



VNQ860-E VNQ860SP-E

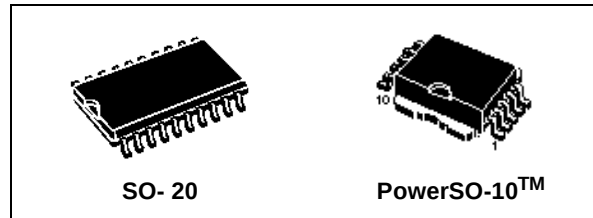
QUAD CHANNEL HIGH SIDE DRIVER

General Features

Type	$R_{DS(ON)}^{(1)}$	I_{out}	V_{CC}
VNQ860-E VNQ860SP-E	270m Ω	0.25A	36V

Note: 1 Per each channel.

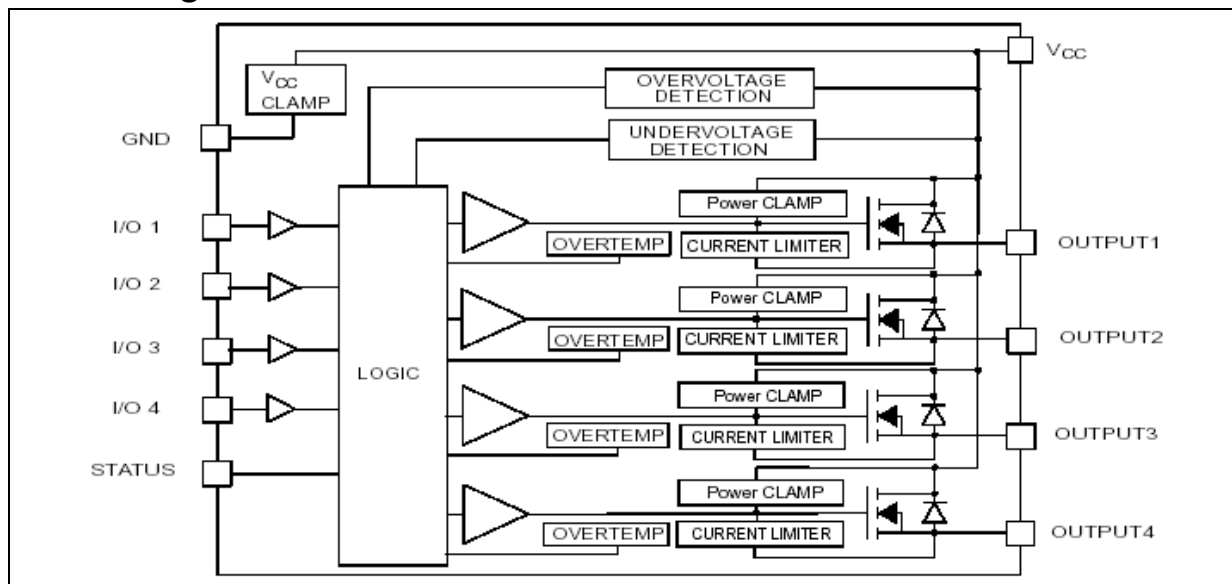
- CMOS COMPATIBLE I/Os
- UNDERVOLTAGE & OVERVOLTAGE SHUT-DOWN
- SHORTED LOAD PROTECTION
- THERMAL SHUT-DOWN
- VERY LOW STAND-BY CURRENT
- PROTECTION AGAINST LOSS OF GROUND



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 $T_c \leq 25^{\circ}\text{C}$	16	90	W
T_J	Junction operating temperature	Internally limited		$^{\circ}\text{C}$
T_c	Case operating temperature	-40 to 150		$^{\circ}\text{C}$
T_{stg}	Storage Temperature	-55 to 150		$^{\circ}\text{C}$

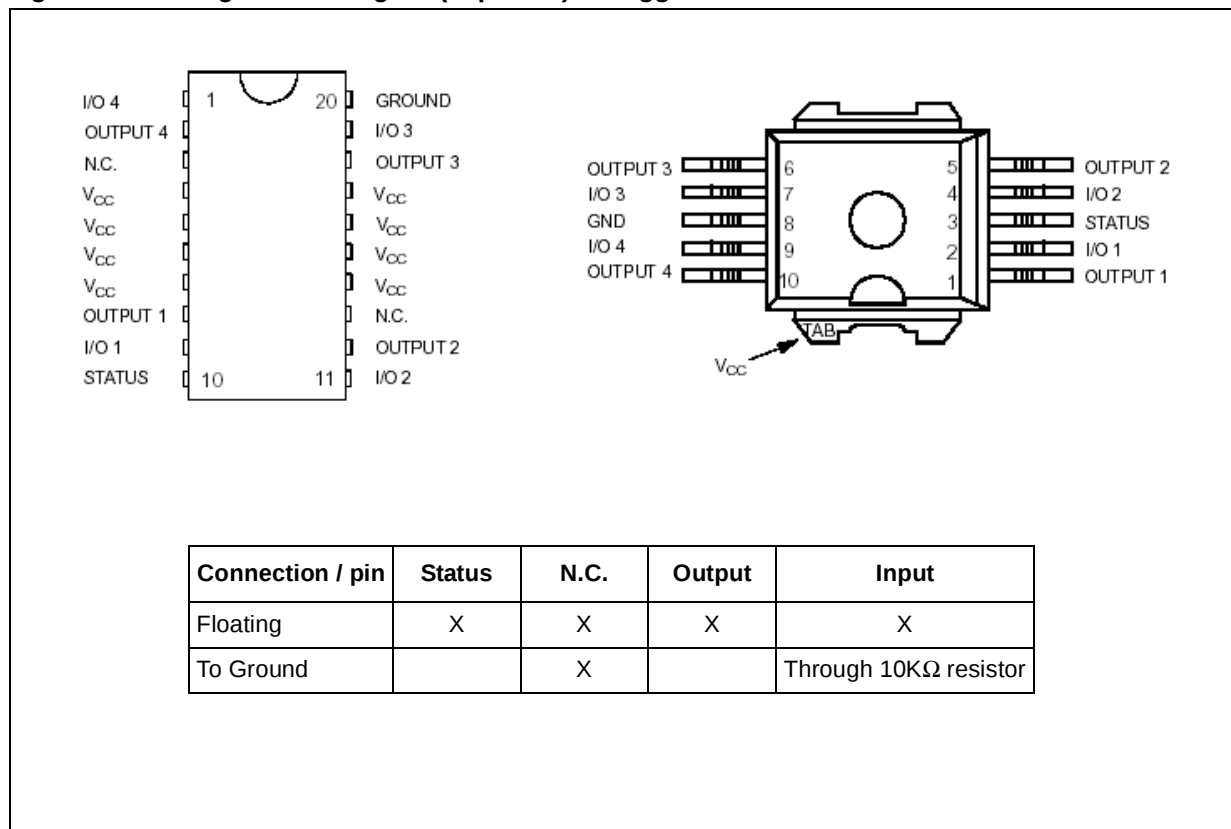
Figure 1. Configuration Diagram(Top View) & Suggested Connections for Unused and N.C. Pins

Figure 2. Current and Voltage Conventions

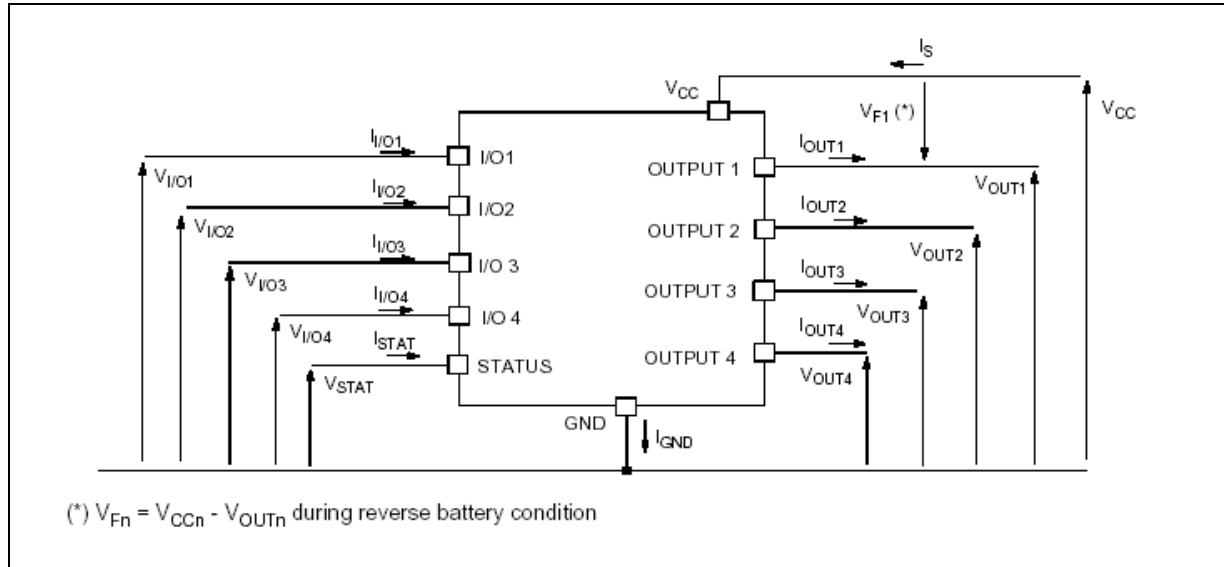


Table 2. Thermal data

Symbol	Parameter		Max Value		Unit
			SO-20	PowerSO-10	
$R_{thj-pin}$	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 0.5cm² of copper area (at least 35μ thick) connected to all V_{CC} pins.

2. When mounted on FR4 printed circuit board with 6cm² of copper area (at least 35μ thick) connected to all V_{CC} pins.

Electrical Characteristics ($8V < V_{CC} < 36V$; $-40^{\circ}C < T_J < 150^{\circ}C$; 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)	$I_{OUT} = 0.25A$; $T_J = 25^{\circ}C$; $I_{OUT} = 0.25A$;			270 540	m Ω
I_S	Supply current	OFF state; $V_{CC} = 24V$; $T_C = 25^{\circ}C$ 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	$V_{IN} = V_{GND} = 0V$; $V_{CC} = V_{OUT} = 24V$; $T_{amb} = 25^{\circ}C$			240	μA
$I_{OUTleak}$	OFF state output leakage current	$V_{IN} = V_{GND} = 0V$; $V_{CC} = 24V$; $V_{OUT} = 10V$; $T_{amb} = 25^{\circ}C$			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		$^{\circ}C$
T_{TSD}	Thermal shut-down temperature		150	175	200	$^{\circ}C$
T_R	Reset temperature		135			$^{\circ}C$
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 vottage	$I_{IN} = 5mA$ (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
C_{STAT}	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	$-I_{OUT} = 0.3A$; $T_J = 150^{\circ}C$			1	V

Table 9. Truth Table

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

Figure 3. Switching Characteristics

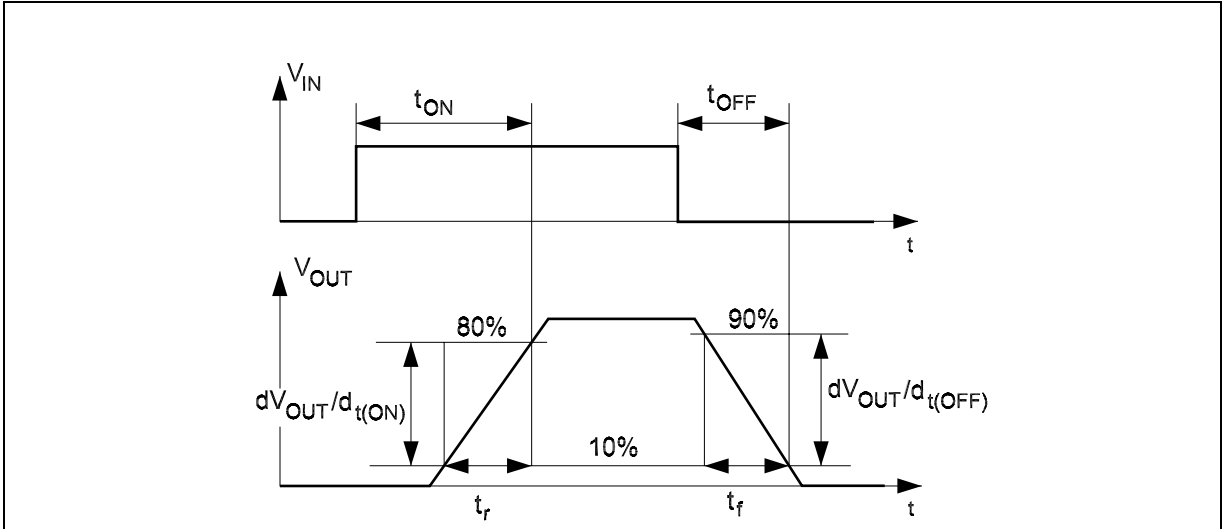


Figure 4. Typical Application Schematic

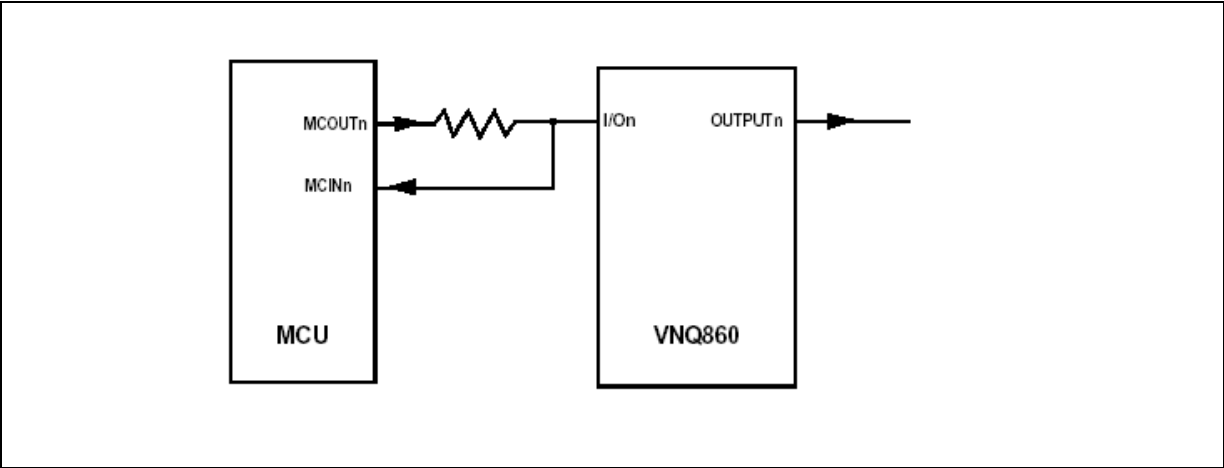
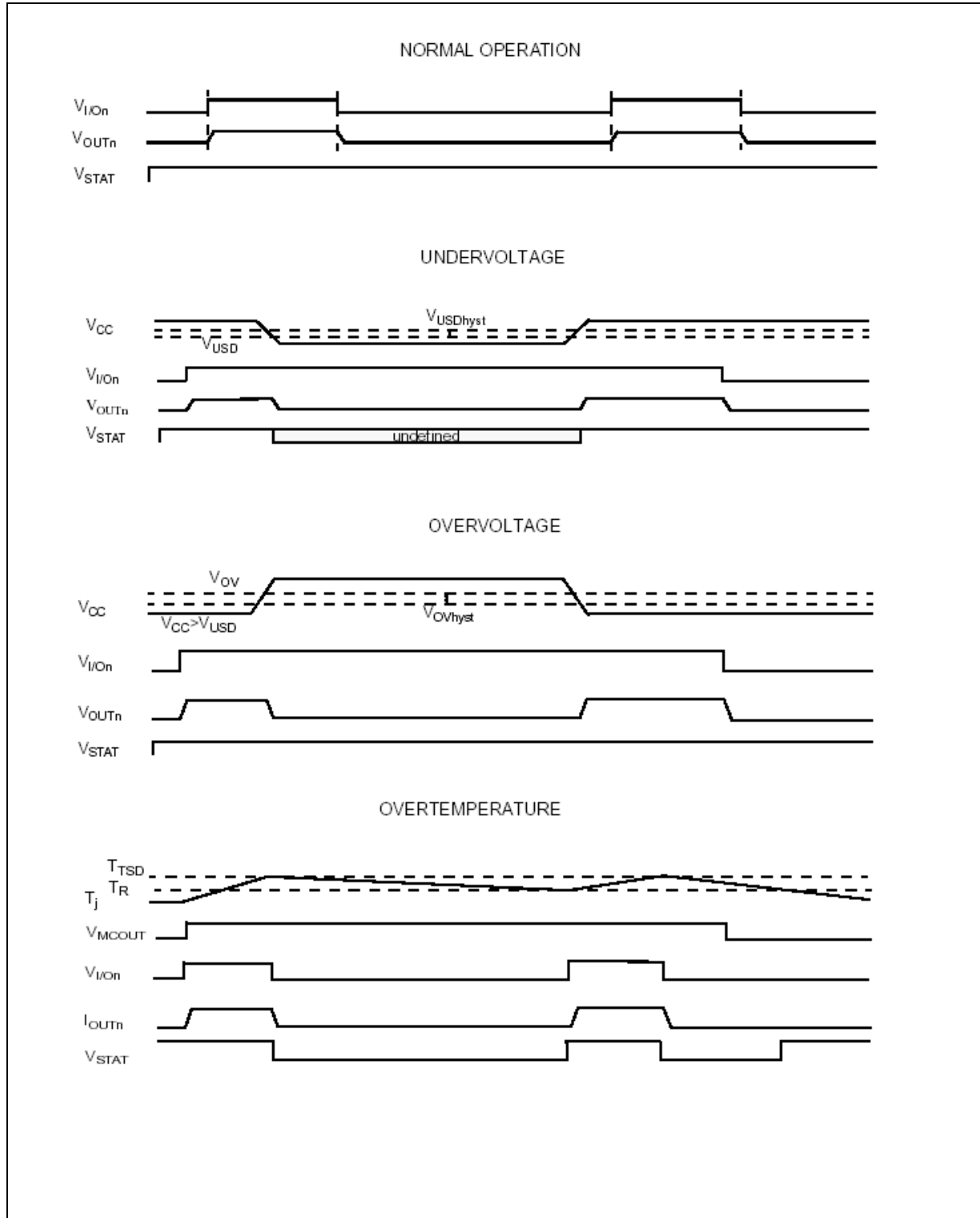


Figure 5. Waveforms



PowerSO-10™ Thermal Data

Figure 6. PowerSO-10™ PC Board

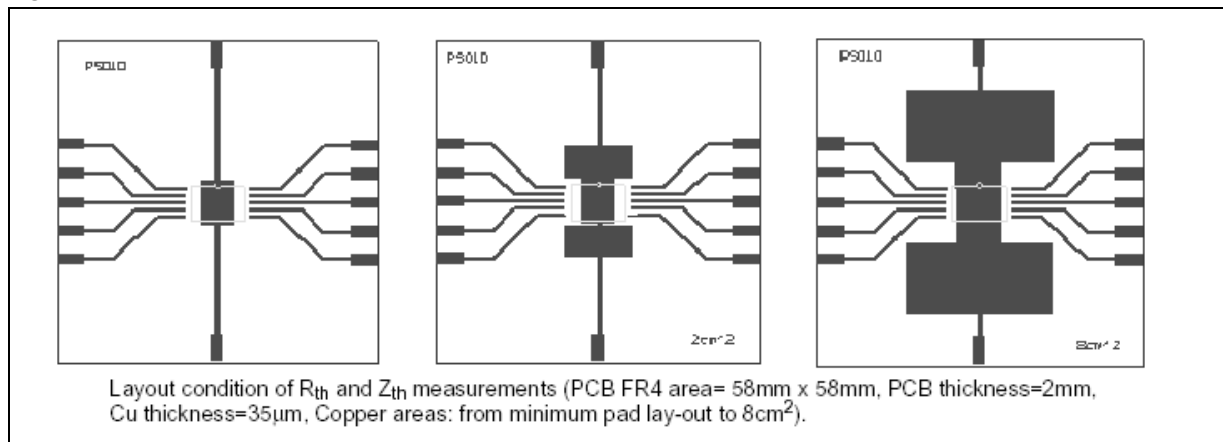
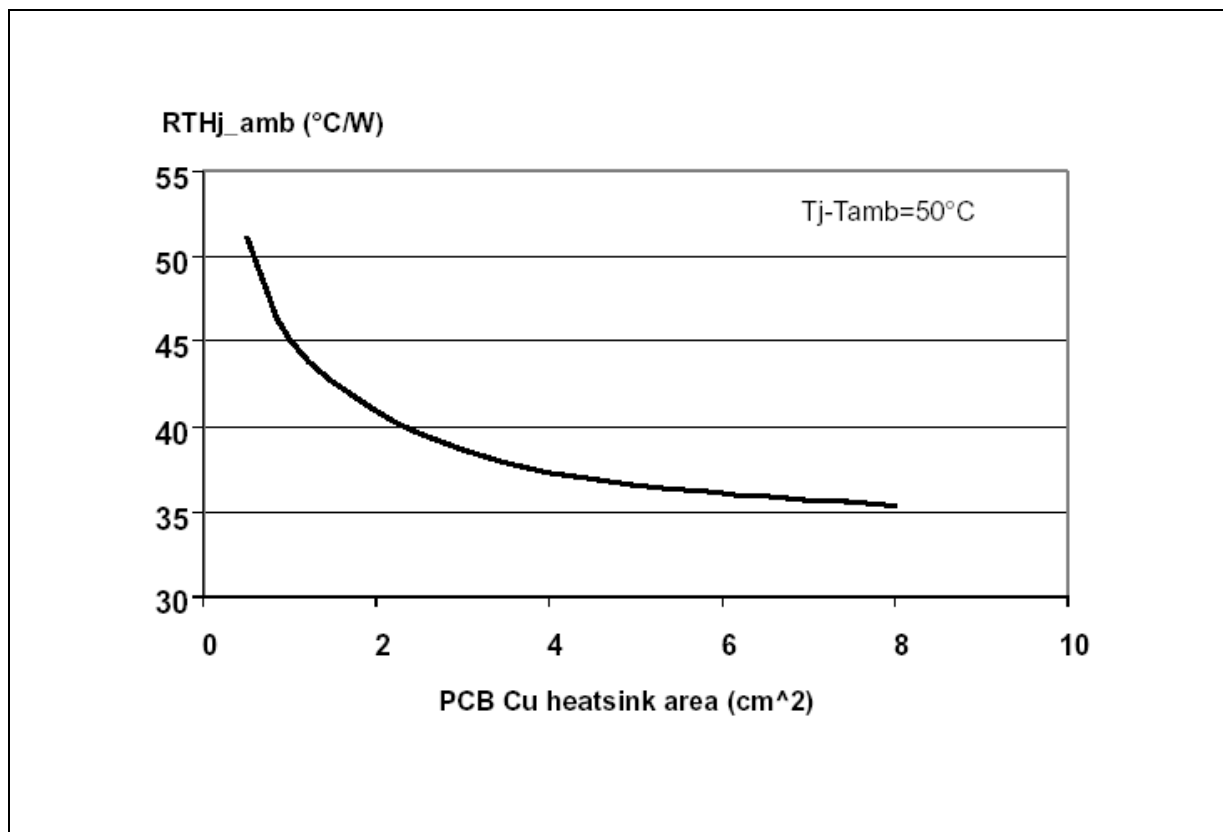


Figure 7. R_{thJA} Vs. PBC copper area in open box free air condition



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

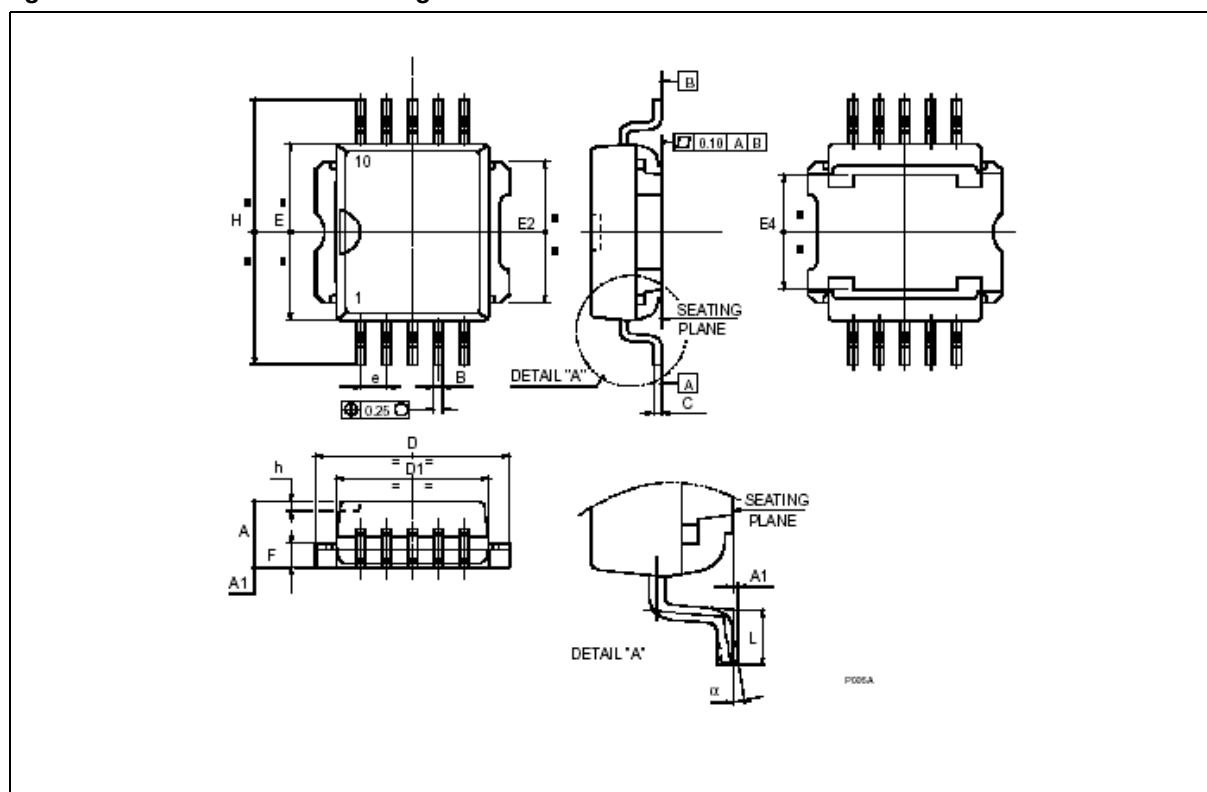


Figure 9. PowerSO-10™ Suggested Pad and Tube Shipment (No Suffix)

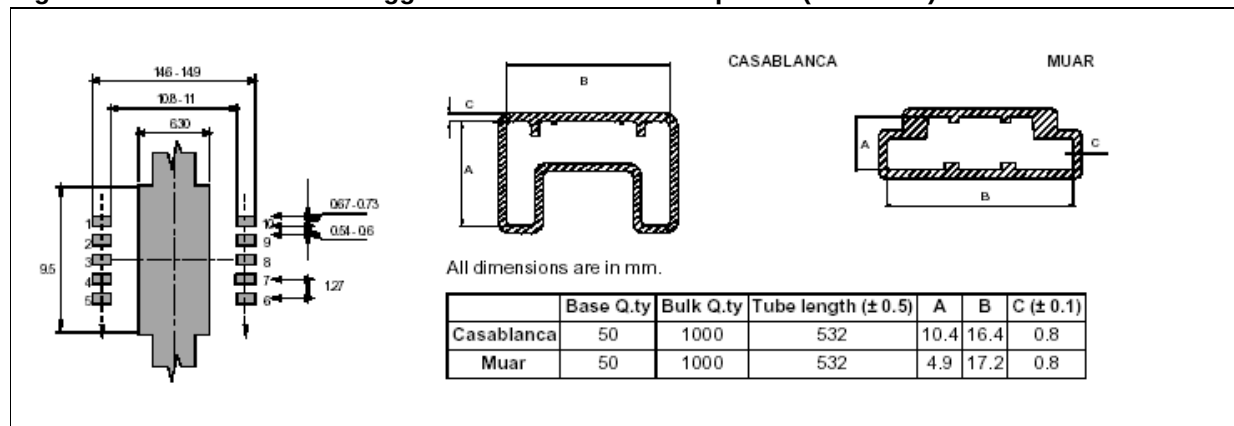


Figure 10. Tape and Reel Shipment (Suffix “TR”)

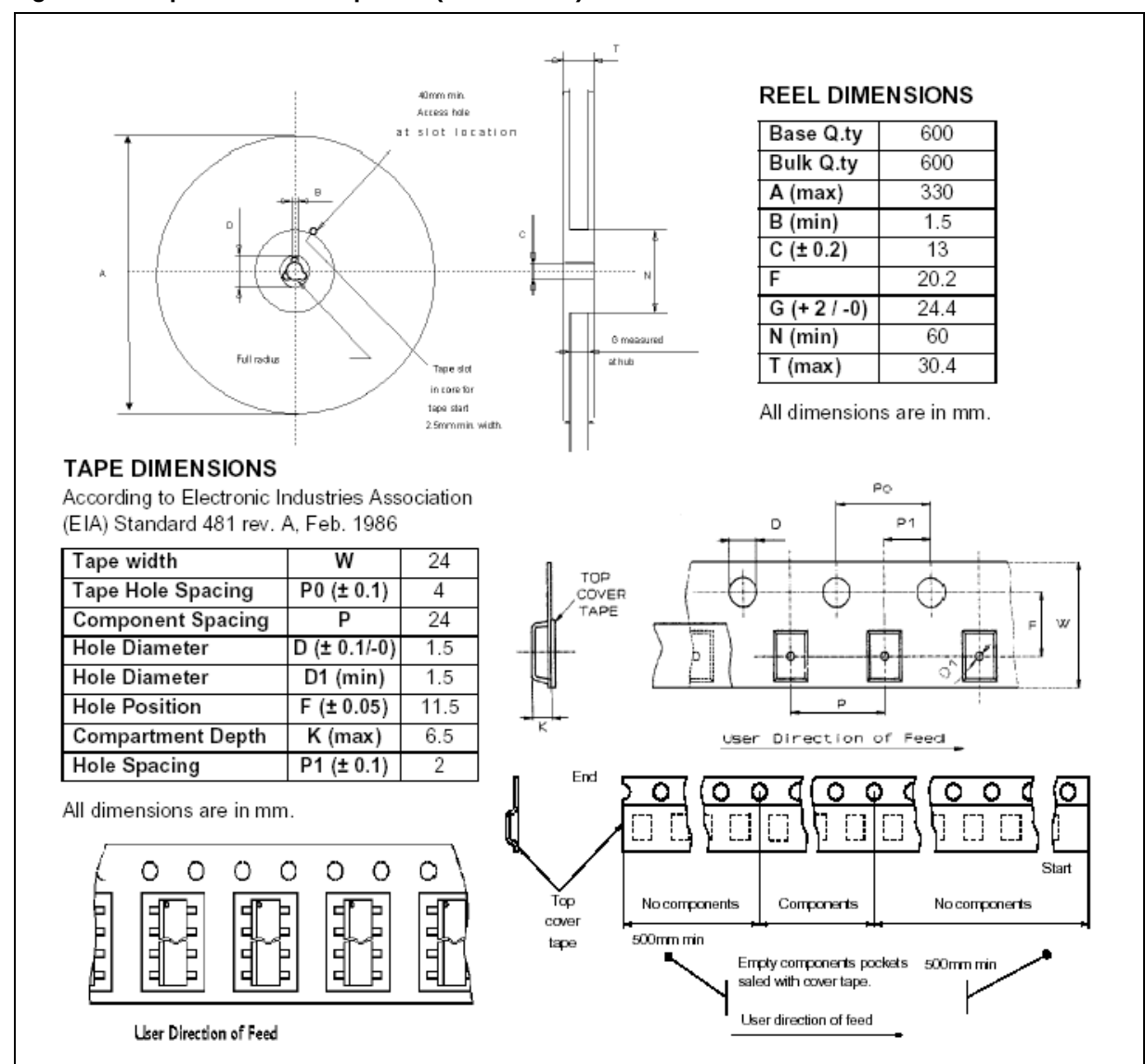


Table 11. SO-20 Mechanical Data

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.)					

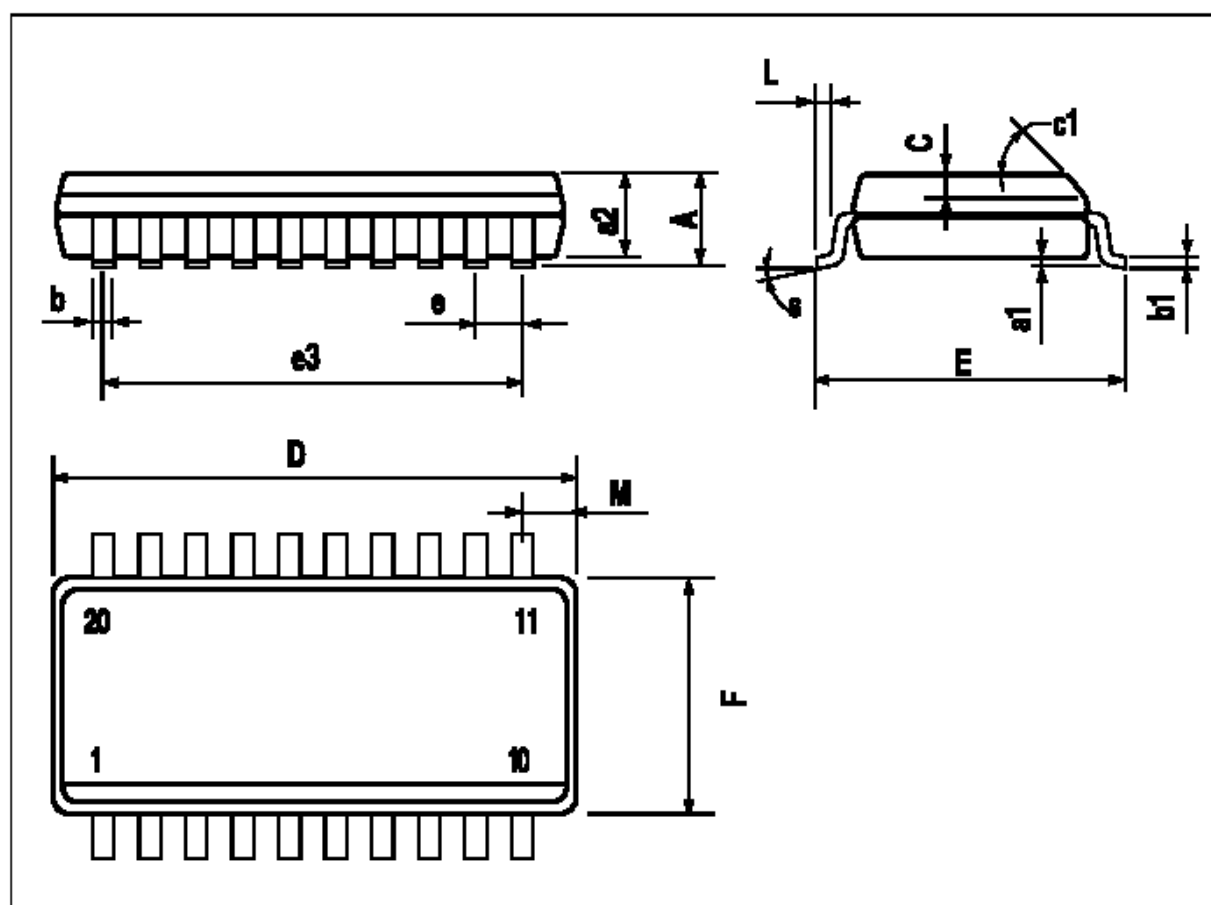


Figure 11. SO-20 Tube Shipment (no suffix)

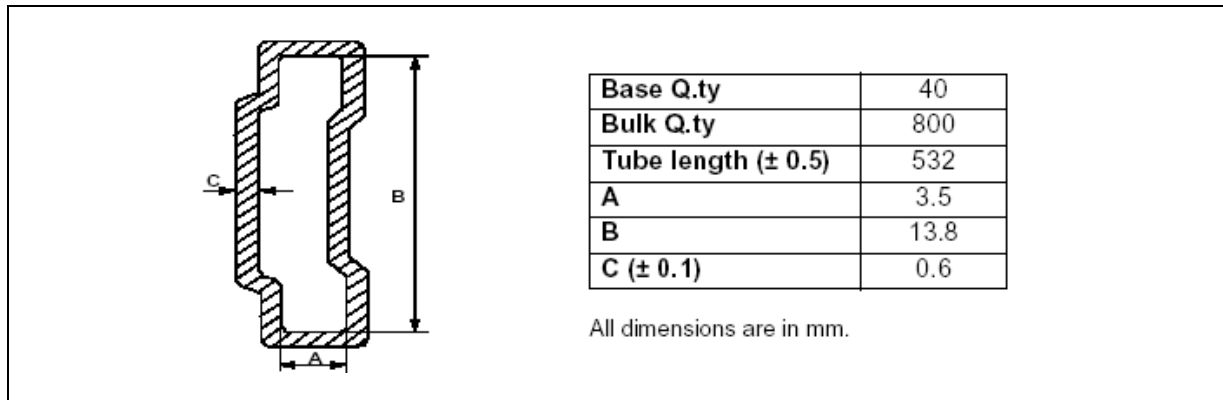


Figure 12. Tape and Reel Shipment (suffix "13TR")

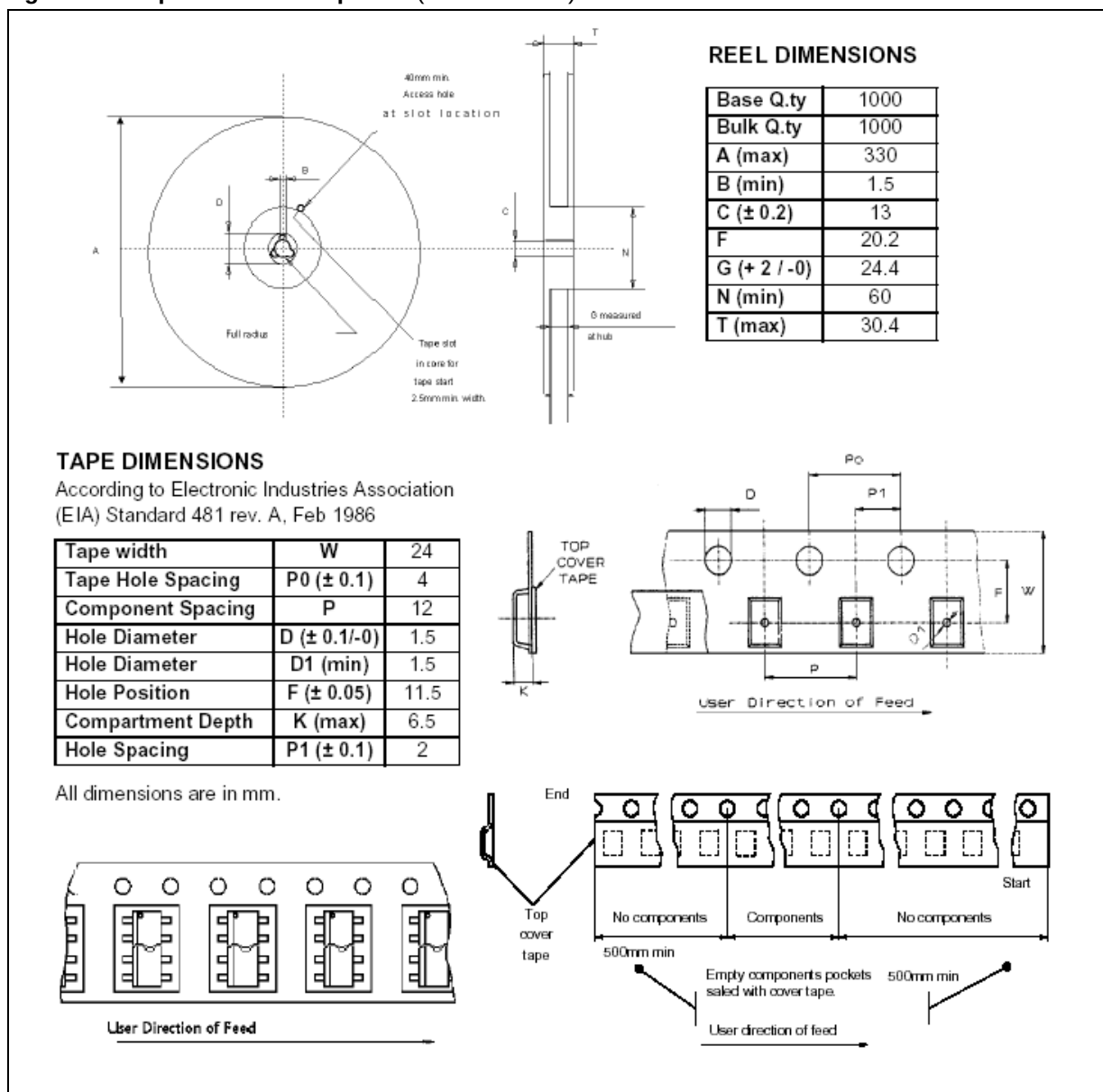


Table 12. Revision History

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

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