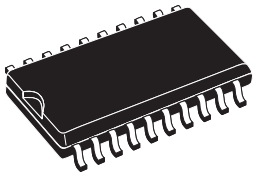
VNQ860
VNQ860SP

QUAD CHANNEL HIGH SIDE DRIVER

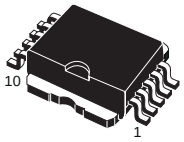
TYPE	$R_{DS(on)}$ (*)	I_{OUT}	V_{CC}
VNQ860 VNQ860SP	270mΩ	0.25A	36V

(*) Per each channel

- CMOS COMPATIBLE I/Os
- UNDERVOLTAGE & OVERVOLTAGE SHUT- DOWN
- SHORTED LOAD PROTECTION
- THERMAL SHUTDOWN
- VERY LOW STAND-BY CURRENT
- PROTECTION AGAINST LOSS OF GROUND



SO-20



PowerSO-10

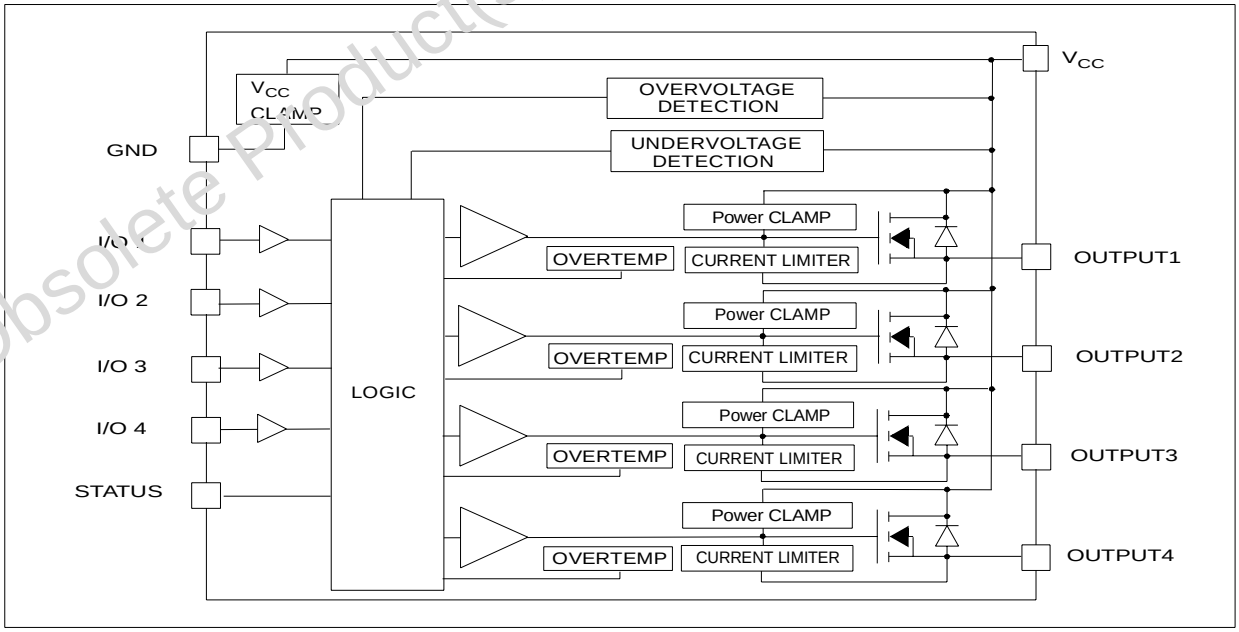
ORDER CODES		
PACKAGE	**TUBE**	**T&R**
SO-20	VNQ860	VNQ86013TR
PowerSO-10	VNQ860SP	VNQ860SP13TR

DESCRIPTION

The VNQ860, VNQ860SP are monolithic devices made using STMicroelectronics VIPower M0-3 Technology, intended for driving any kind load with one side connected to ground. Active current limitation combined with thermal shutdown and automatic restart protect the device against overload. Device automatically turns off in case of ground pin disconnection. This device is especially suitable for industrial applications in norms conformity with IEC1131 (Programmable Controllers International Standard).

Obsolete Product(s) - Obsolete Product(s)

BLOCK DIAGRAM

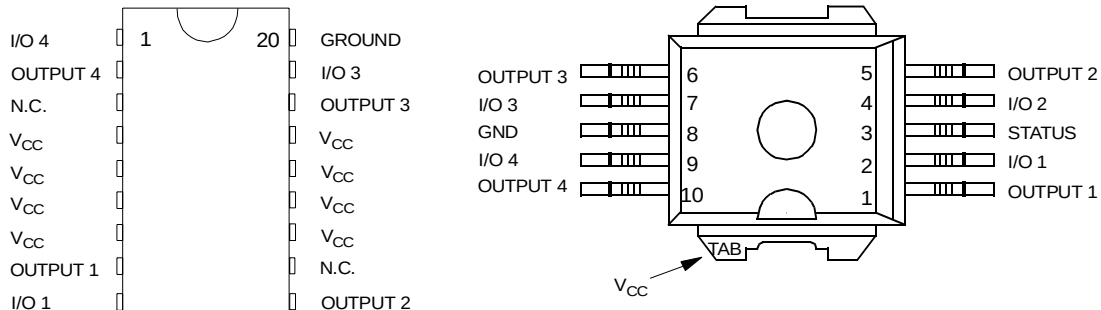


Rev. 1

ABSOLUTE MAXIMUM RATING

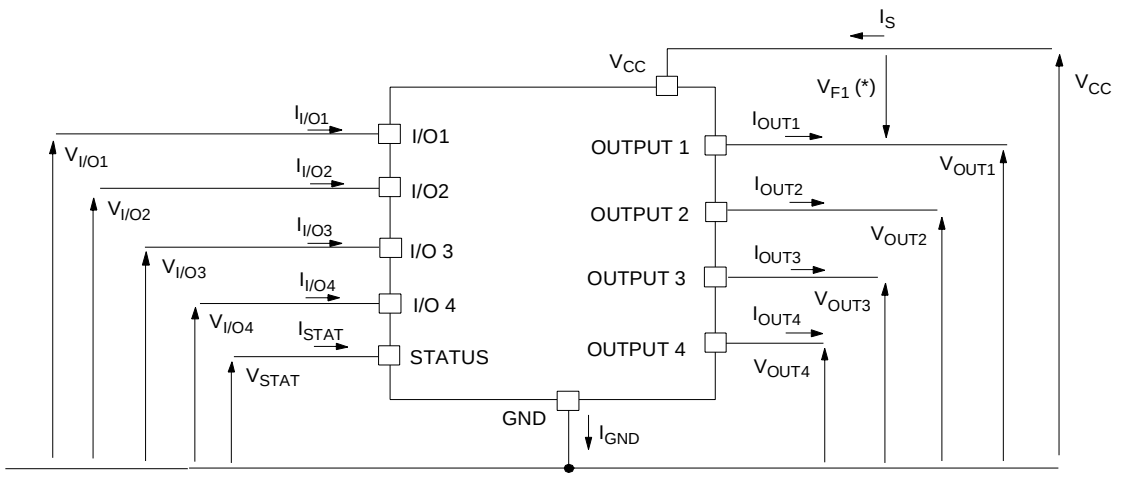
Symbol	Parameter	Value		Unit
		SO-20	PowerSO-10	
V_{CC}	DC supply voltage	41		V
- V_{CC}	Reverse DC supply voltage	- 0.3		V
- I_{GND}	DC reverse ground pin current	- 200		mA
I_{OUT}	DC output current	Internally Limited		A
- I_{OUT}	Reverse DC output current	- 2		A
I_{IN}	DC Input current	+/- 10		mA
V_{IN}	Input voltage range	-3/+V_{CC}		V
V_{STAT}	DC Status voltage	+ V_{CC}		V
V_{ESD}	Electrostatic discharge (R=1.5 KΩ; C=100 pF)	2000		V
P_{tot}	Power dissipation T_C=25 °C	16	90	W
T_j	Junction operating temperature	Internally Limited		°C
T_c	Case operating temperature	- 40 to 150		°C
T_{stg}	Storage temperature	- 55 to 150		°C

CONFIGURATION DIAGRAM (TOP VIEW) & SUGGESTED CONNECTIONS FOR UNUSED AND N.C. PINS



Connection / Pin	Status	N.C.	Output	Input
Floating	X	X	X	X
To Ground		X		Through 10KΩ resistor

CURRENT AND VOLTAGE CONVENTIONS



(*) $V_{Fn} = V_{CCn} - V_{OUTn}$ during reverse battery condition

THERMAL DATA

Symbol	Parameter		Value		Unit
			SO-20	PowerSO-10	
$R_{thj\text{-}amb}$	Thermal resistance junction-pins	(MAX)	8	-	°C/W
$R_{thj\text{-}case}$	Thermal resistance junction-ambient	(MAX)	58	52 (1)	°C/W
				37 (2)	°C/W
$R_{thj\text{-}pin}$	Thermal resistance junction-case	(MAX)	-	1.4	°C/W

(1) When mounted on FR4 printed circuit board with 0.5cm^2 of copper area (at least 35µ thick) connected to all V_{CC} pins.
(2) When mounted on FR4 printed circuit board with 6cm^2 of copper area (at least 35µ thick) connected to all V_{CC} 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		36	V
V_{USD}	Undervoltage shut-down		3	4	5.5	V
V_{OV}	Overvoltage shut-down		36	42	48	V
R_{ON}	On state resistance (per channel)	I_{OUT}=0.25A; T_j=25°C			270	mΩ
		I_{OUT}=0.25A			540	mΩ
I_S	Supply current	Off state; V_{CC}=24V; T_c=25°C		70	120	µA
		On state (all channels on)		5	10	mA
I_{LGND}	Output current	V_{CC}-V_{STAT}=V_{IN}=V_{GND}=24V V_{OUT}=0V			1	mA
$I_{L(off)}$	Off state output current	V_{IN}=V_{OUT}=0V	0		10	µA
$I_{OUTleak}$	Off state output leakage current	V_{IN}=V_{GND}=0V; V_{CC}=V_{OUT}=24V; T_{amb}=25°C			240	µA
$I_{OUTleak}$	Off state output leakage current	V_{IN}=V_{GND}=0V; V_{CC}=24V; V_{OUT}=10V; T_{amb}=25°C			100	µA

SWITCHING (V_{CC}=24V) (Per channel)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$t_{D(on)}$	Turn-on delay time	R_L=96Ω from V_{IN} rising edge to V_{OUT} =2.4V		10		µs
$t_{D(off)}$	Turn-off delay time	R_L=96Ω from V_{IN} falling edge to V_{OUT}=21.6V		40		µs
$(dV_{OUT}/dt)_{on}$	Turn-on voltage slope	R_L=96Ω from V_{OUT}=2.4V to 19.2V		0.75		V/µs
$(dV_{OUT}/dt)_{off}$	Turn-off voltage slope	R_L=96Ω from V_{OUT}=21.6V to 2.4V		0.25		V/µs

PROTECTIONS (Per channel)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
I_{lim}	Current limitation		0.35	0.7	1.1	A
$T_{(hyst)}$	Thermal hysteresis		7	15		°C
T_{TSD}	Thermal shut-down temperature		150	175	200	°C
T_R	Reset temperature		135			°C
V_{demag}	Turn-off output clamp voltage	I_{OUT}=0.25A	V_{CC}-47	V_{CC}-52	V_{CC}-59	V

ELECTRICAL CHARACTERISTICS (continued)

LOGIC INPUT (Per channel)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IL}	Low level input voltage				1.25	V
I_{IL}	Low level input current	V_{IN}=1.25V	1			µA
V_{IH}	High level input voltage		3.25			V
I_{IH}	High level input current	V_{IN}=3.25V			10	µA
$V_{I(hyst)}$	Input hysteresis Voltage		0.5			V
I_{IN}	Input current	V_{IN}=V_{CC}=36V			200	µA
V_{OL}	I/O Output voltage	I_{IN}=5mA (Fault condition)			1	V

STATUS PIN

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
V_{STAT}	Status low output voltage	I_{STAT}=5mA (Fault condition)			1	V
I_{LSTAT}	Status leakage current	Normal operation; V_{STAT}=V_{CC}=36V			10	µA
C_{STAT}	Status pin input capacitance	Normal operation; V_{STAT}=5V			100	pF

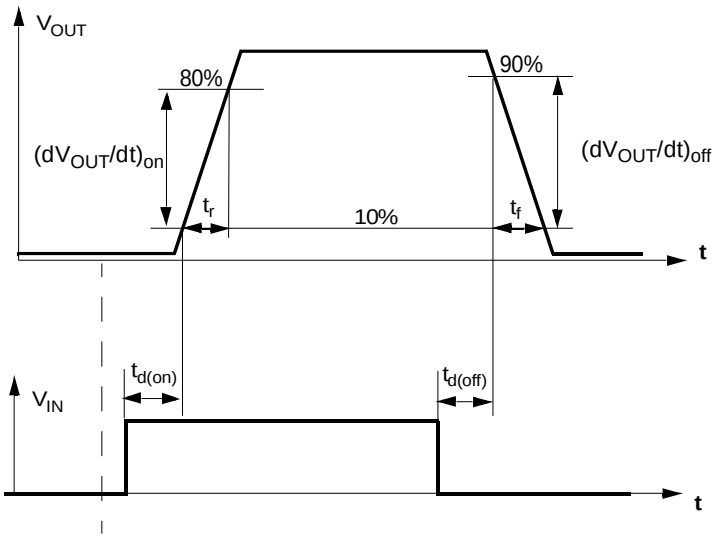
V_{CC} - OUTPUT DIODE

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_F	Forward on Voltage	-I_{OUT}=0.3A; T_j=150°C			0.6	V

TRUTH TABLE

CONDITIONS	MCOUTn	I/On	OUTPUTn	STATUS
Normal operation	L H	L H	L H	H H
Current limitation	L H	L H	L X	H H
Overtemperature	L H	L Driven low	L L	L L
Undervoltage	L H	L H	L L	X X
Overvoltage	L H	L H	L L	H H

SWITCHING CHARACTERISTICS



Typical application schematic

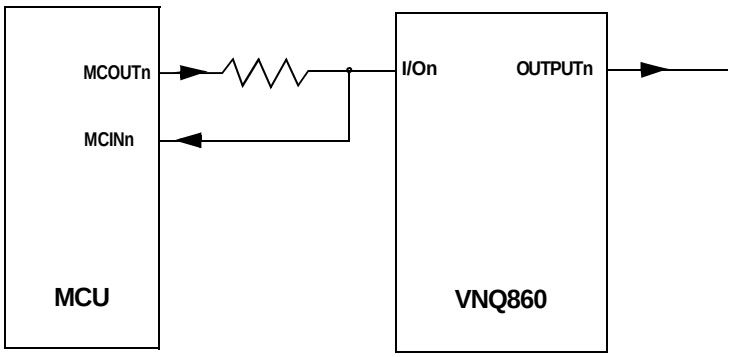
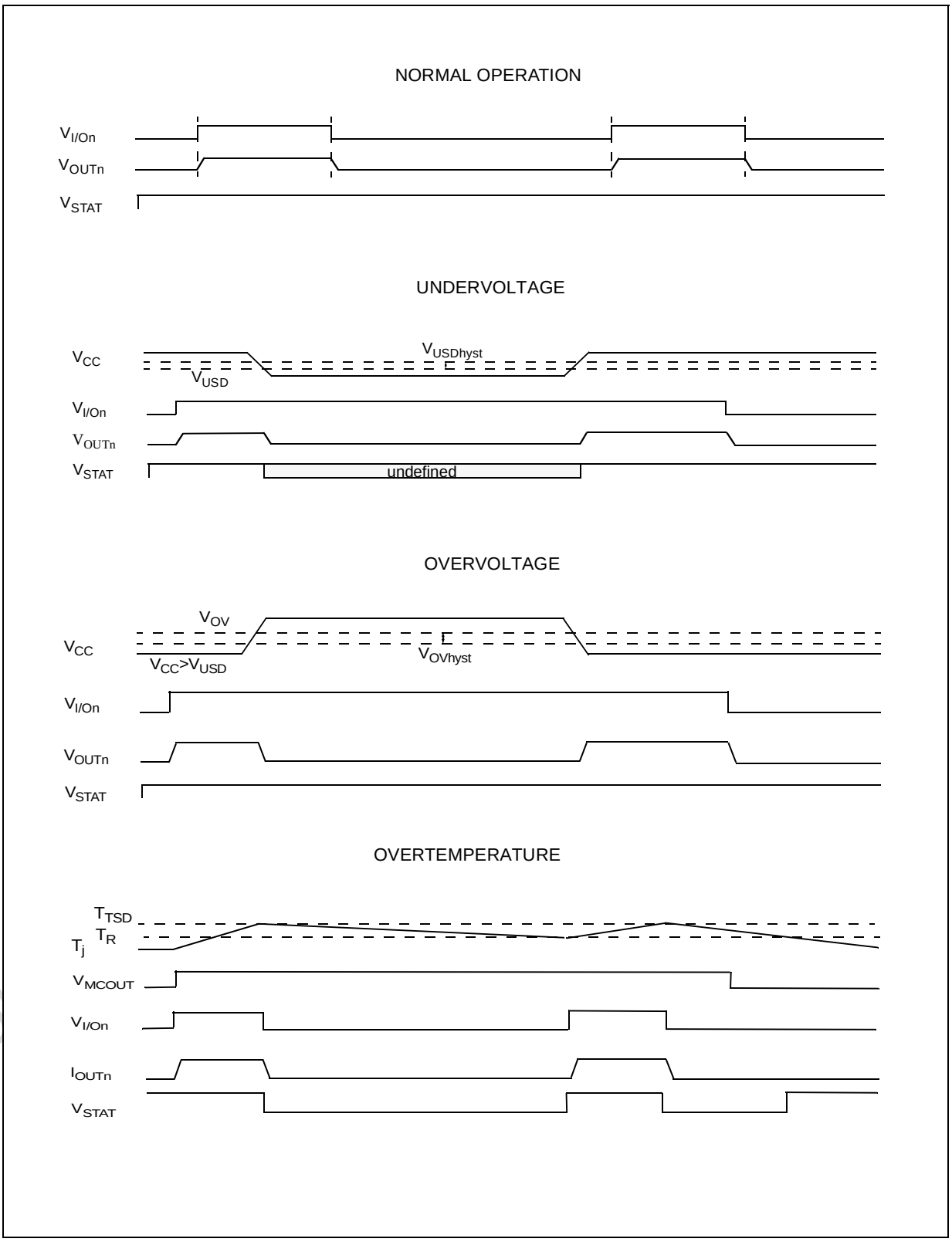
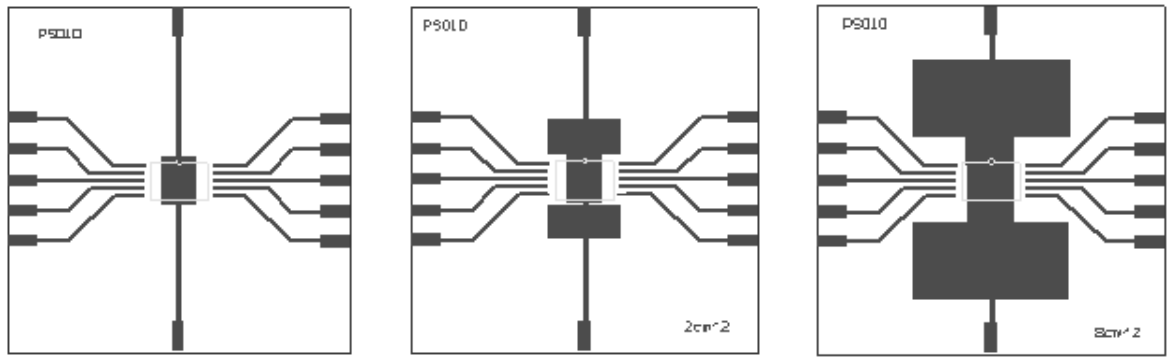


Figure 1: Waveforms



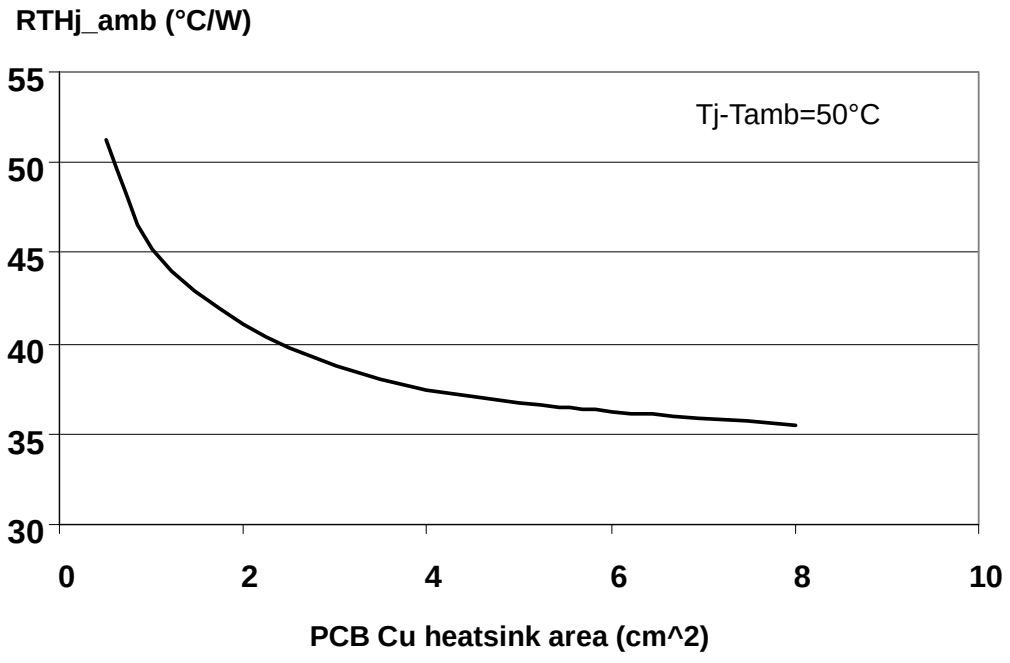
PowerSO-10™ THERMAL DATA

PowerSO-10™ PC Board



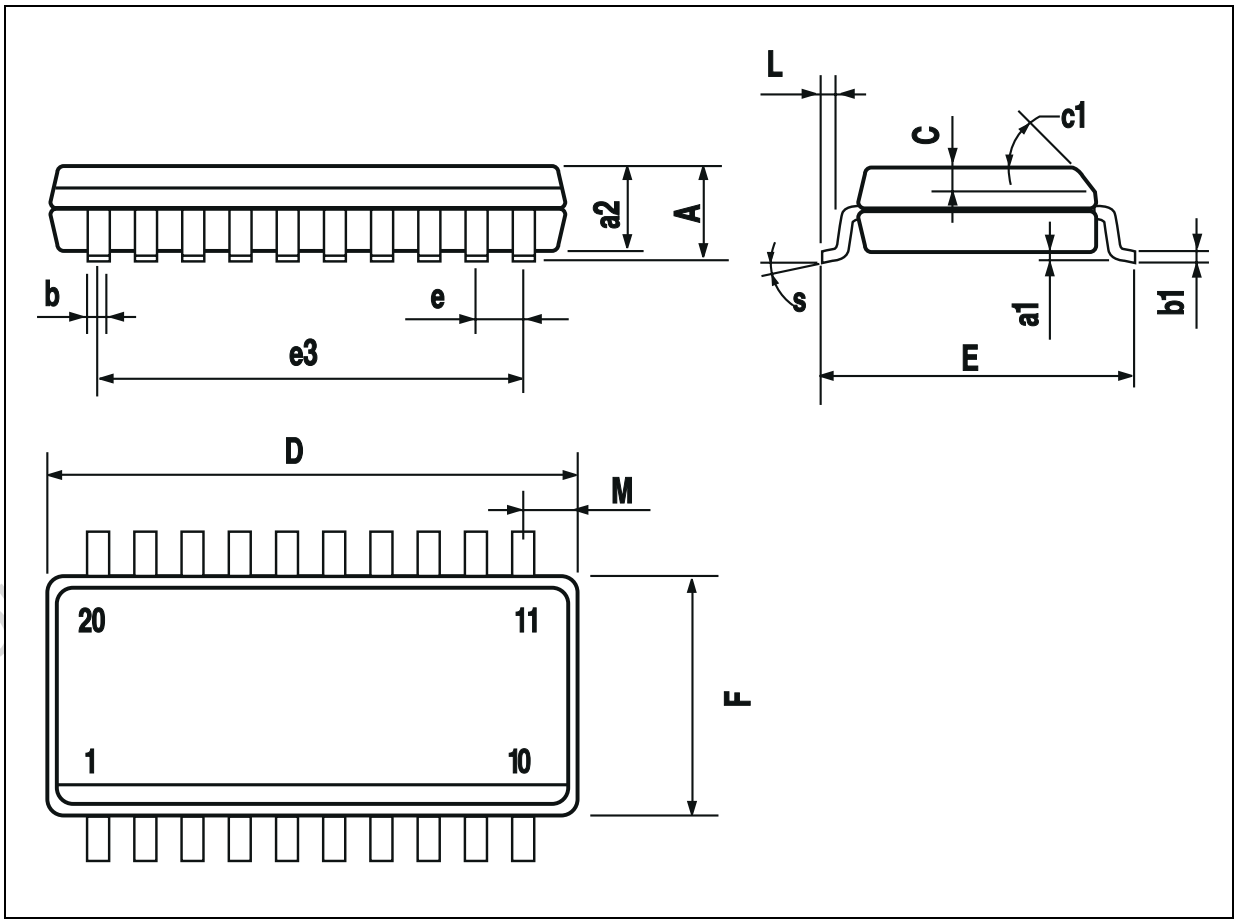
Layout condition of R_{th} and Z_{th} measurements (PCB FR4 area= 58mm x 58mm, PCB thickness=2mm, Cu thickness=35µm, Copper areas: from minimum pad lay-out to 8cm^2).

$R_{thj\text{-}amb}$ Vs PCB copper area in open box free air condition



SO-20 MECHANICAL DATA

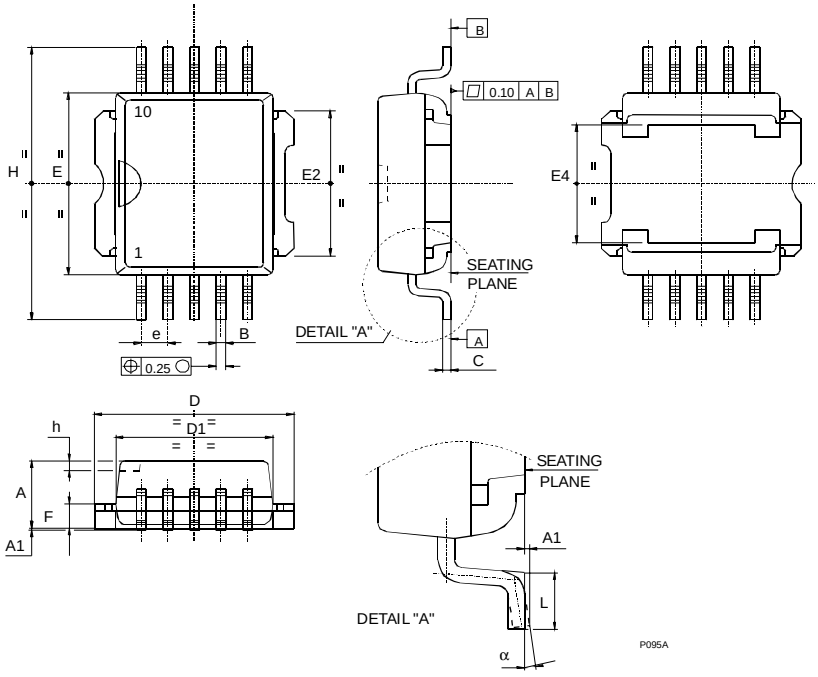
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			2.65			0.104
a1	0.10		0.20	0.004		0.007
a2			2.45			0.096
b	0.35		0.49	0.013		0.019
b1	0.23		0.32	0.009		0.012
C		0.50			0.020	
c1	45° (typ.)					
D	12.60		13.00	0.496		0.512
E	10.00		10.65	0.393		0.419
e		1.27			0.050	
F	7.40		7.60	0.291		0.299
L	0.50		1.27	0.19		0.050
M			0.75			0.029
S	8° (max.)					



PowerSO-10™ MECHANICAL DATA

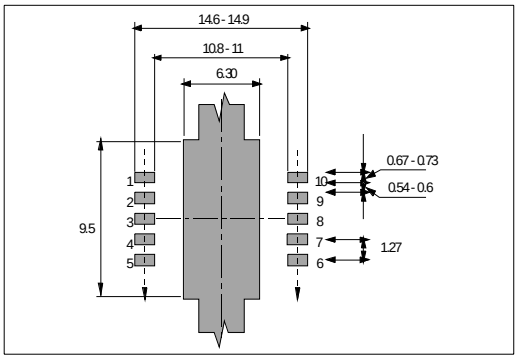
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	3.35		3.65	0.132		0.144
A (*)	3.4		3.6	0.134		0.142
A1	0.00		0.10	0.000		0.004
B	0.40		0.60	0.016		0.024
B (*)	0.37		0.53	0.014		0.021
C	0.35		0.55	0.013		0.022
C (*)	0.23		0.32	0.009		0.0126
D	9.40		9.60	0.370		0.378
D1	7.40		7.60	0.291		0.300
E	9.30		9.50	0.366		0.374
E2	7.20		7.60	0.283		300
E2 (*)	7.30		7.50	0.287		0.295
E4	5.90		6.10	0.232		0.240
E4 (*)	5.90		6.30	0.232		0.248
e		1.27			0.050	
F	1.25		1.35	0.049		0.053
F (*)	1.20		1.40	0.047		0.055
H	13.80		14.40	0.543		0.567
H (*)	13.85		14.35	0.545		0.565
h		0.50			0.002	
L	1.20		1.80	0.047		0.070
L (*)	0.80		1.10	0.031		0.043
α	0º		8º	0º		8º
α (*)	2º		8º	2º		8º

(*) Muar only POA P013P

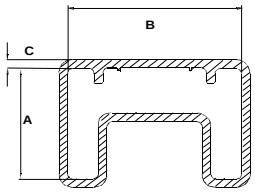


Obsolete Product(s)
Obso'

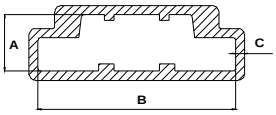
PowerSO-10™ SUGGESTED PAD LAYOUT



TUBE SHIPMENT (no suffix)



CASABLANCA

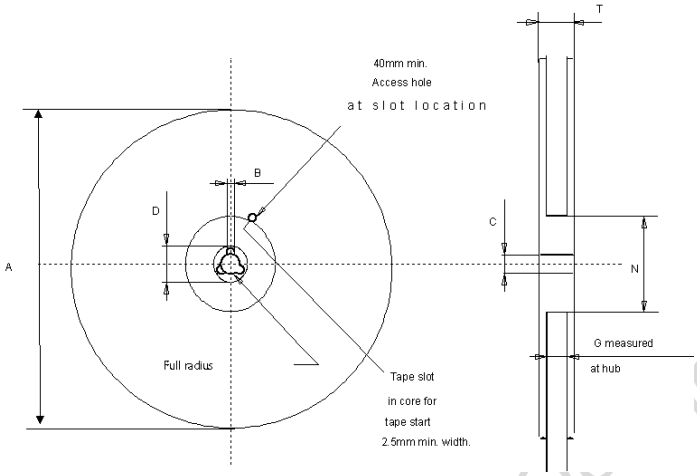


MUAR

All dimensions are in mm.

	Base Q.ty	Bulk Q.ty	Tube length (± 0.5)	A	B	C (± 0.1)
Casablanca	50	1000	532	10.4	16.4	0.8
Muar	50	1000	532	4.9	17.2	0.8

TAPE AND REEL SHIPMENT (suffix "13TR")



REEL DIMENSIONS

Base Q.ty	600
Bulk Q.ty	600
A (max)	330
B (min)	1.5
C (± 0.2)	13
F	20.2
G (+ 2 / -0)	24.4
N (min)	60
T (max)	30.4

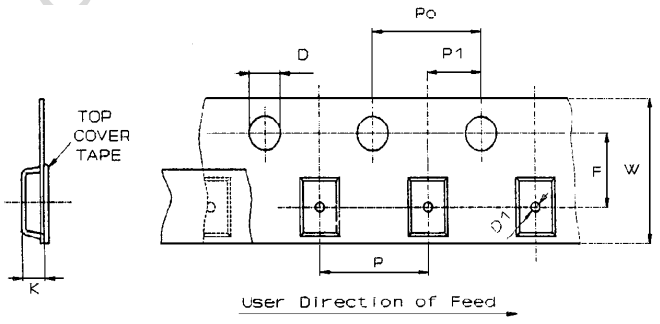
All dimensions are in mm.

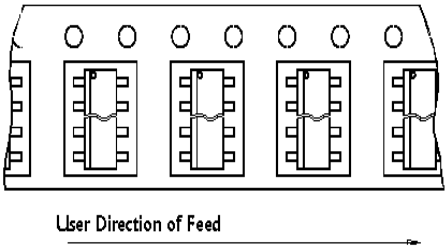
TAPE DIMENSIONS

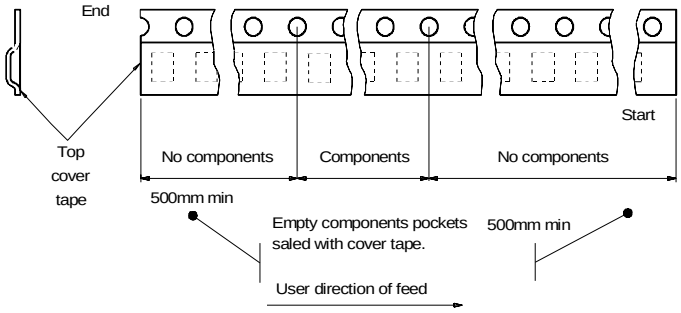
According to Electronic Industries Association (EIA) Standard 481 rev. A, Feb. 1986

Tape width	**W**	24
Tape Hole Spacing	**P0 (± 0.1)**	4
Component Spacing	**P**	24
Hole Diameter	**D (± 0.1/-0)**	1.5
Hole Diameter	**D1 (min)**	1.5
Hole Position	**F (± 0.05)**	11.5
Compartment Depth	**K (max)**	6.5
Hole Spacing	**P1 (± 0.1)**	2

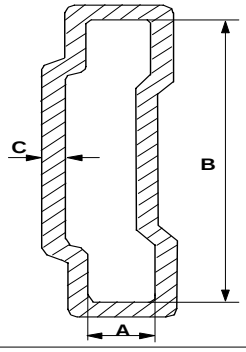
All dimensions are in mm.







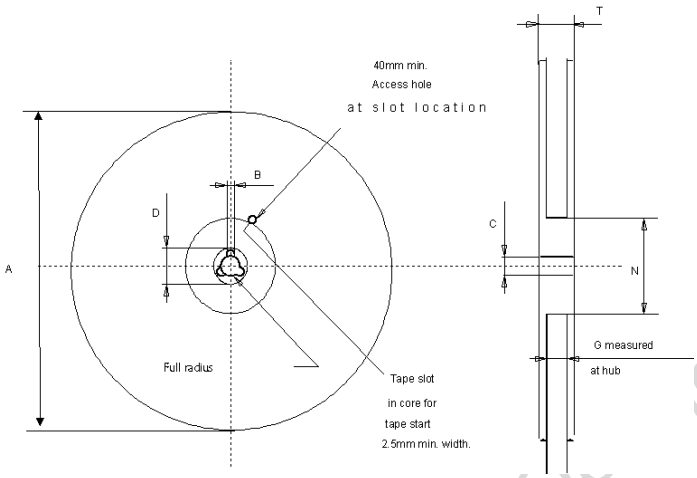
SO-20 TUBE SHIPMENT (no suffix)



Base Q.ty	40
Bulk Q.ty	800
Tube length (± 0.5)	532
A	3.5
B	13.8
C (± 0.1)	0.6

All dimensions are in mm.

TAPE AND REEL SHIPMENT (suffix "13TR")



REEL DIMENSIONS

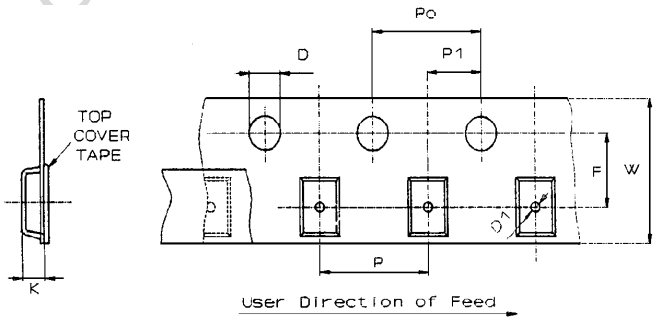
Base Q.ty	1000
Bulk Q.ty	1000
A (max)	330
B (min)	1.5
C (± 0.2)	13
F	20.2
G (+ 2 / -0)	24.4
N (min)	60
T (max)	30.4

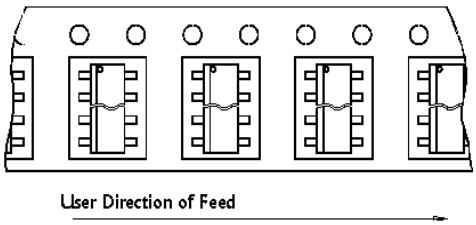
TAPE DIMENSIONS

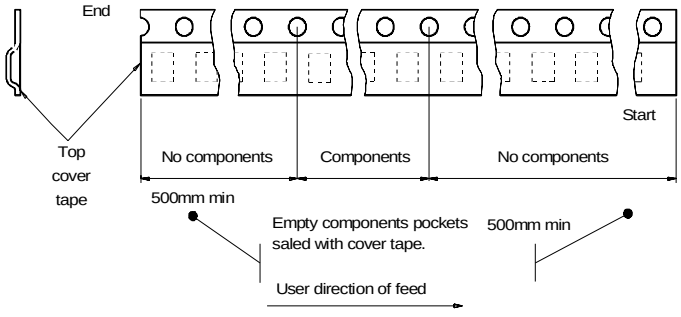
According to Electronic Industries Association (EIA) Standard 481 rev. A, Feb 1986

Tape width	**W**	24
Tape Hole Spacing	**P0 (± 0.1)**	4
Component Spacing	**P**	12
Hole Diameter	**D (± 0.1/-0)**	1.5
Hole Diameter	**D1 (min)**	1.5
Hole Position	**F (± 0.05)**	11.5
Compartment Depth	**K (max)**	6.5
Hole Spacing	**P1 (± 0.1)**	2

All dimensions are in mm.







REVISION HISTORY

Date	Revision	Description of Changes
Jul 2004	1	- Minor changes. - Order Codes table insertion (page 1). - Current and voltage convention update (page 2). - “Configuration diagram (top view) & suggested connections for unused and n.c. pins” insertion (page 2). - 6cm^2 Cu condition insertion in Thermal Data table (page 3). - V_{CC} - OUTPUT DIODE section insertion (page 4). - SO-20 Shipment Data insertion (page 11) - Revision History table insertion (page12). - Disclaimers update (page 13).

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