M735

SGS-THOMSON MICROELECTRONICS

297-276
297-282

AVS10

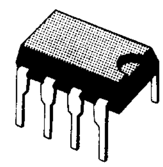
AUTOMATIC VOLTAGE SWITCH (SMPS < 300W)

CONTROLLER

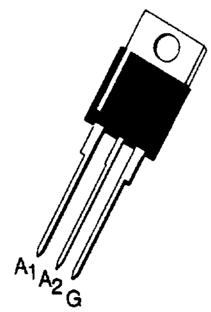
- 50/60Hz FULL COMPATIBILITY
- INTEGRATED VOLTAGE REGULATOR
- TRIGGERING PULSE TRAIN OF THE TRIAC
- PARASITIC FILTER
- LOW POWER CONSUMPTION

TRIAC

- HIGH EFFICIENCY AND SAFETY SWITCHING
- UNINSULATED PACKAGE : AVS10CB
- INSULATED PACKAGE 2500V(RMS) : AVS10CBI
- $V_{DRM} = \pm 600V$
- $I_{T(RMS)}$: 8A



P
DIP8
(Plastic)



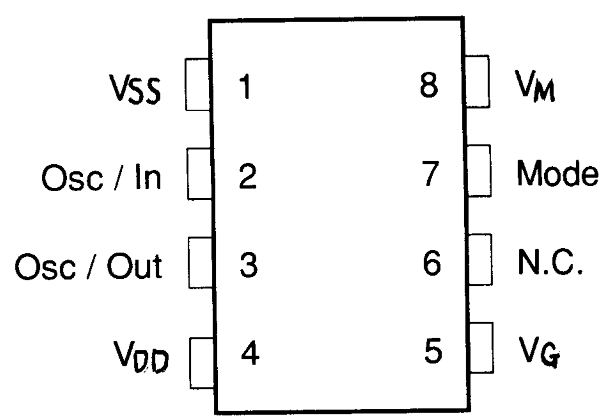
B
TO220AB
(Plastic)

DESCRIPTION

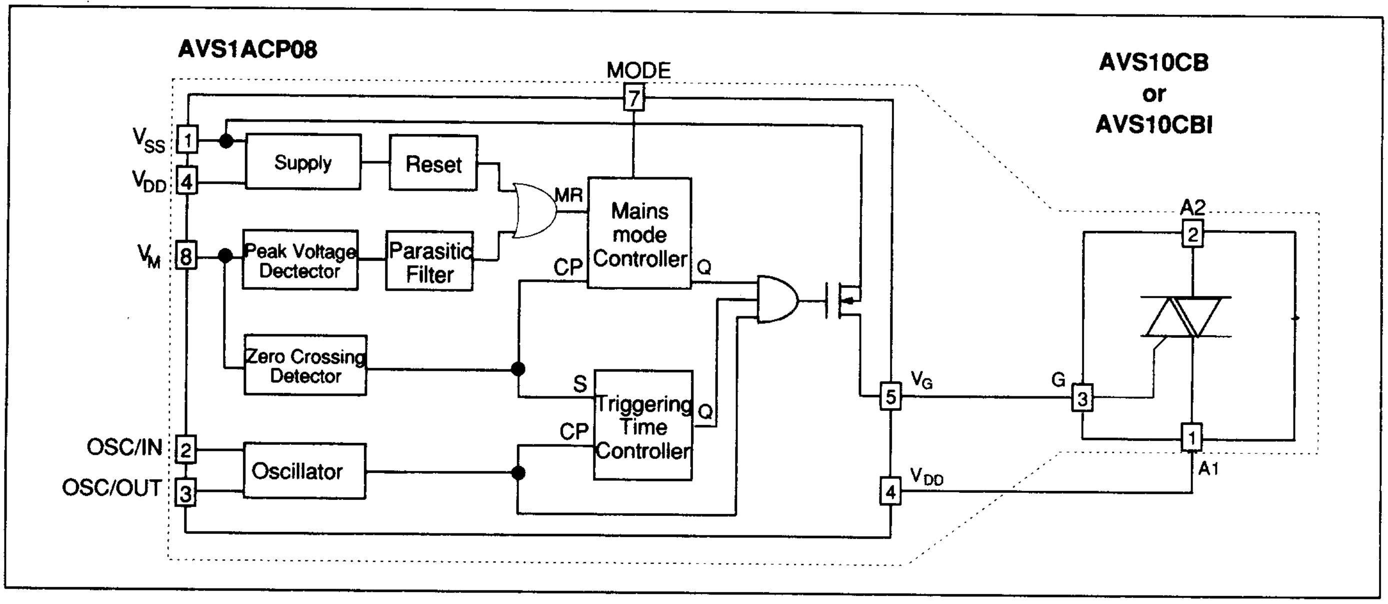
The AVS10 kit is an automatic mains selector (110/220V AC) to be used in SMPS < 300 W. It is composed of 2 devices :

- The **Controller** is optimized for low consumption and high security triggering of the triac. When connected to V_{SS}, the **mode** input activates an additional **option**. If the main power drops from 220V to 110V, the triac control remains locked to the 220V mode and avoids any high voltage spike when the voltage is restored to 220V.
  When connected to V_{DD}, the **mode** input desactivates this **option**.
- The TRIAC is specially designed for this application. An optimization between sensitivity and dynamic parameters of the triac gate highly reduces the losses of supply resistor and allows excellent immunity against disturbances.

PIN CONNECTION



BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

CONTROLLER AVS1ACP08

Symbol	Parameter	Value Min.	Value Max.	Unit
V_{SS}	Supply voltage	- 12	0.5	V
V_I / V_O	I / O voltage	V_{SS} - 0.5	0.5	V
I_I / I_O	I / O current	- 40	+ 40	mA
T_{stg}	Storage Temperature	- 60	+ 150	°C
T_{oper}	Operating Temperature code " C " " T "	0 - 40	+ 70 + 105	°C

TRIAC AVS10CB / AVS10CBI T_j = +25°C (unless otherwise specified)

Symbol	Parameter			Value	Unit
V_{DRM}	Repetitive peak off-state voltage (2)			± 600	V
$I_{T(RMS)}$	RMS on-state current (360° conduction angle)	AVS10CB	T_C = 80°C	8	A
		AVS10CBI	T_C = 70°C		
I_{TSM}	Non repetitive surge peak on-state current (T_j initial = 25°C)		t = 8.3ms t = 10ms	85 80	A
I^2t	I^2t value		t = 10ms	32	A^2s
dI/dt	Critical rate of rise of on-state current (1)		Repetitive F = 50Hz	20	A/µs
			Non Repetitive	100	
dv/dt *	Linear slope up to 0.67 V_{DRM} Gate open		T_j = 110°C	50	V/µs
T_{stg} T_j	Storage Temperature Operating Junction Temperature			- 40 + 150 0 + 110	°C

(1) Gate supply : IG = 100mA – di/dt = 1A/µs
(2) Tj = 110°C

* For either polarity of electrode A2 voltage with reference to electrode A1

THERMAL RESISTANCES

TRIAC AVS10CB / AVS10CBI

Symbol	Parameter		Value	Unit
Rth (j-a)	Junction-to-ambient		60	°C/W
Rth (j-c) DC	Junction-to-case for DC	AVS10CB	3.5	°C/W
		AVS10CBI	4.4	
Rth (j-c) AC	Junction-to-case for 360° conduction angle (F = 50Hz)	AVS10CB	2.6	°C/W
		AVS10CBI	3.3	

DC GENERAL ELECTRICAL CHARACTERISTICS

TRIAC AVS10CB / AVS10CBI

Symbol	Parameter		Value		Unit
			Min.	Max.	
V_{GD}	$V_D = V_{DRM}$ $R_L = 3.3k\Omega$ Pulse duration> 20µs	Tj = 110°C	0.2		V
V_{TM} *	$I_{TM} = 11A$ $t_p = 10ms$	Tj = 25°C		1.75	V
I_{DRM} *	V_{DRM} rated Gate open	Tj = 25°C		10	µA
		Tj = 110°C		500	

* For either polarity of electrode A2 voltage with reference to electrode A1.

Fig.1 :Maximum RMS power dissipation versus RMS on-state current (F = 60Hz).
(Curves are cut off by (dl/dt)c limitation)

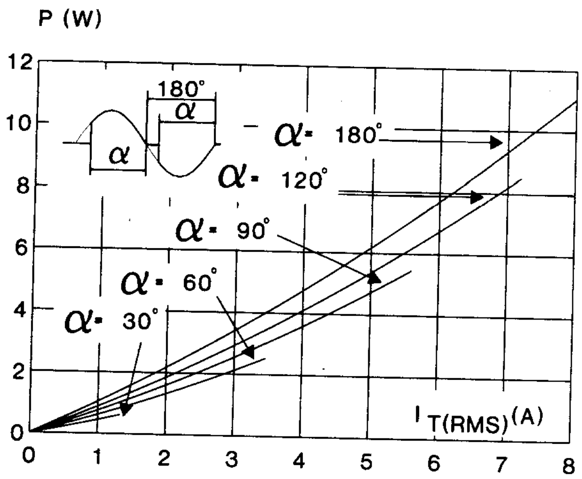


Fig. 2 :Correlation between maximum mean power dissipation and maximum allowable temperatures (Tamb and Tcase) for different thermal resistances heatsink + contact (AVS10CB).

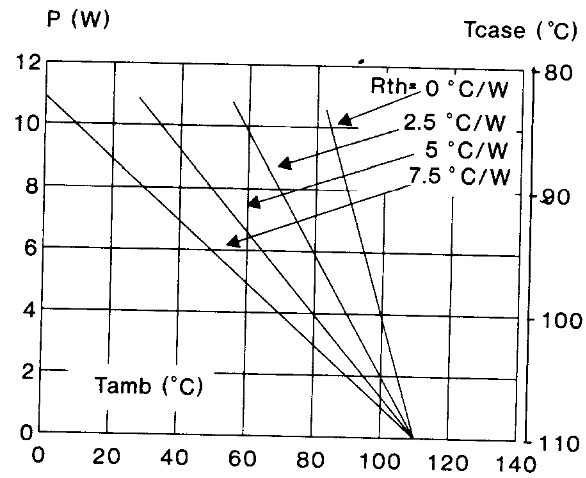


Fig. 3 :Correlation between maximum mean power dissipation and maximum allowable temperatures (Tamb and Tcase) for different thermal resistances heatsink + contact (AVS10CBI).

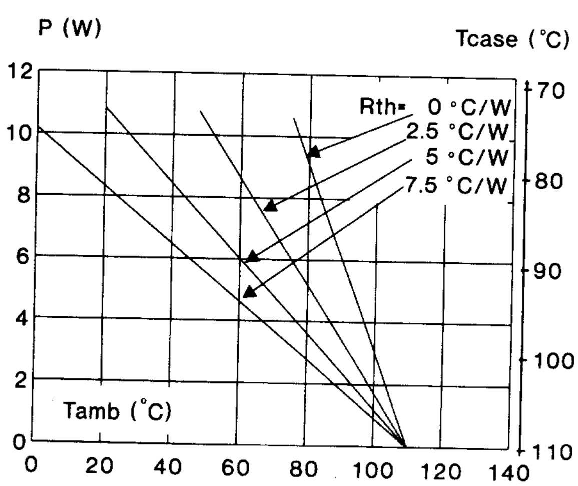


Fig. 4 :Non repetitive surge peak on-state current for a sinusoidal pulse with width : t ≤ 10ms, and corresponding value of I^2t.

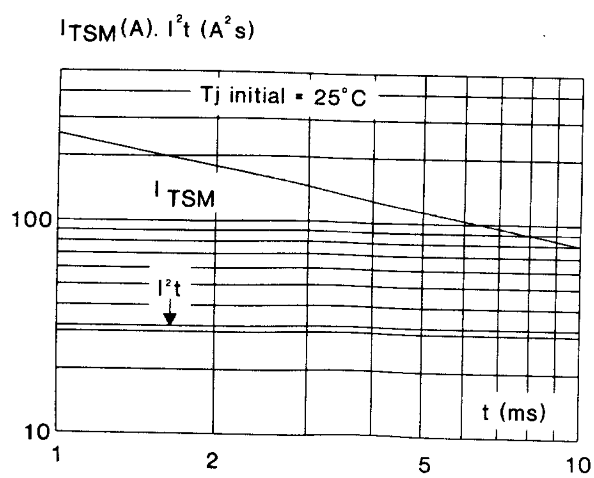
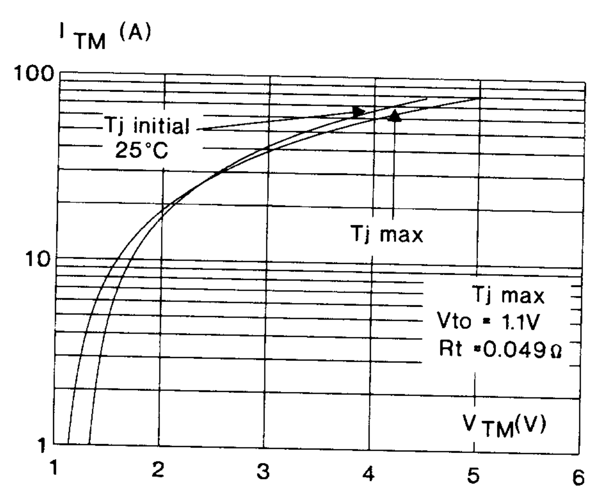


Fig. 5 :On-state characteristics (maximum values).



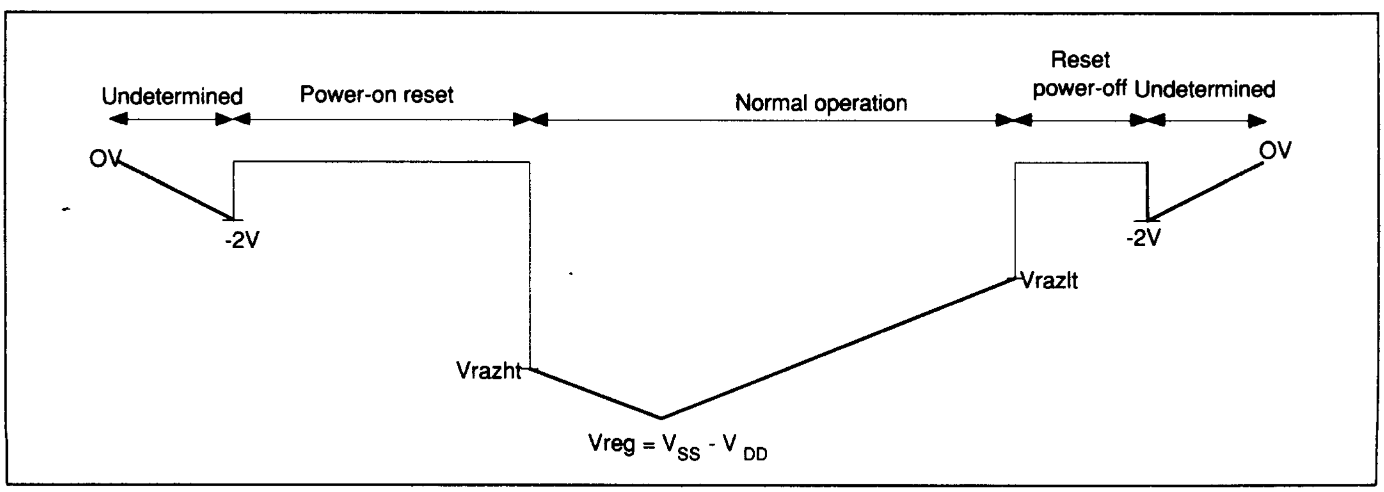
DC GENERAL ELECTRICAL CHARACTERISTICS (continued)

CONTROLLER AVS1ACP08 T_{oper} = 25°C (unless otherwise specified)

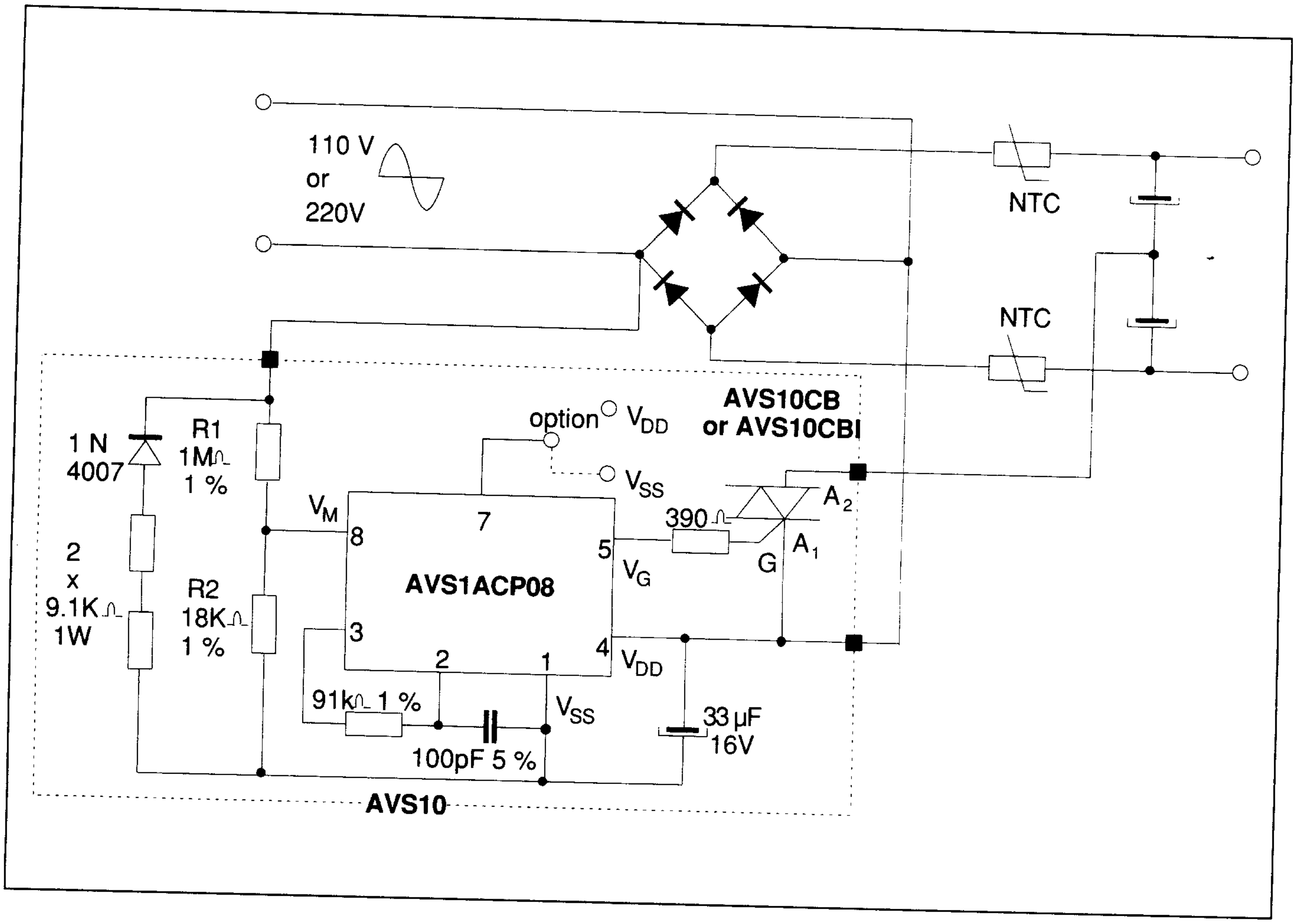
Symbol	Parameter	Value			Unit
		Min	Typ	Max	
V_{SS} (pin 1) (Vreg)	Shunt regulator	- 10	- 9	- 8	V
I_{SS} (pin 1) (Vreg) (@ V_{SS} = 9V)	Supply current	0.4		30	mA
I_{SS} (pin 1) (@ triac gate non connected)	Quiescent current			0.7	mA
f (pin 3) (@ R = 91kΩ) (C = 100pF)	Oscillator frequency	42	44	46	kHz
V_M (pin 8) Vth (3)	Peak voltage of detection high-threshold	4.08	4.25	4.42	V
V_M (pin 8) Vh (3)	Peak voltage of detection hysteresis	0.370	0.4	0.420	V
(1) V_M (pin 8) Vth (3)	Zero-crossing detection high-threshold	95	110	125	mV
V_M (pin 8) Vh (3)	Zero-crossing detection hysteresis	20	30	40	mV
(2) Vrazht (4)	Power-on-reset activation threshold		Vreg x 0.89		
(2) Vrazlt (4)	Power-down-reset activation threshold		Vreg x 0.55		
Mode (pin 7)	V_{IL} (4) V_{IH} (4)	 0.7 Vreg		0.3 Vreg 	
V_G (pin 5)	V_{OL} (I_{VG} = 25mA) Leakage current (V_G = V_{DD})			650 + 10	mV µA

NOTES :
(1) : This value gives a typical noise immunity on the zero-crossing detectionof 110mV x 1018/18 = 6.20V on the main supply
(2) : See following diagram
(3) : Voltage referred to VSS
(4) : Voltage referred to VDD

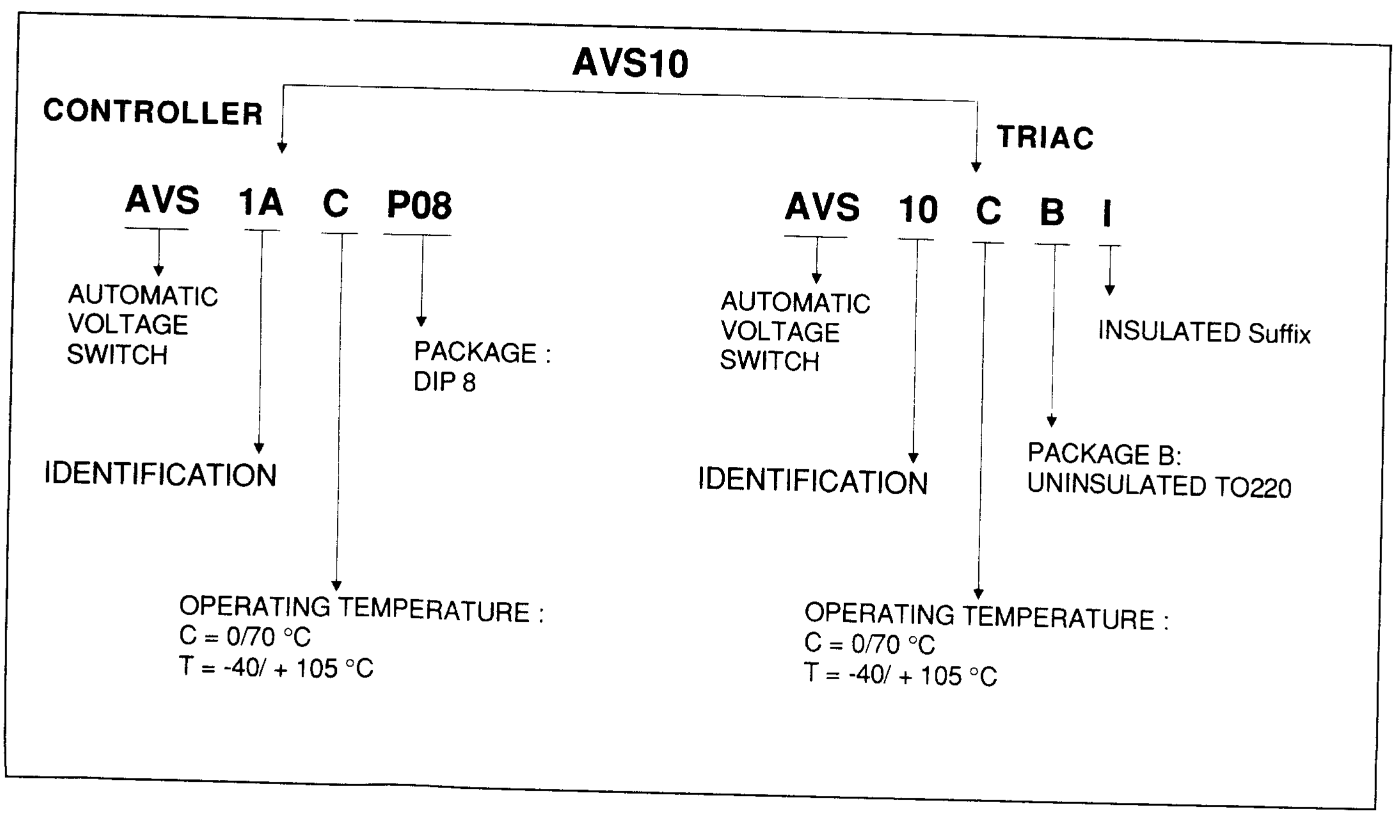
POWER-ON AND POWER-OFF RESET BEHAVIOUR



TYPICAL APPLICATION



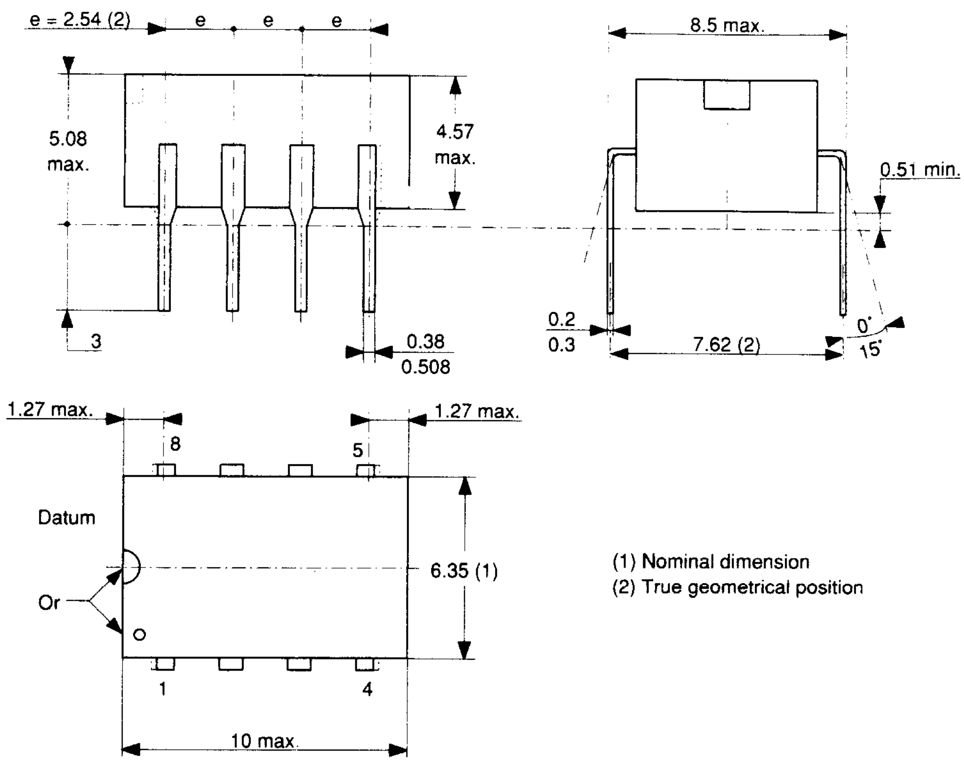
ORDERING INFORMATION



PACKAGE MECHANICAL DATA

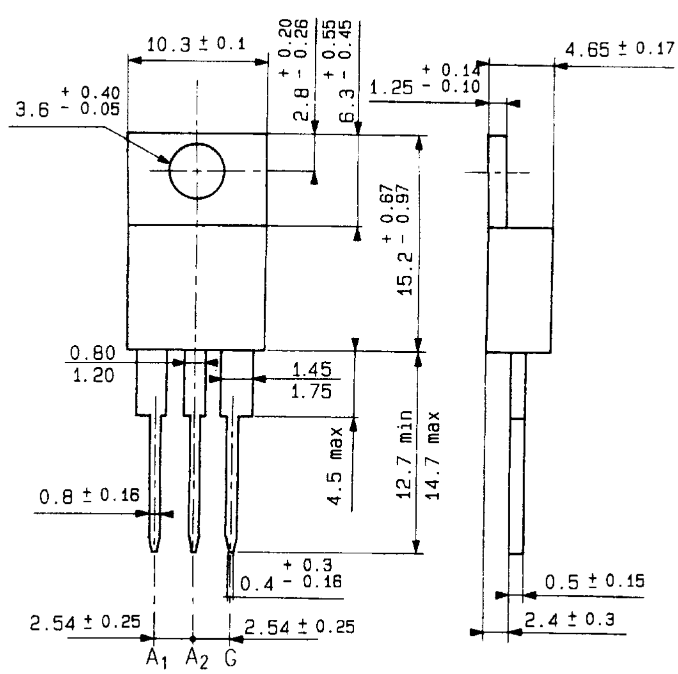
8 PINS - PLASTIC DIP

CONTROLLER



TO220AB (Plastic) (in millimeters)

TRIAC



Cooling method : by conduction (method C)
Marking : Type number
Weight : 2 g
Polarity : N A
Stud torque : N A

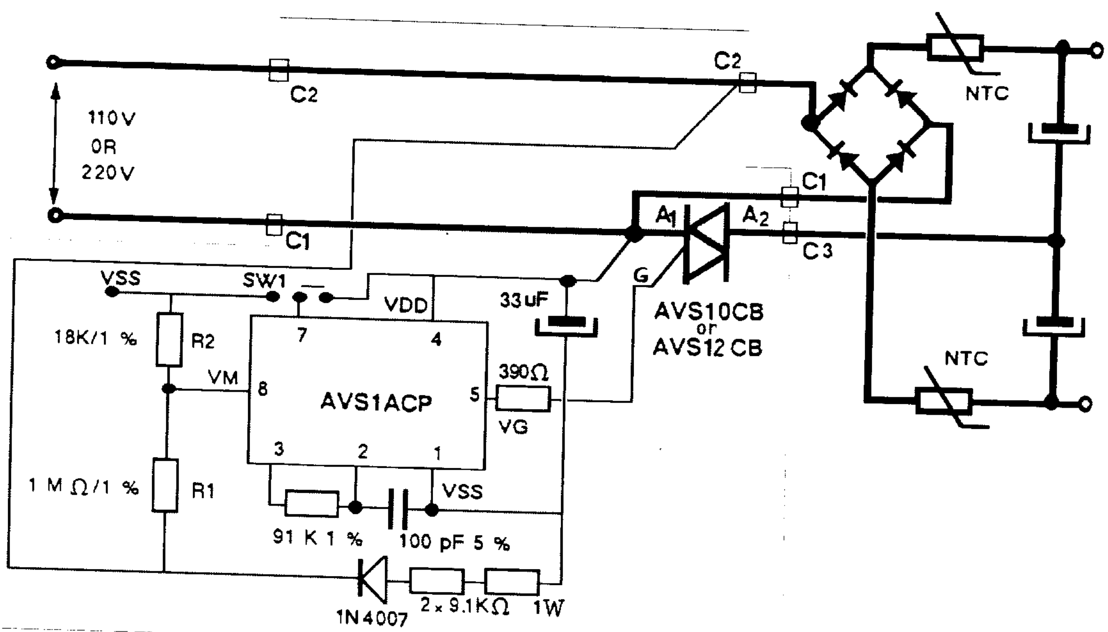
HOW TO USE THE AVS KIT

PRELIMINARY NOTE

I DESCRIPTION OF THE AVS KIT :

The AVS10, or AVS12, is an automatic mains selector to be used in on line SMP supply with Power up to 500W. It is made of two devices.

This switch modifies automatically the structure of the input diodes bridge in order to keep a same DC voltage range.



The AVS is compatible with 50 and 60 Hz mains frequency and operates on two mains voltage ranges :

- On range I (110 V_{RMS}) the AC voltage varies from 88 to 132 V and the triac is ON : the bridge operates as voltage doubling circuit.
- On range II (220 V_{RMS}) the AC voltage varies from 176 V to 276 V and the triac is OFF : the circuit operates as full wave bridge.

II PERFORMANCE OF THE AVS :

The control of the switch is made by the comparison of the mains voltage (VM on pin 8) with internal threshold voltages (VTH and VH on pin 8).

When mains voltage increases from range I to range II the triac conduction is completly stopped before one mains period because VM > VTH.

When mains voltage drops from range II to range I VM becomes lower than VTH - VH. There are two options (V mode on pin 7) :

- V mode = VDD ; the triac triggering is valided 8 mains periods after power on reset.
- V mode = VSS ; the triac control remains locked to range II until circuit reset.

III USE OF THE AVS :

Calculation of the oscillator :

The oscillator frequency is determined by the mains frequency (50 and 60 Hz) and the gate control : its required value must be 45 KHz ± 5%; so the value of components is :

C = 100 pF/5%

R = 91 KOhms/1%

The frequency control is made on pin 3.

Adjustement of the mains mode change :

The measure of the mains voltage is made by a detection of the peak value.
The change of mains range is made by adjustement of resistor bridge and we advice :

800 kOhms < R1 + R2 < 2 mOhms

Calculation of the change from range I to range II (on pin 8) :

$[VTH \cdot (R1 + R2)]/(R2 \cdot \sqrt{2}) + Vreg / \sqrt{2} =$ max.RMS voltage on Range I

Vreg typ = - 9 V and VTH typ = 4.25 V

Calculation of the change from Range II to range I :

$[(VTH - VH) \cdot (R1 + R2)/R2 \cdot \sqrt{2}] + Vreg / \sqrt{2} =$ min . RMS voltage on range II

Vreg typ = - 9 V and VH typ = 0.4 V

Performance of the power on reset :

The power on reset permits the charge of the bulk capacitors of the SMP supply through soft start circuit.
The triac triggering is valided (on range I) after the validation of power on reset (charge of supply capacitor C) and a temporization of 8 mains periods.

T delay = delay time between power on and triac triggering

$$Td = 0{,}89 \cdot Vreg \cdot R \cdot C/[(V_{RMS} \cdot \sqrt{2}/\pi) - R \cdot Iss] + 8/f$$

f = mains frequency

R = supply resistor = 18 kOhms

C = supply capacitor = 33 µF

V_{RMS} = mains voltage

Iss = quiescent supply current of AVS

Supply of the controller :

The structure of the supply regulator is a shunt regulator and its current must be lower than Iss max = 30 mA.

In order to have a good behavior of the circuit against mains voltage spikes the pin 4 (VDD) of the integrated circuit has to be connected straightly with the A1 of the triac. In same way the supply diode rectifier and R1 have to be connected to the diode bridge (see typical application diagram).

Triac control :

Between pin 5 and triac gate there is a resistor in order to limit the gate current; its value is given by the controller supply and triac ; the required value is 390 Ohms (5%).

Thermal rating of triac :

The knowlegde of the maximum triac current I_{TM} and the current pulse width tp in worst case conditions allows to calculate the losses, PT dissipated by the triac :

$$I_{TRM} = R_{MS} \text{ triac current} = I_{TM} \times \sqrt{tp} \times \sqrt{f}$$

$$PT = 4 \cdot tp \cdot f \cdot I_{TM} \cdot V_{TO}/\pi + rt \cdot tp \cdot f \cdot (I_{TM}^2)$$

for AVS10CB :

V_{TO} = threshold voltage of triac = 1.1 V

rt = on state triac resistance = 49 mohms

for AVS12CB:

VTO = 1V

rt = 45 mOhms

The figure 1 of DC general characteristics of triac gives these losses PT versus I_{TRMS} for this application. The figure 2 allows to calculate the external heatsink R_{TH} versus PT and Tamb when Tj = 110C

$$Tj - Tc = R_{TH}\, j\text{-}c\ AC \cdot PT$$

$$Tc - Tamb = R_{TH} \cdot PT$$

Example on AVS10 :

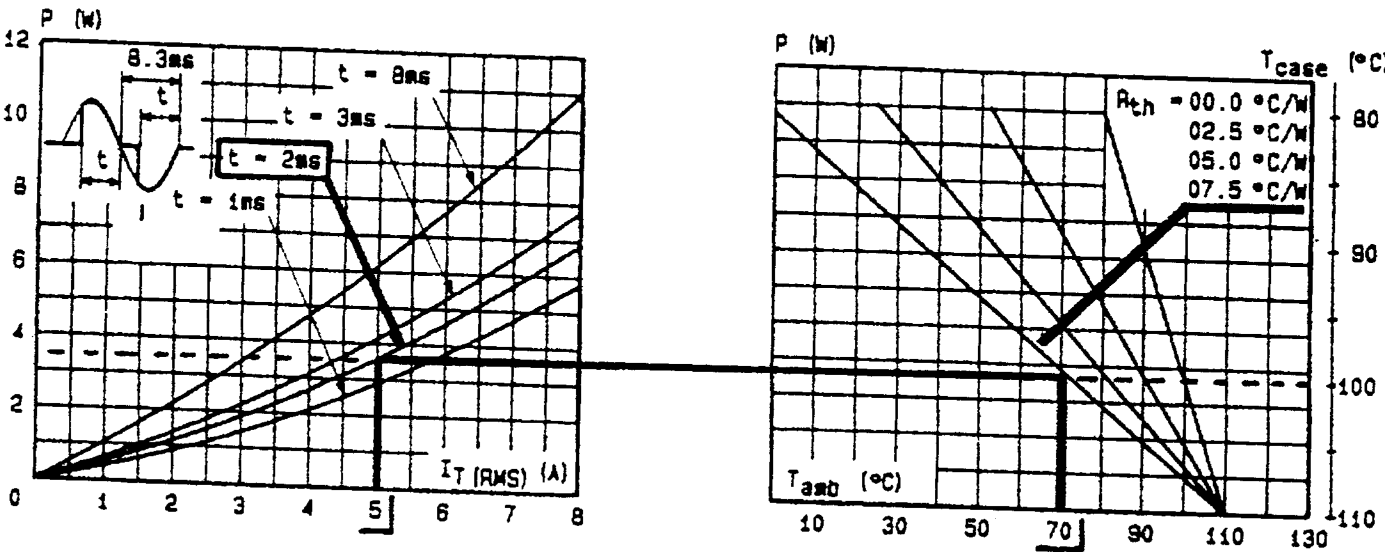


Figure 1 and Figure 2 of AVS10 Datasheet

if tp = 2ms and I_{TRMS} = 5A

- PT = 3.8W

- Tc = 100°C if Tj = 110°C

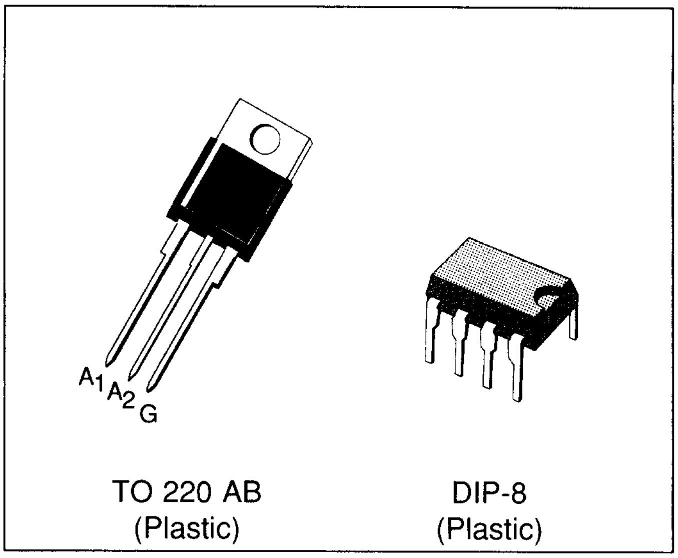
- R_{TH} = 7.5 °C/W if Tj = 110°C and Tamb < 70°C

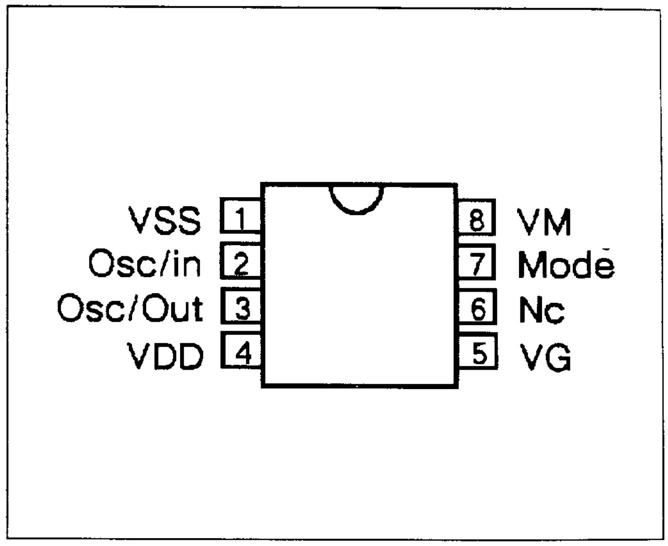
Annex : AVS demo board

COMPONENT LIST FOR AVS10.

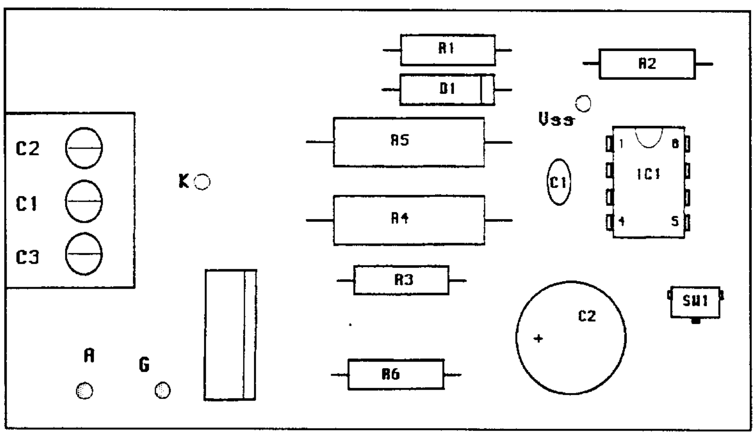
DESIGNATION	QTE	REFERENCE	OBSERVATIONS	MARQUE
PRINTED CIRCUIT	1	4751		
RESISTANCE	1	R1	1 MOhms 1%	
RESISTANCE	1	R2	18 KOhms 1%	
RESISTANCE	1	R3	91 KOhms 1%	
RESISTANCE	2	R4	9.1 KOhms 1W	
RESISTANCE	1	R6	390 Ohms 5%	
DIODE	1	D1	1N4007	
CONDENSATOR	1	C1	100 pF 5%	
CONDENSATOR	1	C2	33µF 16V RADIAL	
TRIAC	1	IC2	AVS10CB / AVS12CB	SGS-THOMSON
INTEGRATED CIRCUIT	1	IC1	AVS1ACP08	SGS-THOMSON
SUPPORT	1		CI 8 PINS	
INVERTER	1	SW1	MINIDIP	
SOCKET	1	SL 3W	3 PINS	WEIDMULLER
PLUG	1	BL3	3 PINS	WEIDMULLER

Products PIN out





Components layout



Printed circuit layout (Copper side) : 1/1 scale