VNQ860-E
VNQ860SP-E

QUAD CHANNEL HIGH SIDE DRIVER

General Features

| Type	$R_{DS(ON)}$[(1)]	I_{out}	V_{CC}
VNQ860-E VNQ860SP-E	270mΩ	0.25A	36V

Note: 1 Per each channel.

■ CMOS COMPATIBLE I/Os

■ UNDERVOLTAGE & OVERVOLTAGE SHUT-DOWN

■ SHORTED LOAD PROTECTION

■ THERMAL SHUT-DOWN

■ VERY LOW STAND-BY CURRENT

■ PROTECTION AGAINST LOSS OF GROUND

SO- 20　　　　**PowerSO-10^{TM}**
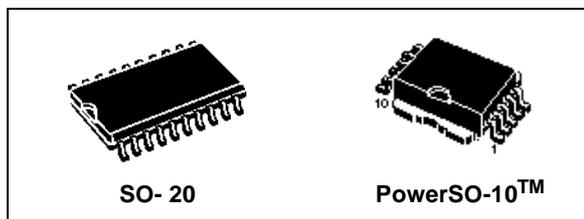
Description

The VNQ860-E, VNQ860SP-E 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 shut-down 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 IEC 61131, (Programmable Controllers International Standard).

Block Diagram
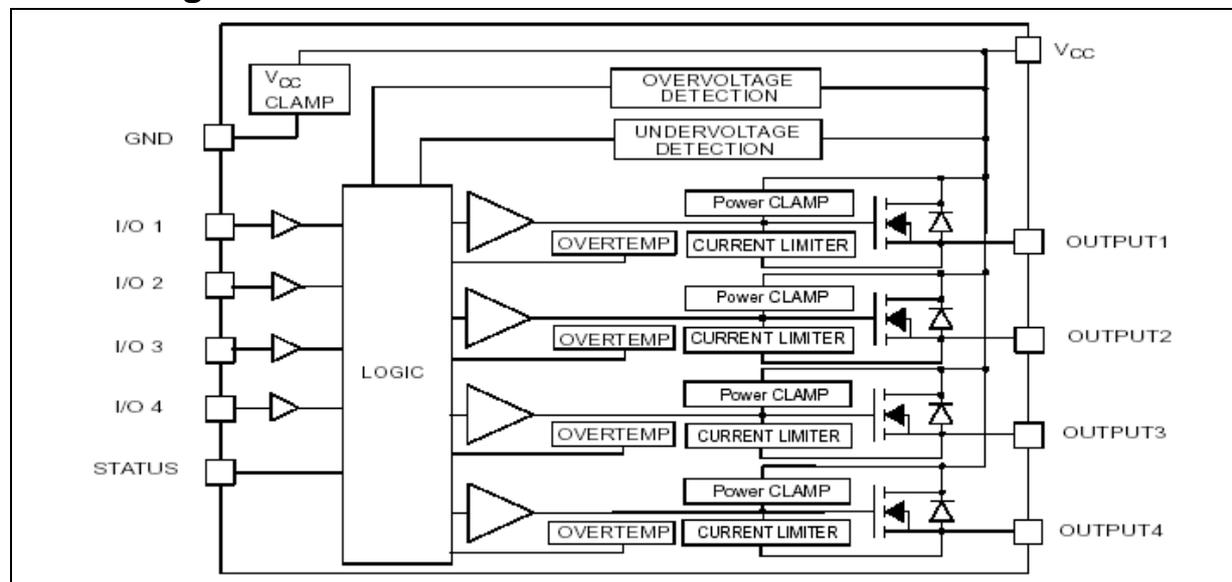
Order Codes

Package	Tube	Tape and Reel
SO-20	VNQ860	VNQ86013TR-E
PowerSO-10^{TM}	VNQ860SP	VNQ860SP13TR-E

Table 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	-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
I_{STAT}	DC Status voltage	$+ V_{CC}$		V
V_{ESD}	Electrostatic discharge (R = 1.5KW; C = 100pF)	2000		V
P_{tot}	Power dissipation at 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

Figure 1.   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
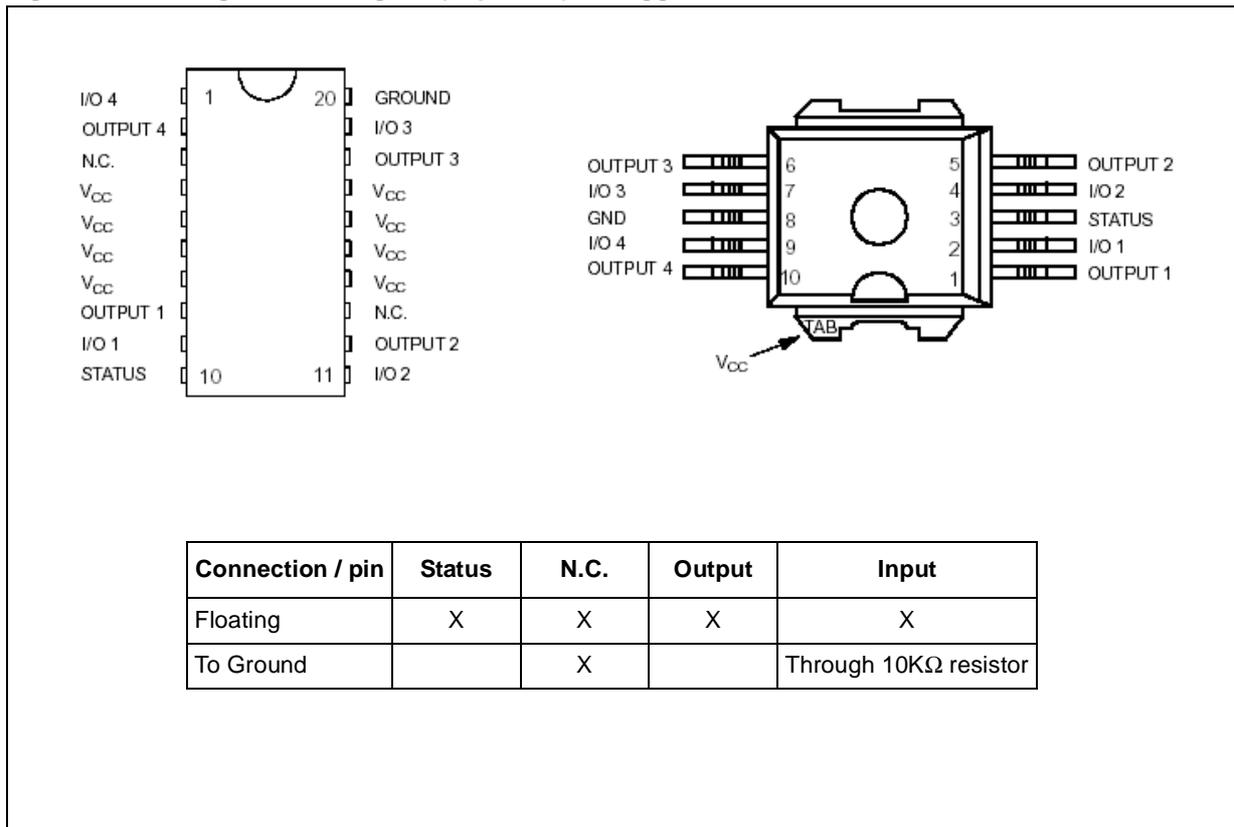
Figure 2.   Current and Voltage Conventions

(*) $V_{Fn} = V_{CCn} - V_{OUTn}$ during reverse battery condition
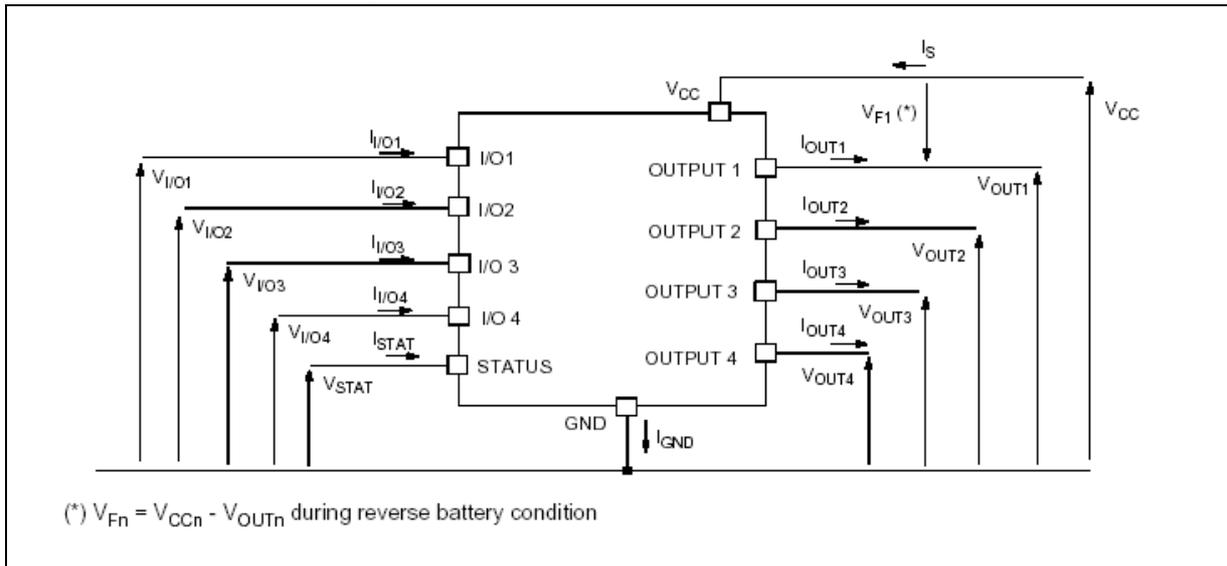
Table 2.   Thermal data

Symbol	Parameter		Max Value		Unit
			SO-20	**PowerSO-10**	
$R_{thj\text{-}pin}$	Thermal resistance junction-pins	Max	8	-	°C/W
R_{thJA}	Thermal resistance junction-ambient	Max	58	52 *Note* 1	°C/W
				37 *Note* 2	
R_{thJC}	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)

Table 3.   Power Section

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; I_{OUT} = 0.25A;			270 540	mΩ
I_S	Supply current	OFF state; V_{CC} = 24V; T_C = 25°C ON state (all channels ON)		70 5	120 10	μA 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

Table 4.   Switching (V_{CC} = 24V)

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

Table 5.   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} = 24V	V_{CC}-59	V_{CC}-52	V_{CC}-47	V

Table 6.   Logical 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 votage	I_{IN} = 5mA (Fault condition)			1	V

Table 7.   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
CSTAT	Status pin input capacitance	Normal operation; V_{STAT} = 5V			100	pF

Table 8. V_{CC} - Output Diode

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Forwardon Voltage	-I_{OUT} = 0.3A; T_J = 150°C			1	V

Table 9.   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	X X
Undervoltage	L H	L H	L L	X X
Overvoltage	L H	L H	L L	H H

Figure 3.   Switching Characteristics
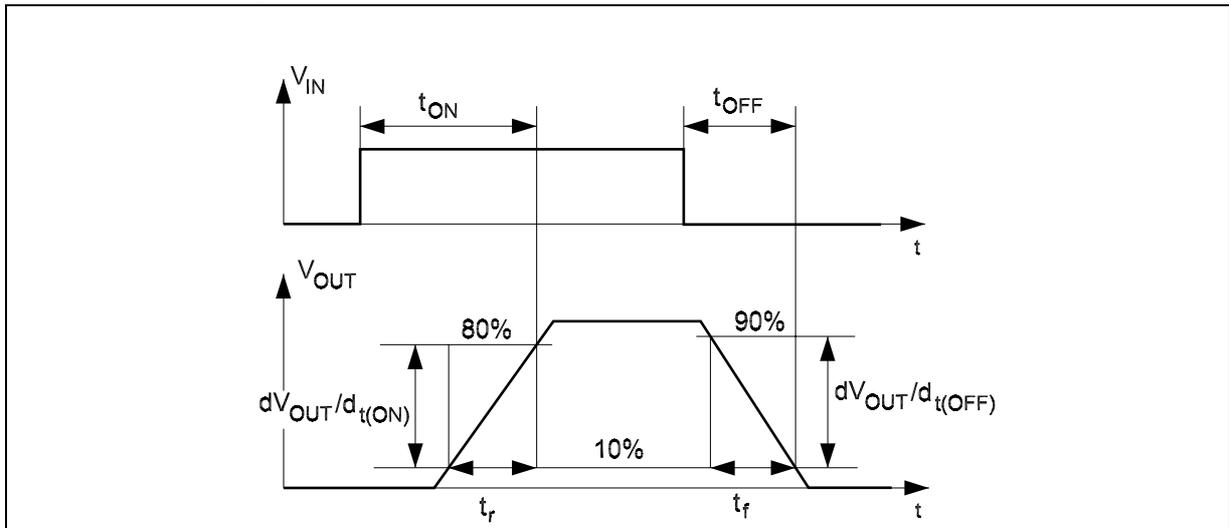

Figure 4.   Typical Application Schematic
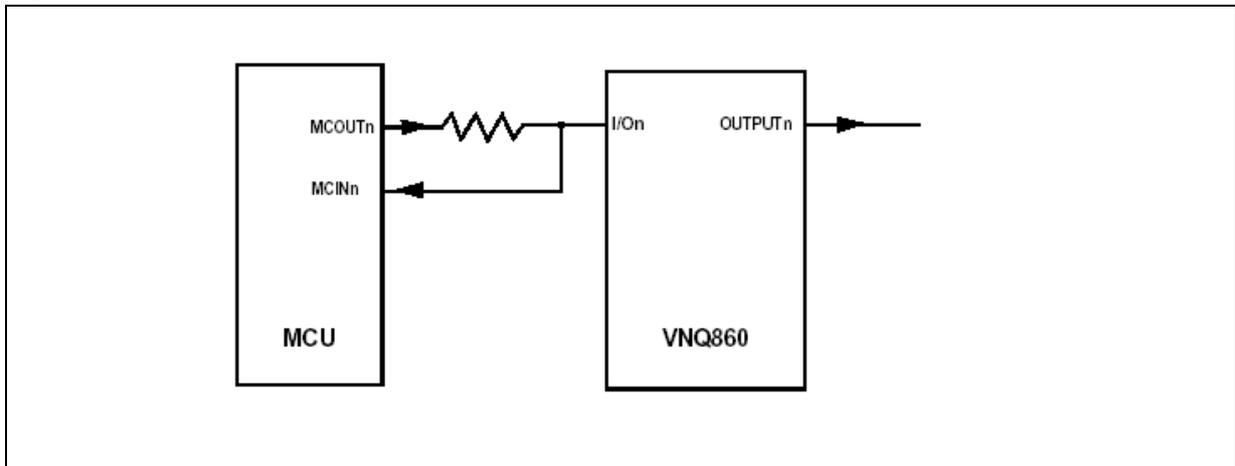
Figure 5.   Waveforms
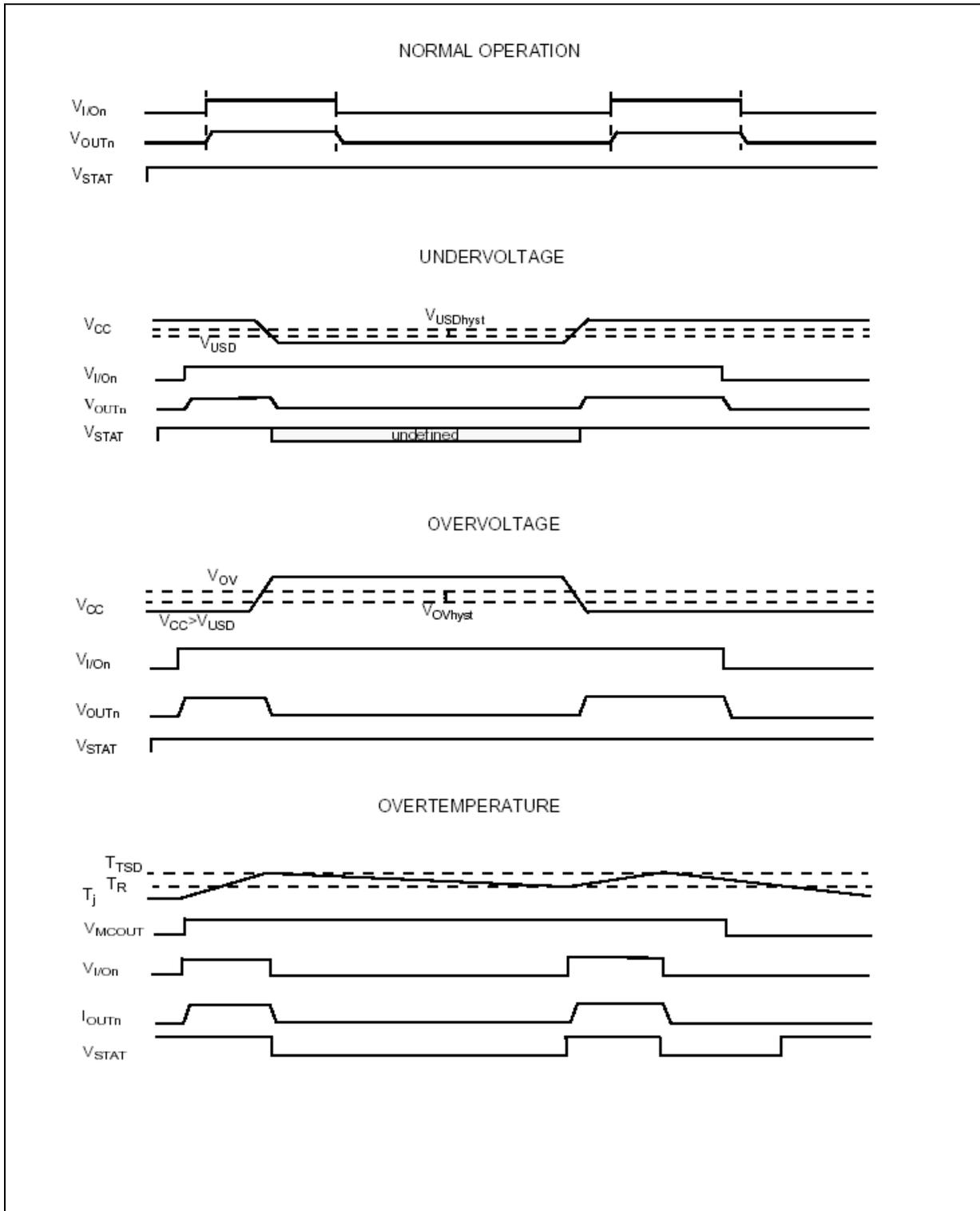
PowerSO-10^TM Thermal Data

Figure 6.   PowerSO-10^TM 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).
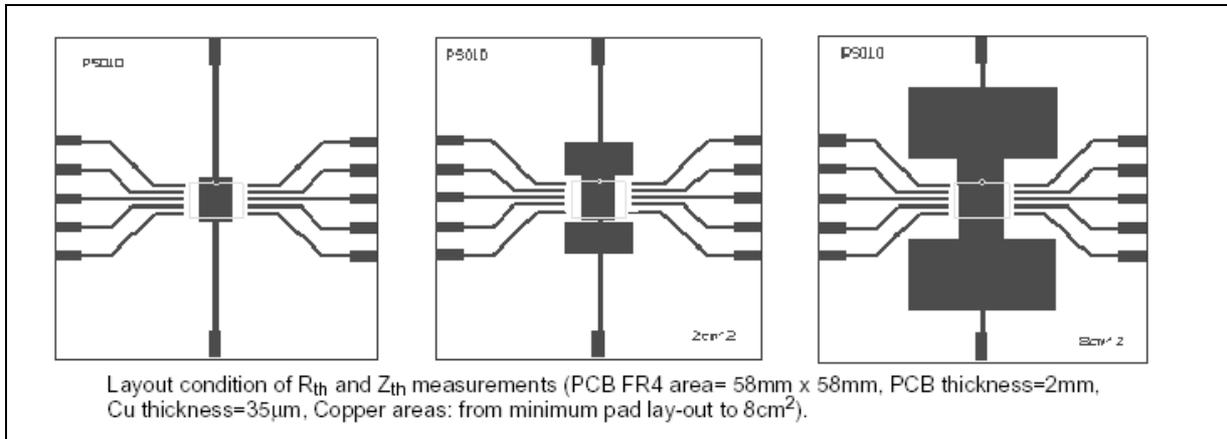
Figure 7. R_{thJA} Vs. PBC copper area in open box free air condition
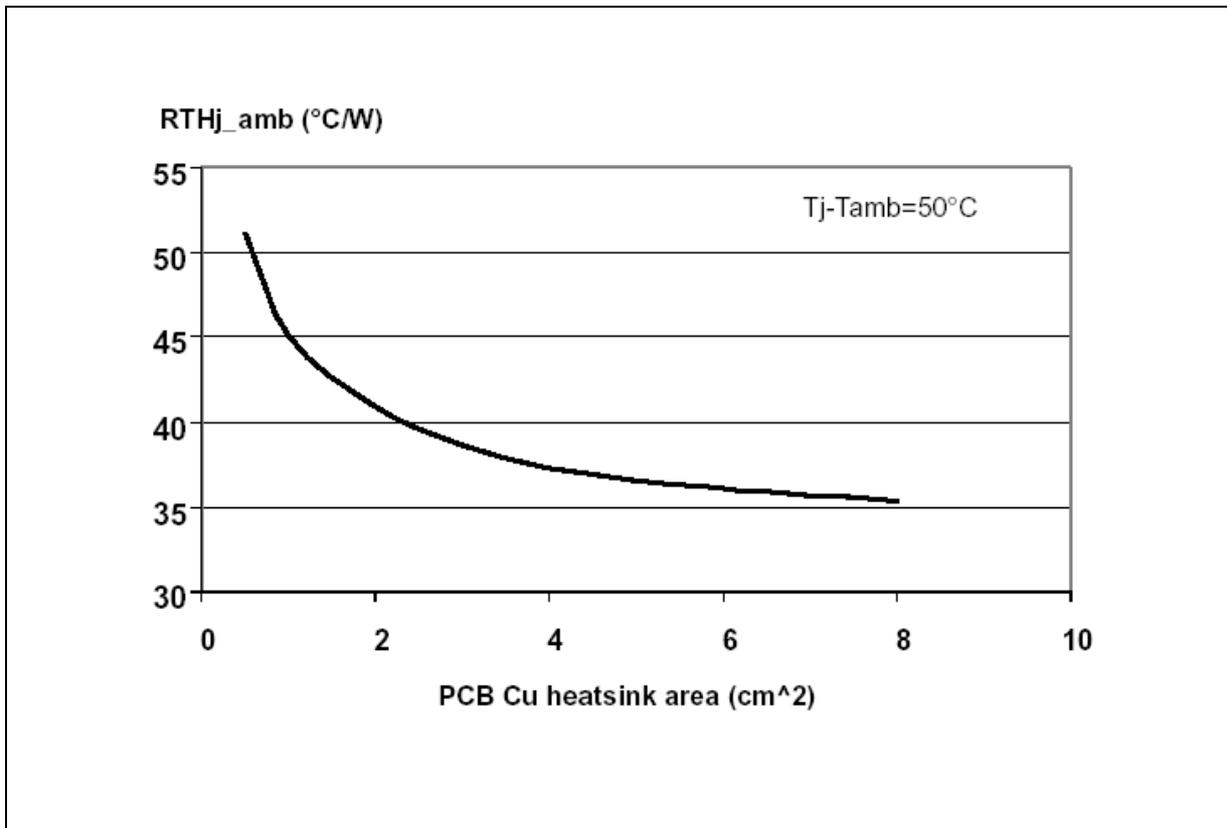
Mechanical Data

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

Table 10.   PowerSO-10™ Mechanical Data

Symbol	millimeters		
	Min	Typ	Max
A	3.35		3.65
A (*)	3.4		3.6
A1	0.00		0.10
B	0.40		0.60
B (*)	0.37		0.53
C	0.35		0.55
C (*)	0.23		0.32
D	9.40		9.60
D1	7.40		7.60
E	9.30		9.50
E2	7.20		7.60
E2 (*)	7.30		7.50
E4	5.90		6.10
E4 (*)	5.90		6.30
e		1.27	
F	1.25		1.35
F (*)	1.20		1.40
H	13.80		14.40
H (*)	13.85		14.35
h		0.50	
L	1.20		1.80
L (*)	0.80		1.10
a	0°		8°
α (*)	2°		8°

Note: (*) Muar only POA P013P

Figure 8.   PowerSO-10™ Package Dimensions
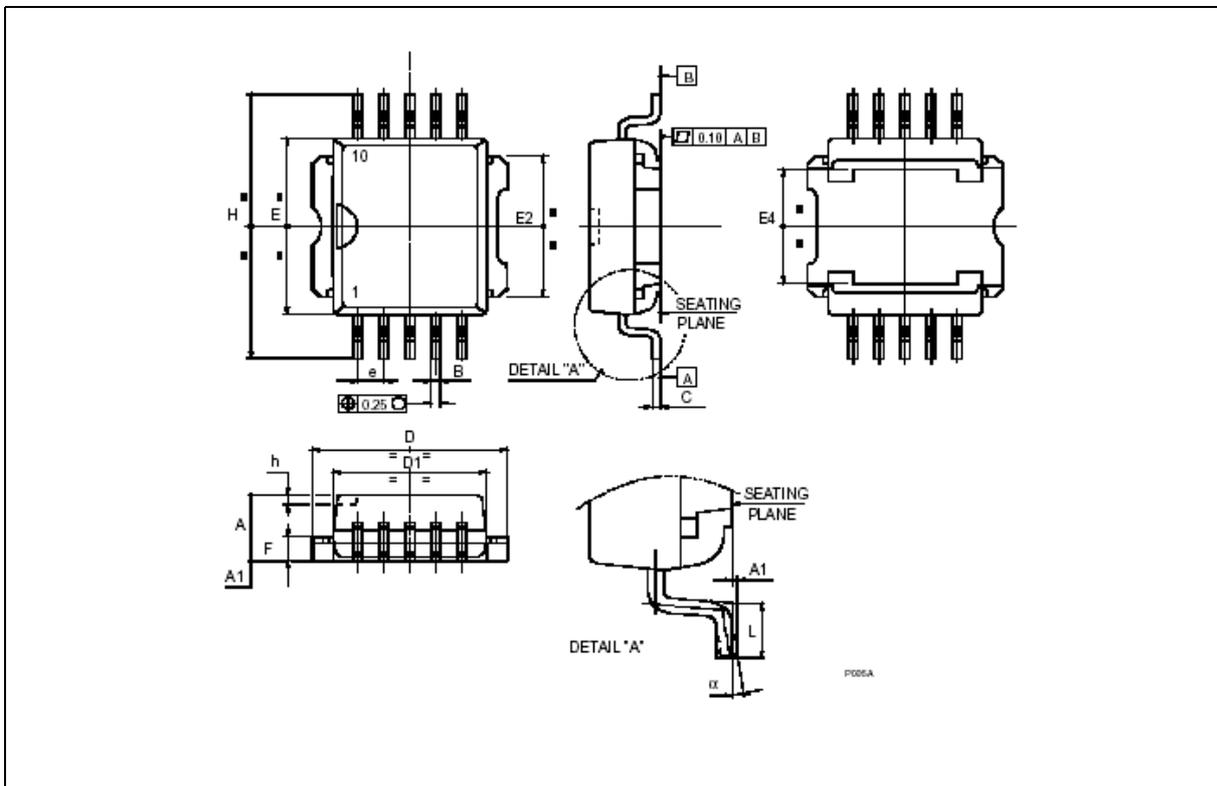
**Figure 9.   PowerSO-10TM Suggested Pad and Tube Shipment (No Suffix)**

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
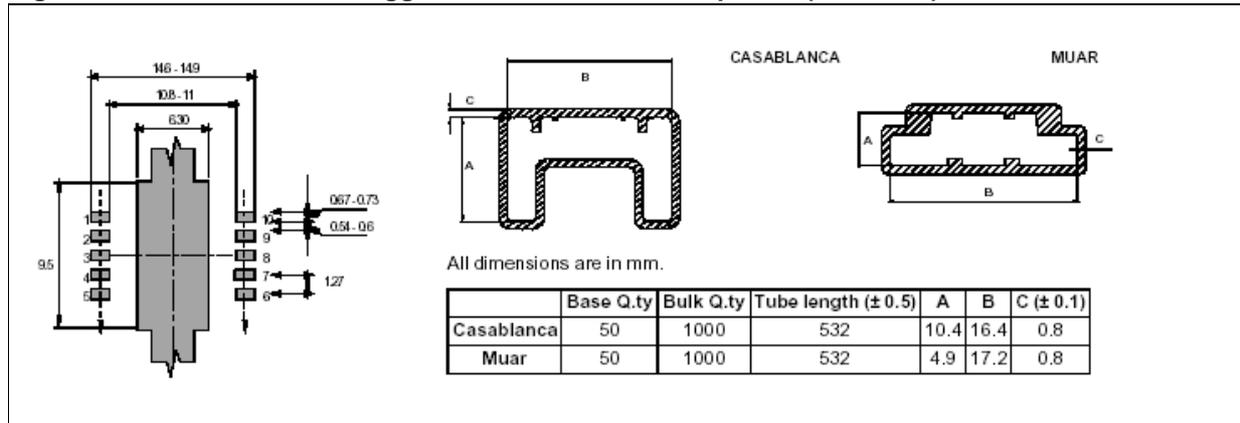
Figure 10. Tape and Reel Shipment (Suffix "TR")

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.

Table 11.   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.)					
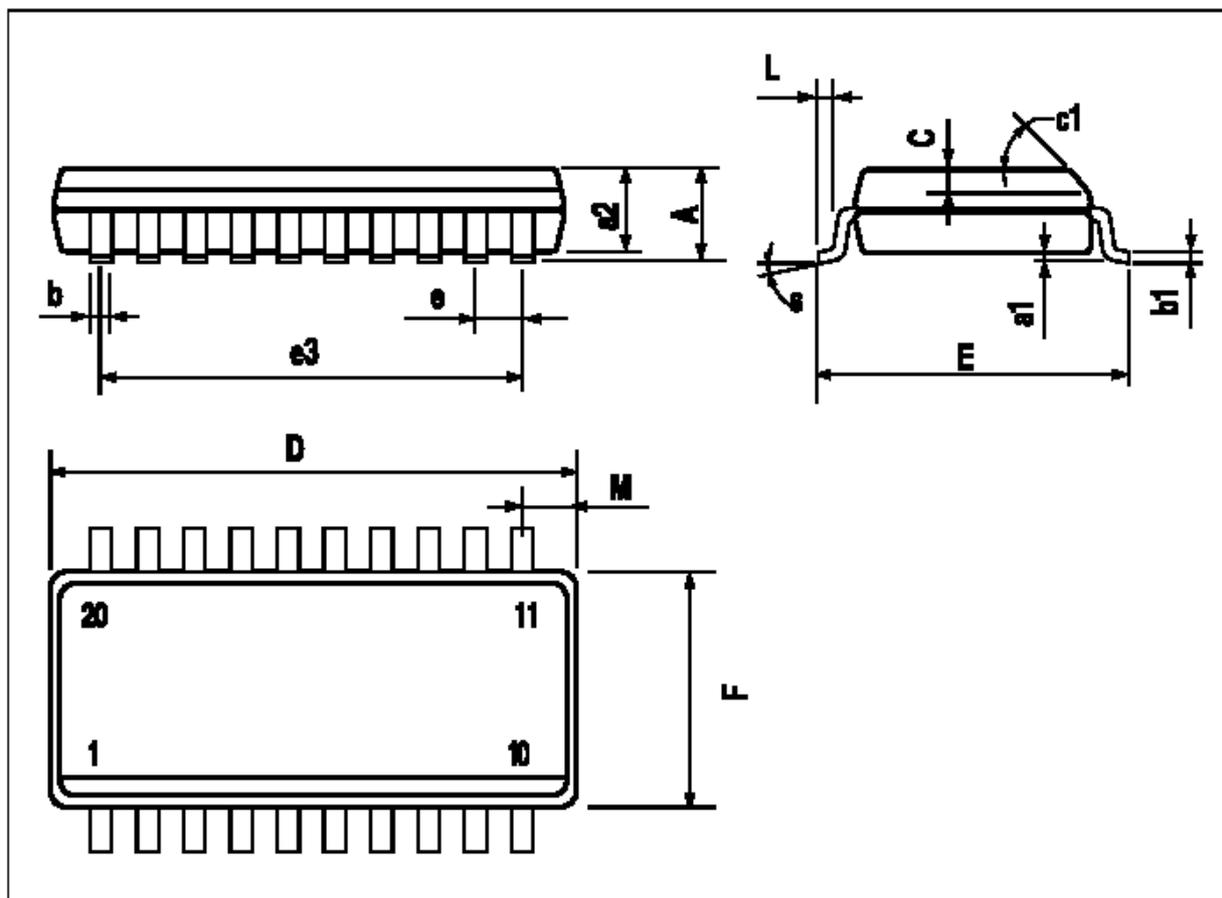
Figure 11. SO-20 Tube Shipment (no suffix)

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.
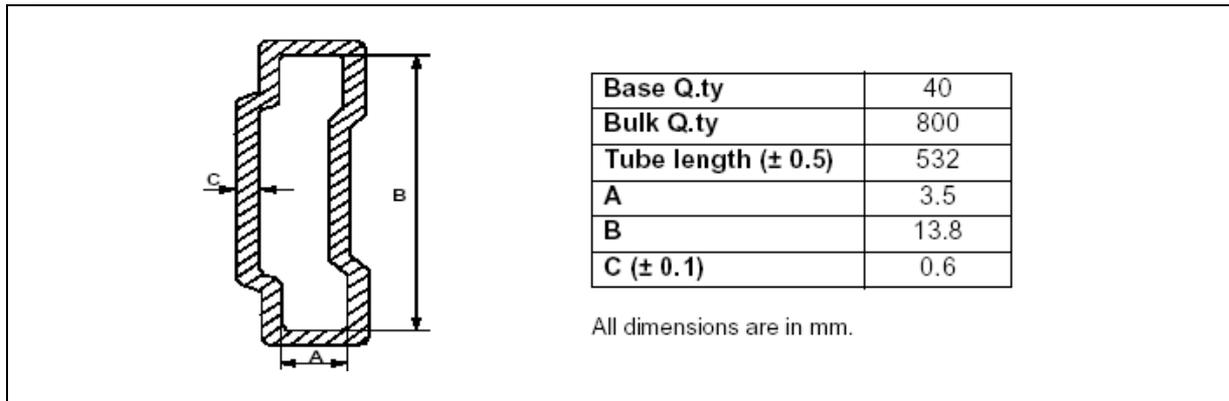
Figure 12. Tape and Reel Shipment (suffix "13TR")

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.

Table 12.   Revision History

Date	Revision	Description of Change
14-Jul-2005	1	Updates , New template.
7-Nov-2005	2	Few Updates.

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