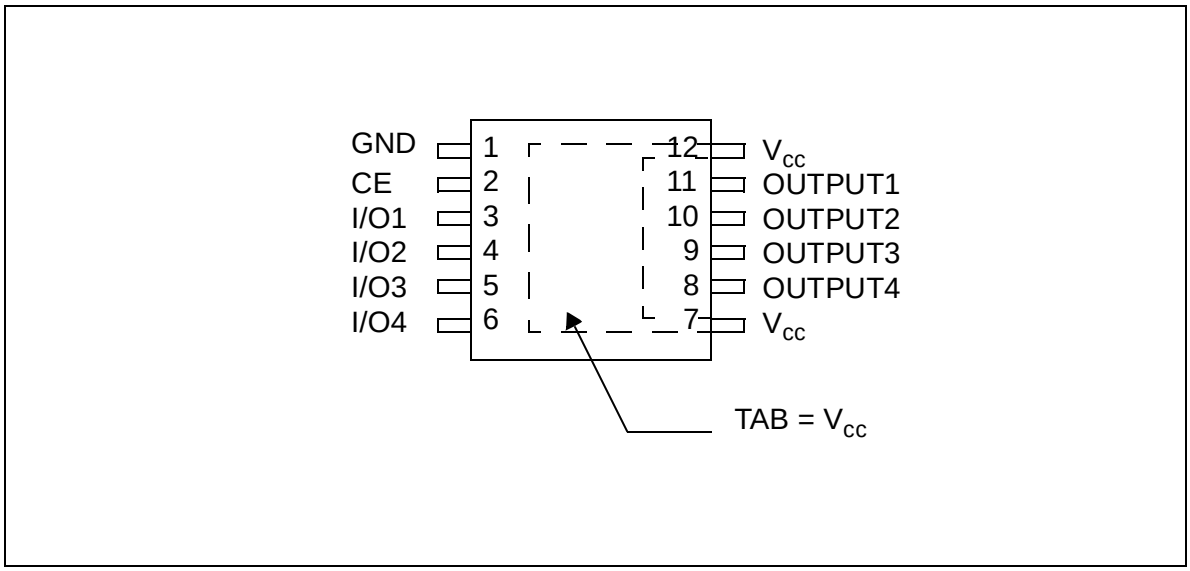
BLOCK DIAGRAM



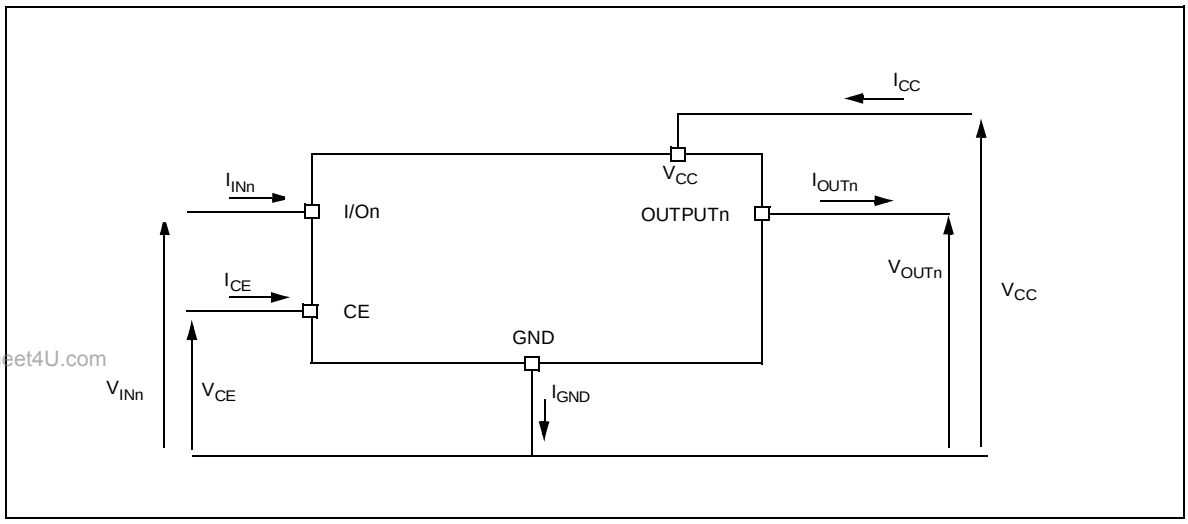
PIN DEFINITIONS AND FUNCTIONS

Pin No	Symbol	Function
TAB	V_{CC}	Positive power supply voltage
7,12	V_{CC}	Positive power supply voltage
1	GND	Logic ground
2	CE	Chip Enable
3	I/O 1	Input/Output of channel 1
4	I/O 2	Input/Output of channel 2
5	I/O 3	Input/Output of channel 3
6	I/O 4	Input/Output of channel 4
8	OUTPUT 4	High-Side output of channel 4
9	OUTPUT 3	High-Side output of channel 3
10	OUTPUT 2	High-Side output of channel 2
11	OUTPUT 1	High-Side output of channel 1

CONNECTION DIAGRAM (TOP VIEW)



CURRENT AND VOLTAGE CONVENTIONS



THERMAL DATA

Symbol	Parameter		Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case	Max	4.6	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient (*)	Max	60	°C/W

(*) When mounted on FR4 printed circuit board with 0.5 cm^2 of copper area (at least 35µ thick) connected to all TAB pins.

ELECTRICAL CHARACTERISTICS ($8V<V_{CC}<36V$; $-40°C<T_j<150°C$, unless otherwise specified)

POWER

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{CC}(**)	Operating supply voltage		5.5	13	36	V
V_{USD}(**)	Undervoltage shut-down		3	4	5.5	V
V_{OV} (**)	Overvoltage shutdown		36			V
R_{ON}	On state resistance	I_{OUTn}=0.25A; T_j=25°C I_{OUTn}=0.25A			500 1000	mΩ mΩ
I_S	Supply current	$V_{CE}=V_{I/On}$=0V; V_{CC}=13V; T_{case}=25°C On state (all channels ON); V_{CC}=13V			20 8	µA mA
I_{LGND}(**)	Output current at turn-off	$V_{CC}=V_{CE}=V_{I/On}=V_{GND}$=13V V_{OUTn}=0V			1	mA
$I_{L(off)}$(**)	Off state output current	$V_{I/On}=V_{OUTn}$=0V	0		5	µA
I_{Loff2}(**)	Off state output current	$V_{I/On}$=0V, V_{OUTn}=0V, V_{CC}=13V; T_{case}=25°C			1	µA

(**) Per channel

SWITCHING (V_{CC}=13V)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
t_{on}	Turn-on time	R_L=52Ω from 80% V_{OUT} (*)		50		µs
t_{off}	Turn-off time	R_L=52Ω to 10% V_{OUT} (*)		75		µs
$dV_{OUT}/dt_{(on)}$	Turn-on voltage slope	R_L=52Ω from V_{OUT}=1.3V to V_{OUT}=10.4V (*)		0.3		V/µs
$dV_{OUT}/dt_{(off)}$	Turn-off voltage slope	R_L=52Ω from V_{OUT}=11.7V to V_{OUT}=1.3V (*)		0.3		V/µs

(*) see fig.1a :switching time waveforms

INPUT & CE PINS

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{INL}	I/O low level				1.25	V
I_{INL}	Low level I/O current	V_{IN}=1.25V	1			µA
V_{INH}	I/O high level		3.25			V
I_{INH}	High level I/O current	V_{IN}=3.25V			10	µA
$V_{I(hyst)}$	I/O hysteresis voltage		0.5			V
V_{ICL}	I/O clamp voltage	I_{IN}=1mA I_{IN}=-1mA	6	6.8 -0.7	8	V V
V_{OL}	I/O low level default detection	I_{IN}=1mA, latched thermal shutdown			0.5	V

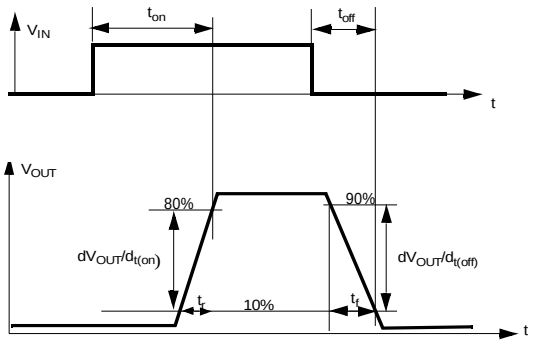
ELECTRICAL CHARACTERISTICS (continued)

PROTECTIONS

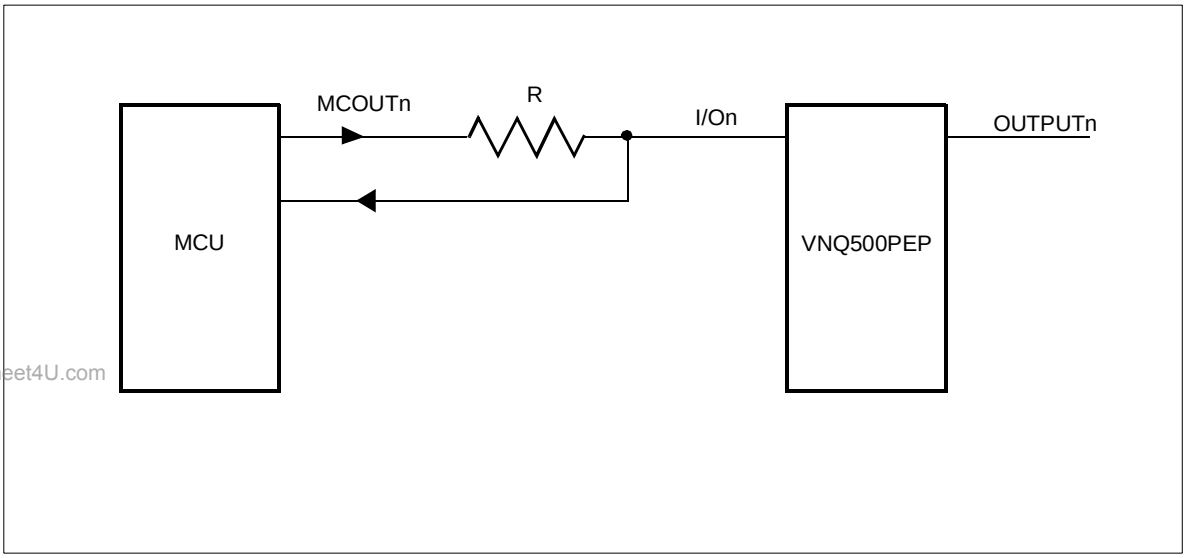
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
T_{TSD}	Junction shut-down temperature		150	175	200	°C
I_{lim}	DC Short circuit current	V_{CC}=13V; R_{LOAD}=10mΩ	0.35		0.7	A
V_{demag}	Turn-off output clamp voltage	I_{OUT}=0.25 A; L=20mH	V_{CC}-41	V_{CC}-48	V_{CC}-55	V
t_{reset}	Thermal latch reset time	Tj < T_{TSD} (see figure 3 in waveforms)			10	µs

Switching Time Waveforms

Fig. 1a : Turn-on & Turn-off



Driving circuit



TRUTH TABLE

CONDITIONS	MCOUTn	CE	I/On	OUTPUTn
Normal operation	L H	H H	L H	L H
Current limitation	L H	H H	L H	L H
Overtemperature	L H	H H	L L (latched)	L L
Undervoltage	L H	H H	L H	L L
Stand-by	X	L	X	L

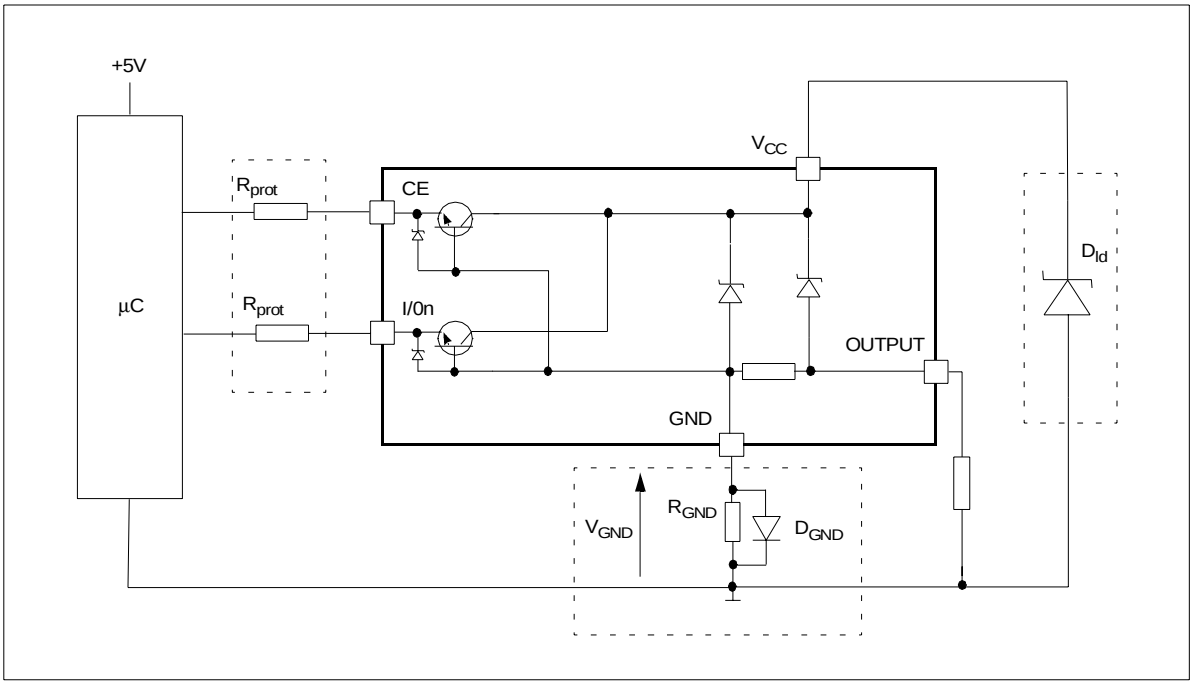
ELECTRICAL TRANSIENT REQUIREMENTS

ISO T/R 7637/1 Test Pulse	TEST LEVELS				
	I	II	III	IV	Delays and Impedance
1	-25 V	-50 V	-75 V	-100 V	2 ms 10 Ω
2	+25 V	+50 V	+75 V	+100 V	0.2 ms 10 Ω
3a	-25 V	-50 V	-100 V	-150 V	0.1 µs 50 Ω
3b	+25 V	+50 V	+75 V	+100 V	0.1 µs 50 Ω
4	-4 V	-5 V	-6 V	-7 V	100 ms, 0.01 Ω
5	+26.5 V	+46.5 V	+66.5 V	+86.5 V	400 ms, 2 Ω

ISO T/R 7637/1 Test Pulse	TEST LEVELS RESULTS			
	I	II	III	IV
1	C	C	C	C
2	C	C	C	C
3a	C	C	C	C
3b	C	C	C	C
4	C	C	C	C
5	C	E	E	E

CLASS	CONTENTS
C	All functions of the device are performed as designed after exposure to disturbance.
E	One or more functions of the device is not performed as designed after exposure to disturbance and cannot be returned to proper operation without replacing the device.

APPLICATION SCHEMATIC



GND PROTECTION NETWORK AGAINST REVERSE BATTERY

Solution 1: Resistor in the ground line (R_{GND} only). This can be used with any type of load.

The following is an indication on how to dimension the R_{GND} resistor.

1) $R_{GND} \leq 600mV / (I_{S(on)max})$.

2) $R_{GND} \geq (-V_{CC}) / (-I_{GND})$

where $-I_{GND}$ is the DC reverse ground pin current and can be found in the absolute maximum rating section of the of the device's datasheet.

Power Dissipation in R_{GND} (when V_{CC}<0: during reverse battery situations) is:

$P_D= (-V_{CC})^2/R_{GND}$

This resistor can be shared amongst several different HSD. Please note that the value of this resistor should be calculated with formula (1) where $I_{S(on)max}$ becomes the sum of the maximum on-state currents of the different devices.

Please note that if the microprocessor ground is not common with the device ground then the R_{GND} will produce a shift ($I_{S(on)max} * R_{GND}$) in the input thresholds and the status output values. This shift will vary depending on many devices are ON in the case of several high side drivers sharing the same R_{GND}.

If the calculated power dissipation leads to a large resistor or several devices have to share the same resistor then the ST suggest to utilize Solution 2 (see below).

Solution 2: A diode (D_{GND}) in the ground line.

A resistor (R_{GND}=1kΩ) should be inserted in parallel to D_{GND} if the device will be driving an inductive load.

This small signal diode can be safely shared amongst several different HSD. Also in this case, the presence of the ground network will produce a shift (≃600mV) in the input threshold and the status output values if the microprocessor ground is not common with the device ground. This shift will not vary if more than one HSD shares the same diode/resistor network.

LOAD DUMP PROTECTION

D_{Id} is necessary (Voltage Transient Suppressor) if the load dump peak voltage exceeds V_{CC} max DC rating. The same applies if the device will be subject to transients on the V_{CC} line that are greater than the ones shown in the ISO T/R 7637/1 table.

µC I/Os PROTECTION:

If a ground protection network is used and negative transient are present on the V_{CC} line, the control pins will be pulled negative. ST suggests to insert a resistor (R_{prot}) in line to prevent the µC I/Os pins to latch-up.

The value of these resistors is a compromise between the leakage current of µC and the current required by the HSD I/Os (Input levels compatibility) with the latch-up limit of µC I/Os.

$-V_{CCpeak}/I_{latchup} \leq R_{prot} \leq (V_{OH\mu C}-V_{IH}-V_{GND}) / I_{IHmax}$

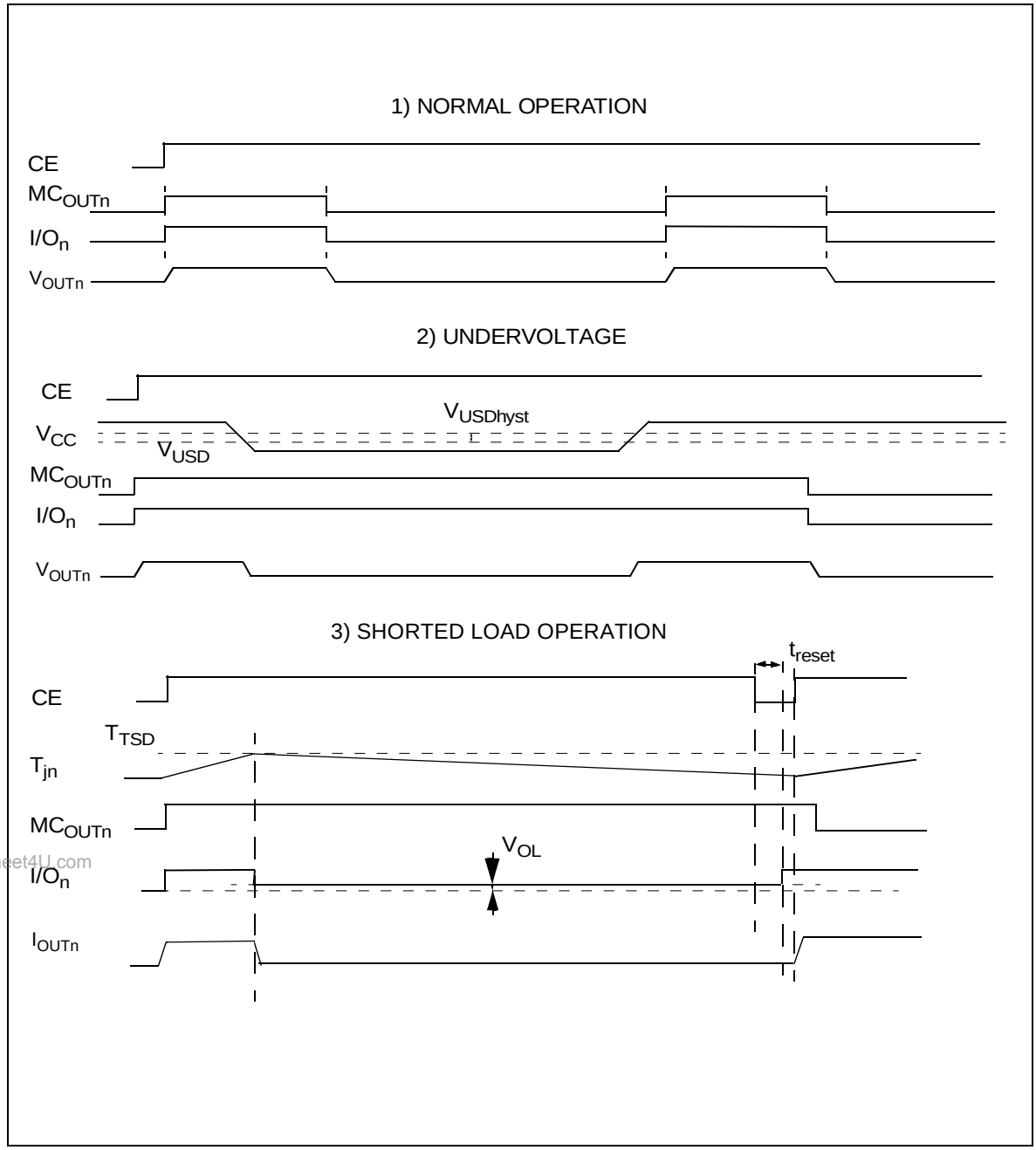
Calculation example:

For V_{CCpeak}= - 100V and $I_{latchup} \geq$ 20mA; $V_{OH\mu C} \geq$ 4.5V

5kΩ ≤ R_{prot} ≤ 65kΩ.

Recommended R_{prot} value is 10kΩ.

Waveforms



PowerSSO-12™ MECHANICAL DATA

DIM.	mm.		
	MIN.	TYP	MAX.
A	1.250		1.620
A1	0.000		0.100
A2	1.100		1.650
B	0.230		0.410
C	0.190		0.250
D	4.800		5.000
E	3.800		4.000
e		0.800	
H	5.800		6.200
h	0.250		0.500
L	0.400		1.270
k	0º		8º
X	1.900		2.500
Y	3.600		4.200
ddd			0.100