STIL02-P5

A.S.D.™
Application Specific Discretes

AC inrush current limiter

MAIN APPLICATIONS

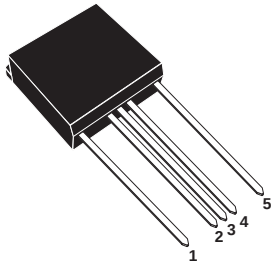
- HIGH POWER DENSITY ADAPTER
- HIGH END TV POWER SUPPLY
- OPENED FRAME SMPS

FEATURES

- Inrush current limitation circuit for off-line power supply
- Dual non-sensitive unidirectional switches in a single package
- Suitable when space and efficiency are critical
- Active after short AC line drop out with a boost converter
- High repetitive forward and reverse off-state voltage (700V)

BENEFITS

- Low consumption (Ipt= 20mA)
- High noise immunity:
  (dV/dt> 500V/µs @ Tj=150°C)
- Low reverse current losses
- Integrated pilot driver of the power switches
- Monolithic ASD™ planar technology for better robustness and reliability



PENTAWATT HV2
(in line)

PIN OUT DESCRIPTION

Pin out designation	Description	Position
L	AC Line (switch1)	1
Pt1	Pilot of power switch 1	2
OUT	Output (connected to Tab)	3
Pt2	Pilot of power switch 2	4
N	AC Neutral (switch 2)	5

Fig. A1: Bloc Diagram.

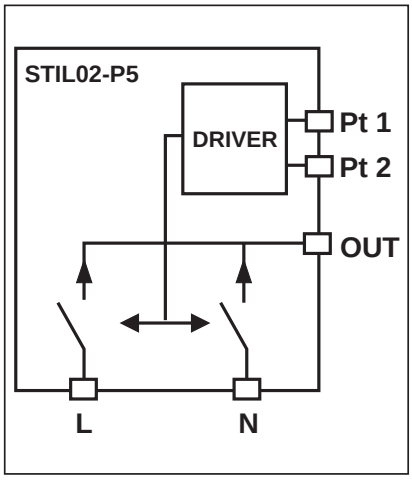
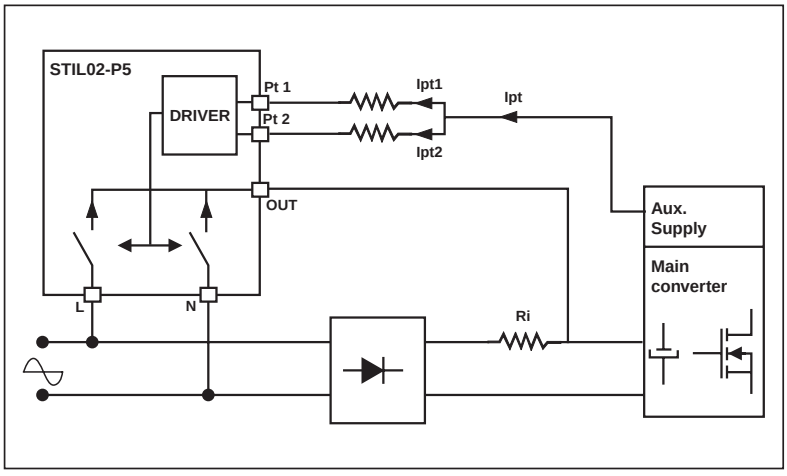


Fig. A2: Basic connection.



Functional Description

The **STIL02** is connected in parallel with the bridge diode and the inrush power resistor Ri (fig. A2). During start up, the two unidirectional **ASD™** power switches of the STIL02 are opened. The inrush current flows through the diodes of the bridge and the external inrush power resistor Ri. Since the main converter turns ON, the auxiliary power supply coupled with the main transformer, supplies the energy required to close the two power switches of the STIL02. At the normal state, the two bottom diodes of the bridge rectifier and the two unidirectional switches of the STIL02 rectify the AC line current.

When the STIL02 is used with a PFC boost converter, the inrush current circuit remains active after a short AC line dropout (see fig. A5). In that configuration, since the AC line disappears, the PFC controller and the auxiliary power supply of the STIL turns OFF. The two switches of the STIL are opened. The output bulk capacitor Cb is discharging and it is providing the energy to the main converter. When the AC line recovers, the two switches remain opened and recharging inrush current of the capacitor Cb is deviated and limited through the resistor Ri. When the capacitor is charged, the PFC turns ON again and the two switches of the STIL switch ON.

More details on the design and operation of the driver circuit of figure A5 can be found in the application note "**AN1600 - STIL: Inrush Current Limitation Device for Off-Line Power Converter**".

ABSOLUTE MAXIMUM RATINGS (Limiting value)

Symbol	Parameter		Value	Unit
V_{Dout} V_{Rout}	Repetitive forward (V_{Dout}) and reverse (V_{Rout}) off-state voltage	$T_{j\ (min)}$ to $T_{j\ (max)}$	700	V
$I_{out(AV)}$	Average on state current at the OUT terminal (180° conduction angle for the internal power switches)	Tj = 150°C	2	A
$I_{out(RMS)}$	RMS on state current at the OUT terminal (180° conduction angle for the internal power switches)	Tj = 150°C	2.2	A
I_{TSM}	Non repetitive surge peak on-state current (Tj initial = 25°C)	tp = 10ms sinusoidal	65	A
I^2t	I^2t value - rating for fusing	tp = 10ms	21	A^2s
dI_{out}/dt	Critical rate of rise of on state current Ipt1 + Ipt2 = 20mA	Tj = 25°C Tj = 150°C	100 -	A/µs
Tstg	Storage temperature range		-40 to +150	°C
T_j	Junction temperature range		0 to +150	°C

THERMAL PARAMETERS

Symbol	Parameter	Value	Unit
$Rth_{(j-c)}$	Junction to case	2	°C/W
$Rth_{(j-a)}$	Junction to ambient (minimum footprint)	60	

ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test conditions		Min.	Typ.	Max.	Unit
Ipt1 + Ipt2	Driver trigger current	V_{Dout} = 12V (DC) R_L = 30Ω tp = 380µs	Tj = 0°C		12	20	mA
			Tj = 25°C		10		
V_D(pt1) V_D(pt2)	Direct pilot trigger voltage	V_{Dout} = 12V (DC) R_L = 30Ω	Tj = 0°C	0.6	0.85	1	V
			Tj = 25°C		0.8	0.95	
			Tj = 150°C	0.2	0.45		
V_R(pt1) V_R(pt2)	Peak reverse driver voltage		Tj = 25°C	8			V
dV_{Dout}/dt	Dynamic voltage rising	Linear slope up to V_{Dout} = 470V	Tj = 150°C	500			V/µs
I_{Rout}(off)	Max reverse current without driver current	V_{Rout} = 700V Ipt1 = Ipt2 = open	Tj = 25°C			5	µA
			Tj = 150°C			300	µA
I_{Rout}(on)	Max reverse current with driver current	V_{Rout} = 400V Ipt1 = Ipt2 = 10mA	Tj = 150°C			300	µA
Vt0	Threshold direct voltage for one power switch	$I_{out(AV)}$ = 2A	Tj = 150°C		0.7	0.8	V
Rd	Dynamic direct resistance for one power switch	$I_{out(AV)}$ = 2A	Tj = 150°C		70	100	mΩ
V_F	Maximum instantaneous direct forward voltage drop for one power switch	$I_{out(AV)}$ = 2A	Tj = 150°C		0.9	1.1	V

Power losses calculations

When the input current is sinusoidal, the conducted power losses can be calculated by using the following formula:

$$P = V_{T0} \cdot I_{out(av)} + R_d \frac{(I_{out(av)} \times \pi)^2}{8}$$

If the output average current is 2Amps, V_{T0} and Rd of the electrical characteristics table can be used. For different output current please refer to the application note **AN1600** that provides guidelines to estimate the correct values of V_{T0} and Rd.

LIGHTNING SURGE IMMUNITY (IEC61000-4-5)

During lightning surge transient voltage across the AC line, over current and over voltage stress are applied on all the components of the power supply. The STIL02 can sustain a maximum peak surge current of **500A as defined by the combine waveform generator (8/20µs waveform as shown in fig. A3 and A4)**.

Special recommendations for the lightning surge immunity:

1 - Check that the **maximum peak surge current** in the STIL stays below the limit specified above.

2 - Check that **no over voltages are applied** on the STIL and the bridge diode.

3 - In order to reduce the dynamic current stress (dI_{out}/dt) through the structure of the STIL02, it is recommended to connect a differential mode choke coil in front of the STIL and the bridge diode.

More details and design guidelines are provided in the application note **"AN1600 - STIL: Inrush Current Limitation Device for Off-Line Power Converter"**.

Fig. A3: Surge test condition.

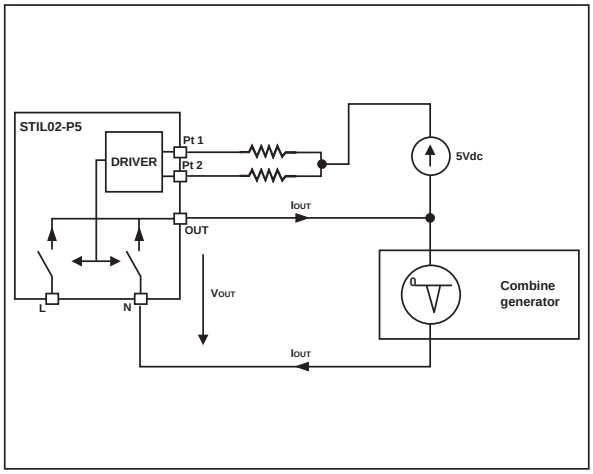


Fig. A4: Surge current waveform.

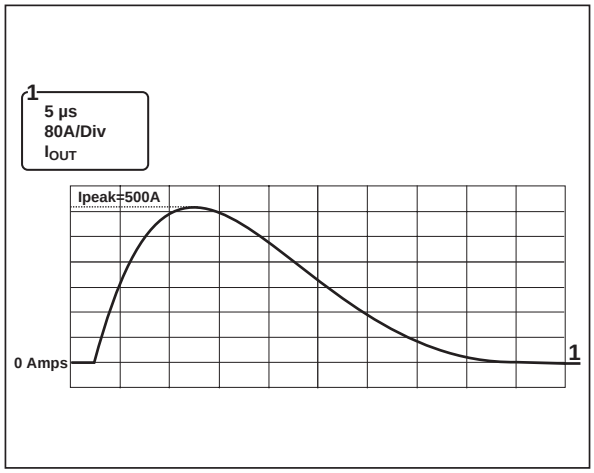


Fig. A5: Basic connection with a PFC Boost preregulator.

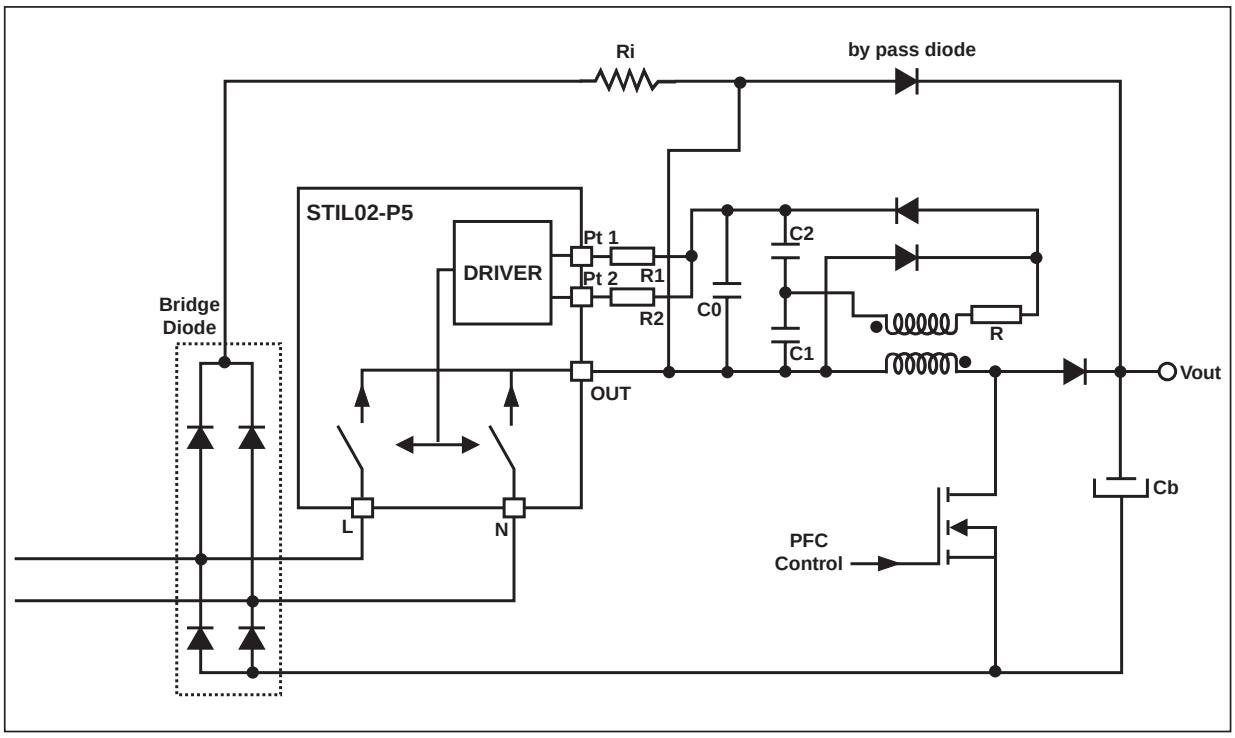


Fig. 1-1: Non repetitive surge peak on-state current (sinusoidal pulse) and corresponding value of I^2t.

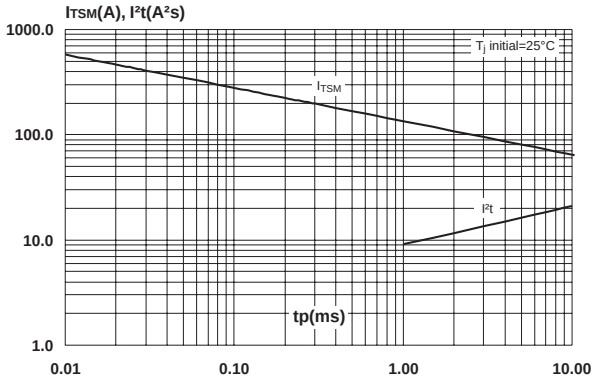


Fig. 1-2: Non repetitive surge peak on-state current (sinusoidal pulse) and corresponding value of I^2t.

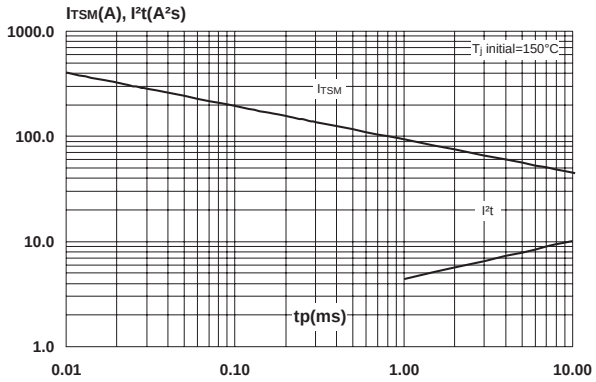


Fig. 2: Relative variation of driver trigger current versus junction temperature (typical values).

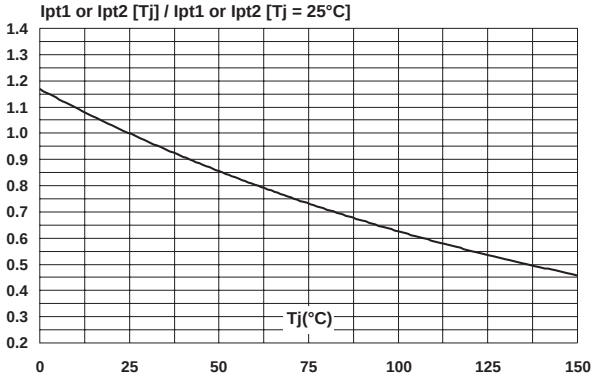


Fig. 3: Relative variation of direct pilot voltage versus junction temperature (typical values).

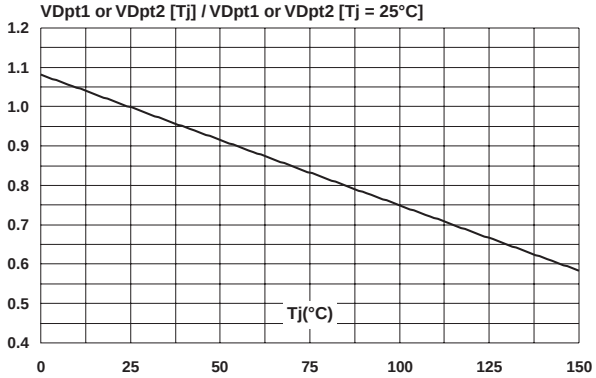


Fig. 4: Relative variation of thermal impedance junction to case versus pulse duration.

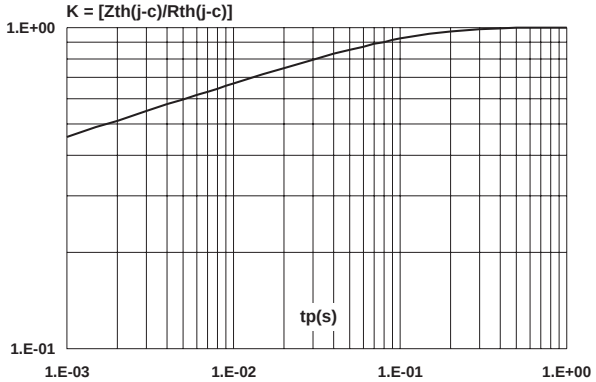


Fig. 5-1: Reverse current versus junction temperature without driver current (typical values).

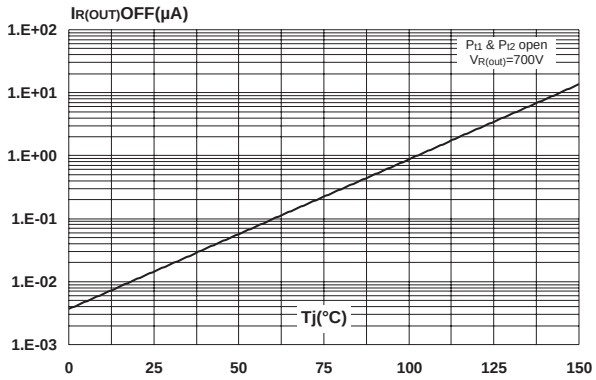


Fig. 5-2: Reverse current versus junction temperature with driver current (typical values).

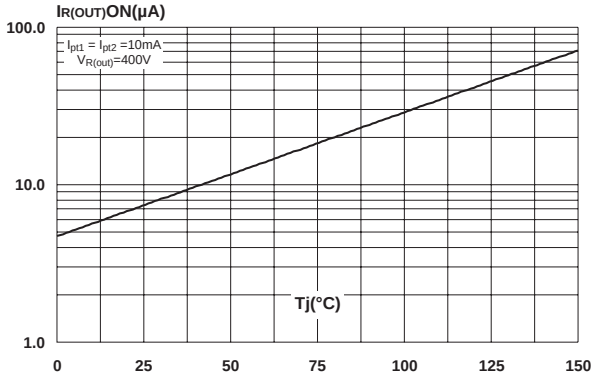


Fig. 6: Forward voltage drop for one power switch versus junction temperature at the peak forward current(typical values).

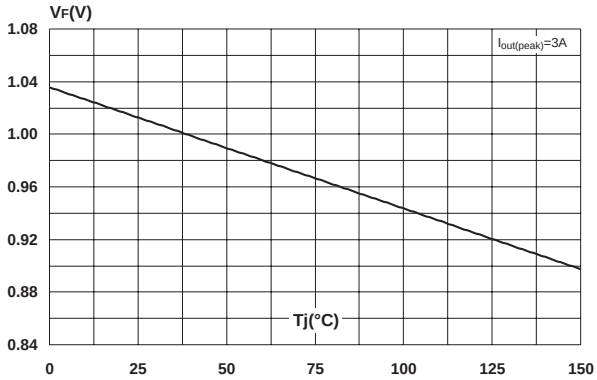


Fig. 7-1: Peak forward voltage drop versus peak forward output current for one power switch at Tj=25°C (typical and maximal values).

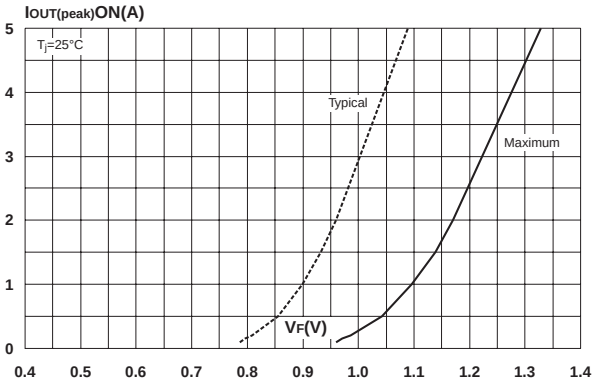


Fig. 7-2: Peak forward voltage drop versus peak forward output current for one power switch at Tj=150°C (typical and maximum values).

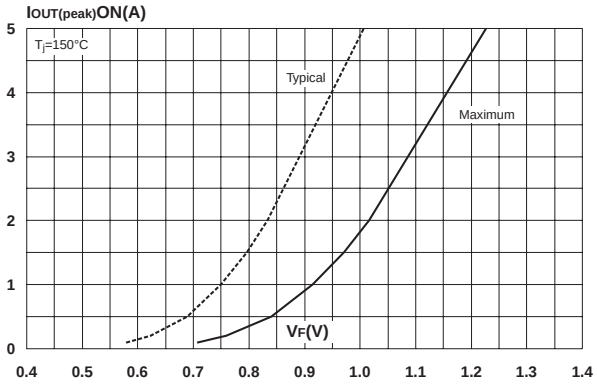
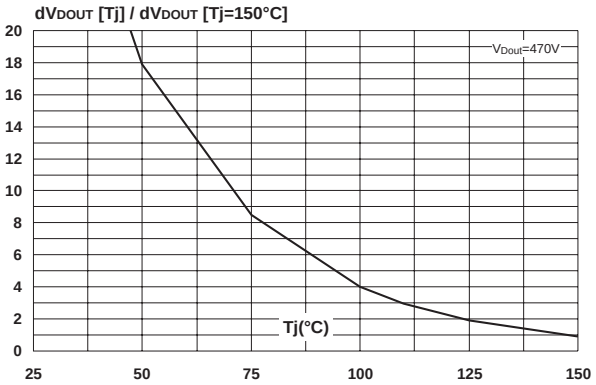
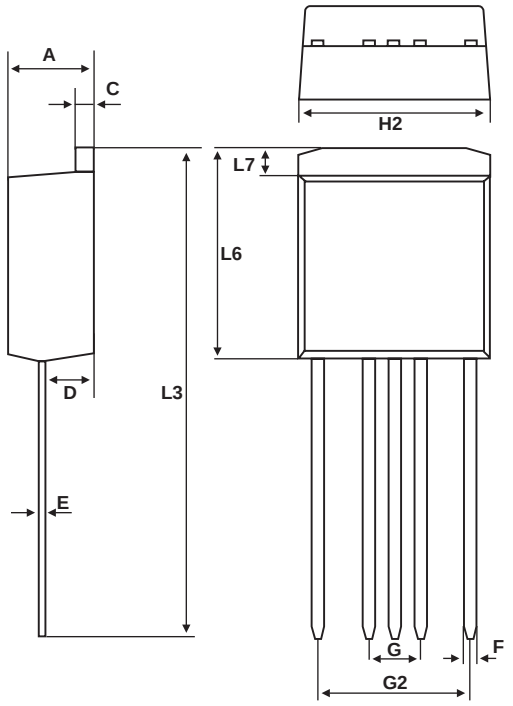


Fig. 8: Relative variation of dV/dt immunity versus junction temperature (typical values).



PACKAGE MECHANICAL DATA

PENTAWATT HV2 (in line)



REF.	DIMENSIONS			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.19	4.70	0.165	0.185
C	1.14	1.40	0.044	0.055
D	2.5	2.72	0.098	0.107
E	0.38	0.51	0.015	0.020
F	0.66	0.82	0.026	0.032
G	2.54 Typ.		0.10 Typ.	
G2	7.62 Typ.		0.30 Typ.	
H2	10.04	10.29	0.395	0.405
L3	23.5 Typ.		0.925 Typ.	
L6	9.90	10.16	0.389	0.400
L7	1.52 Typ.		0.059 Typ.	

Order code	Marking	Package	Weight	Delivery mode	Base qty
STIL02-P5	STIL02	PENTAWATT HV2 (in line)	1.9 g.	Tube	50