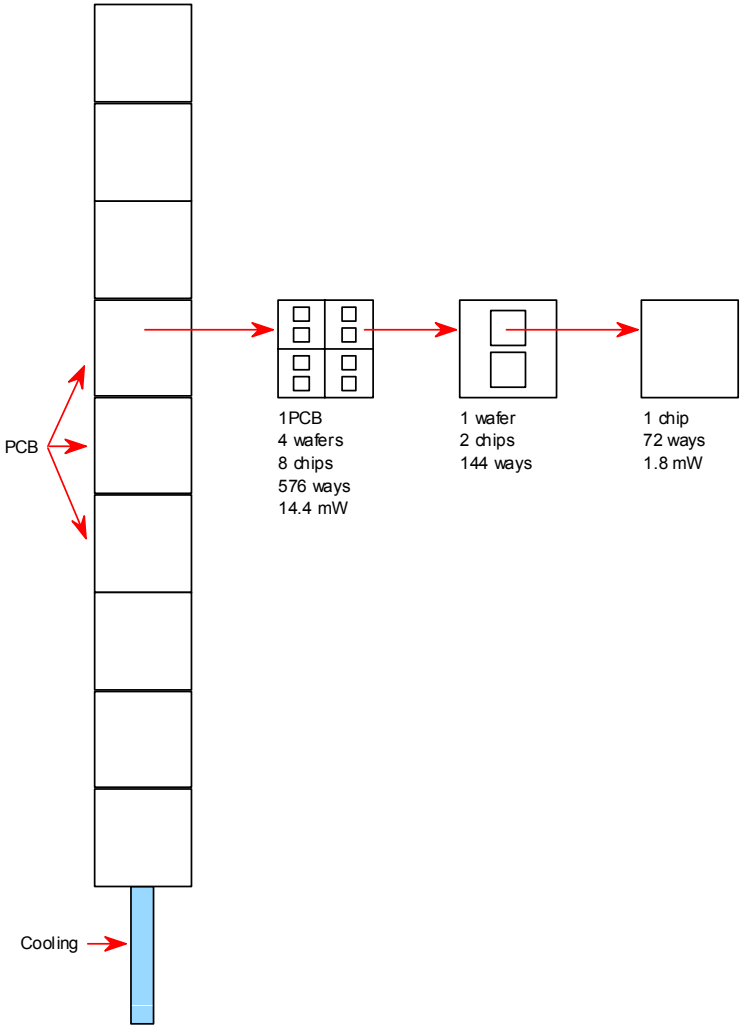
SLAB Integration & Thermal Measurements
Slides Overview

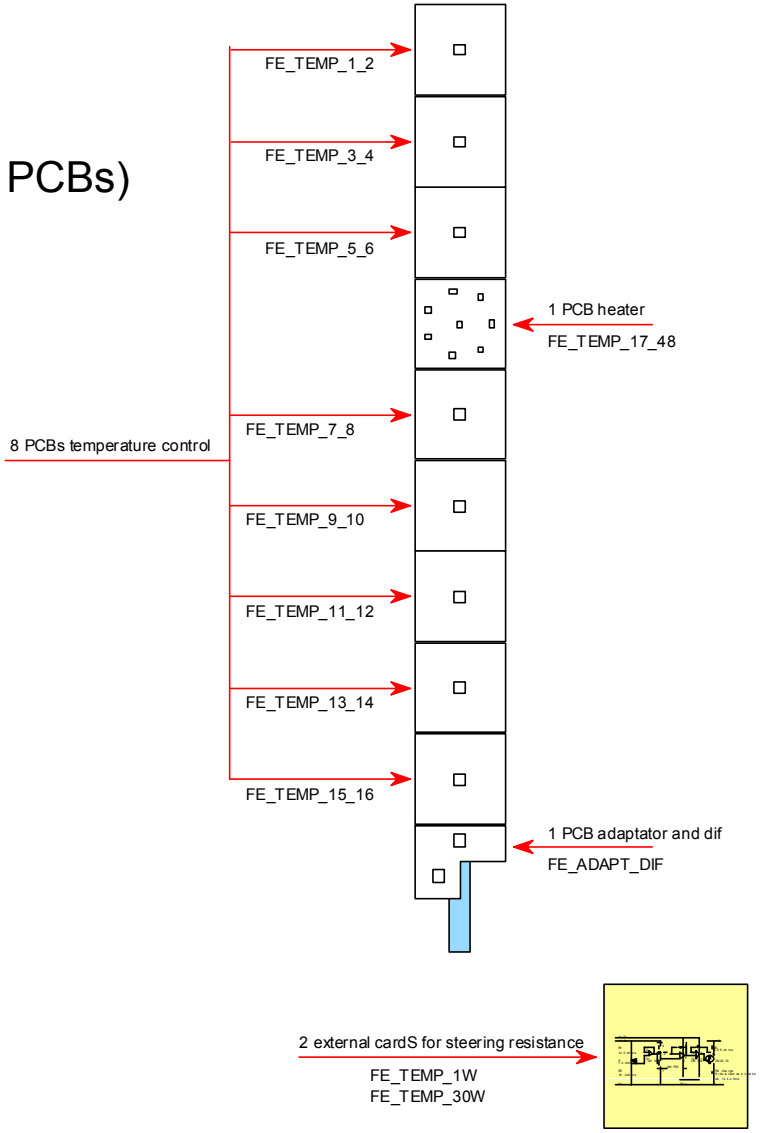
- Thermal Measurements (Demonstrator)
- Detector SLAB Integration
- Open Questions
- Conclusion/ Next Items

Realization of slab model, to simulate the heat dissipation of chips in a slab EUDET in order to valid the future cooling system



To simulate the slab heat dissipation, we decided to use resistances with a temperature control

The choice is to manufacture:
1 PCB able to simulate the power down
to 14.4 mW (1PCB) and power up to 1 W (>7 PCBs)
8 PCBs for temperature control
1 external card for steering resistance



PCB heater

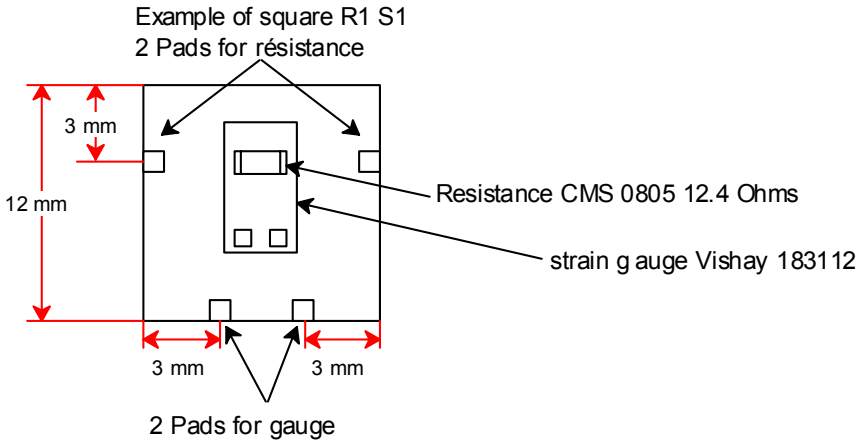
1 card: FE_TEMP_17_48

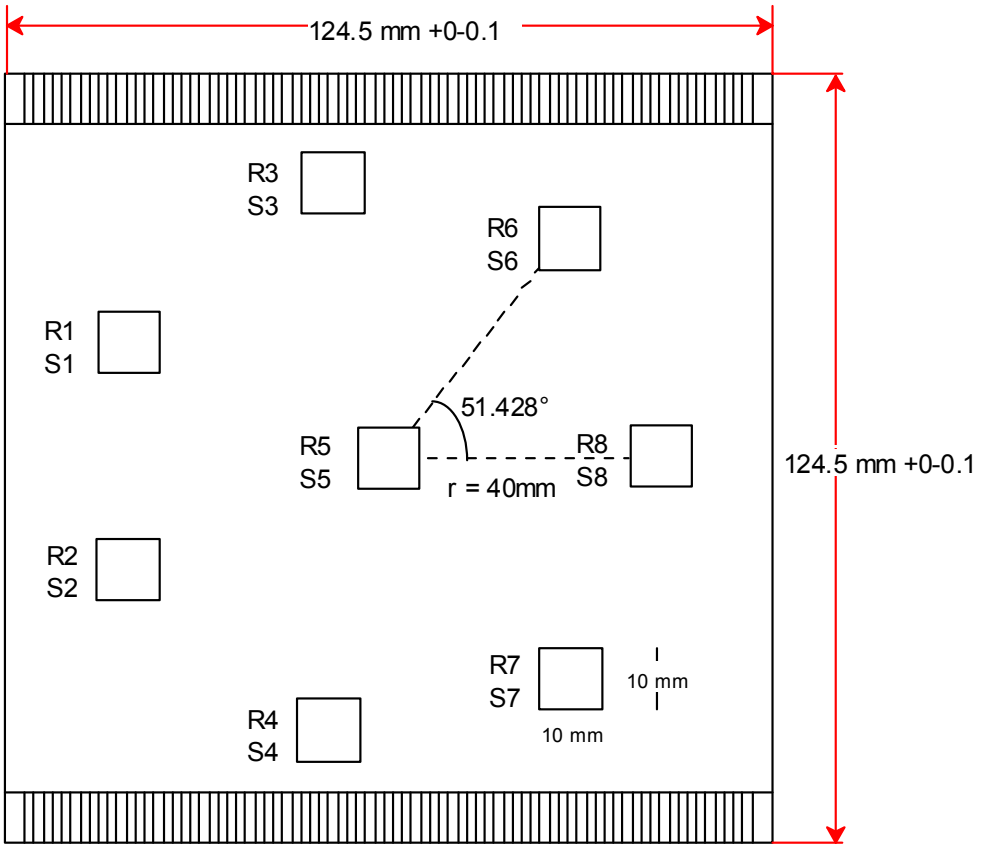
Dimensions:

- Thickness = 0.8 mm
- Width = 124.5 mm +0-0.1
- Length = 124.5 mm +0-0.1

With 8 squares de 12 x 12 mm max as depth as possible

- 4 electric tracks by square,
  - 2 for resistance
  - 2 for T° sensor





PCBs temperature control

8 cards:

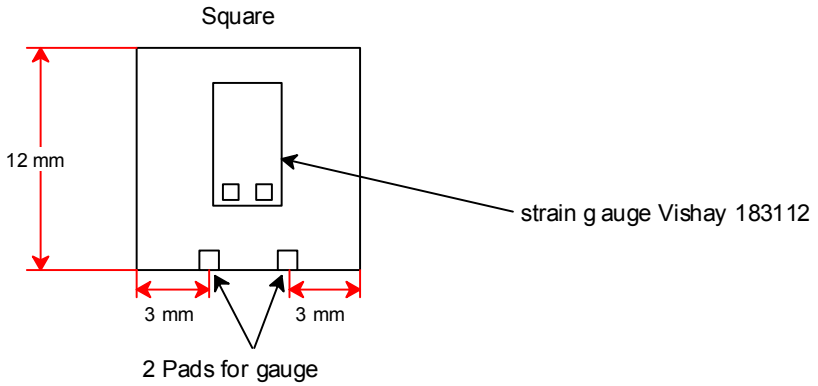
- FE_TEMP_1_2
- FE_TEMP_3_4
- FE_TEMP_5_6
- FE_TEMP_7_8
- FE_TEMP_9_10
- FE_TEMP_11_12
- FE_TEMP_13_14
- FE_TEMP_15_16

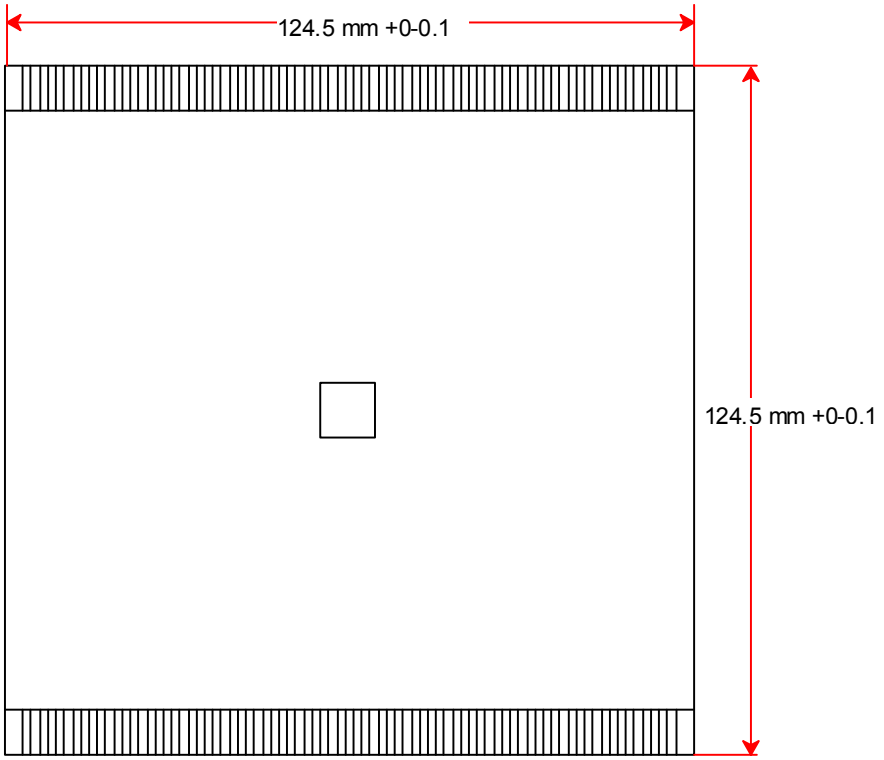
Dimensions:

- Thickness = 0.8 mm
- Width = 124.5 mm +0-0.1
- Length = 124.5 mm +0-0.1

With 1 square 12x12 mm max as depth as possible

- 2 electric tracks for T° sensor





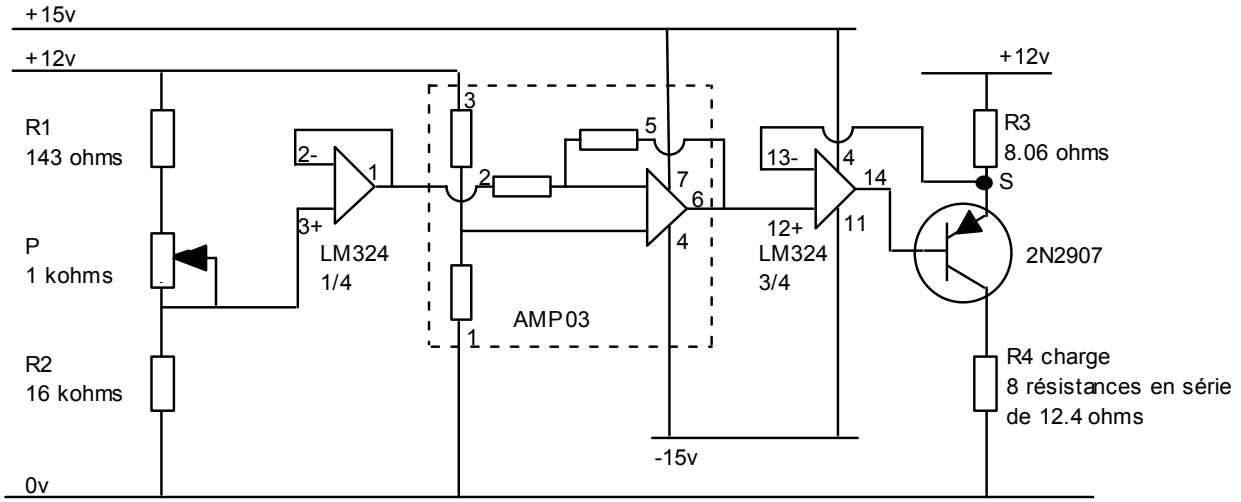
Steering card for resistances

2 external cards:

FE_TEMP_1W for card with 8 resistances

FE_TEMP_??? For card simulate adaptor and dif

FE_TEMP_1W



Measures carried out between S point and 0v, the power is adjust by the potentiometer (P)

U for Imax = 11.9v

U for Imin = 11.2v

Pmax for PCB 8 chips = 1W

Pmin for PCB 8 chips = 14.4 mW

Adaptor and dif card

1 card: FE_ADAPT_DIF

2 parts:

-Adaptor, with a square for 1 resistance and 1 gauge for temperature

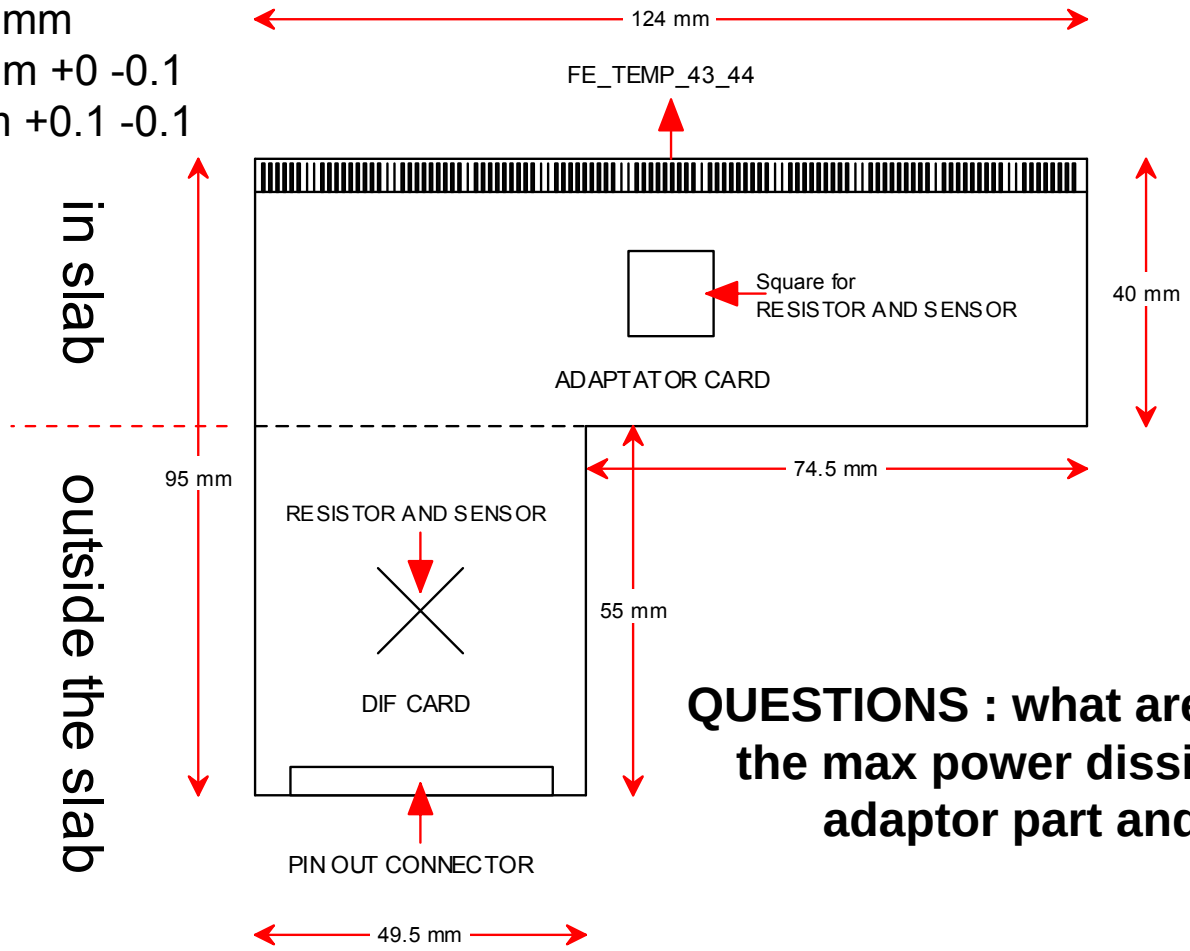
-Dif with 1 big resistance 1 pt100 for temperature

Dimensions:

Thickness = 0.8 mm

Width = 124.5 mm +0 -0.1

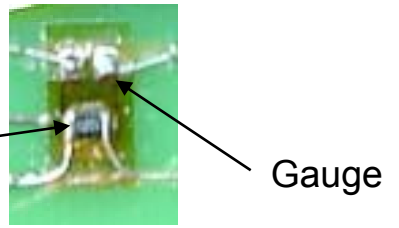
Length = 95 mm +0.1 -0.1

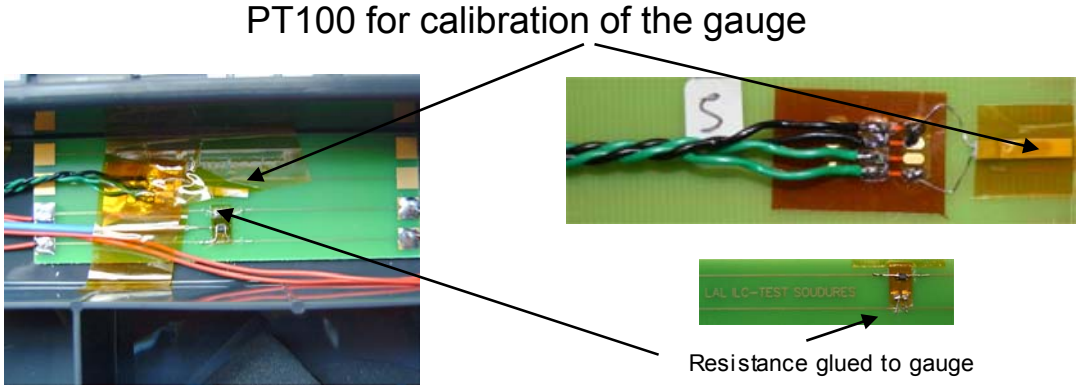


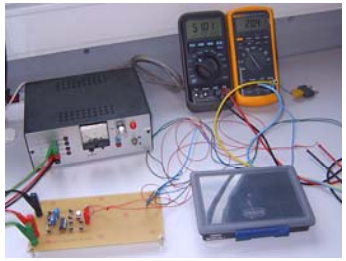
QUESTIONS : what are the values of the max power dissipated in the adaptor part and dif part

Test and measurement

A strain gauge Vishay (reference 183112 used as T° sensor) is glued on the PCB and the resistance which simulates the chip, is directly bonded to the gage.

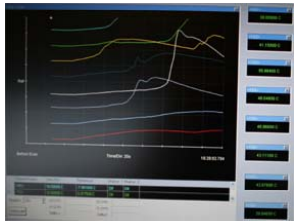




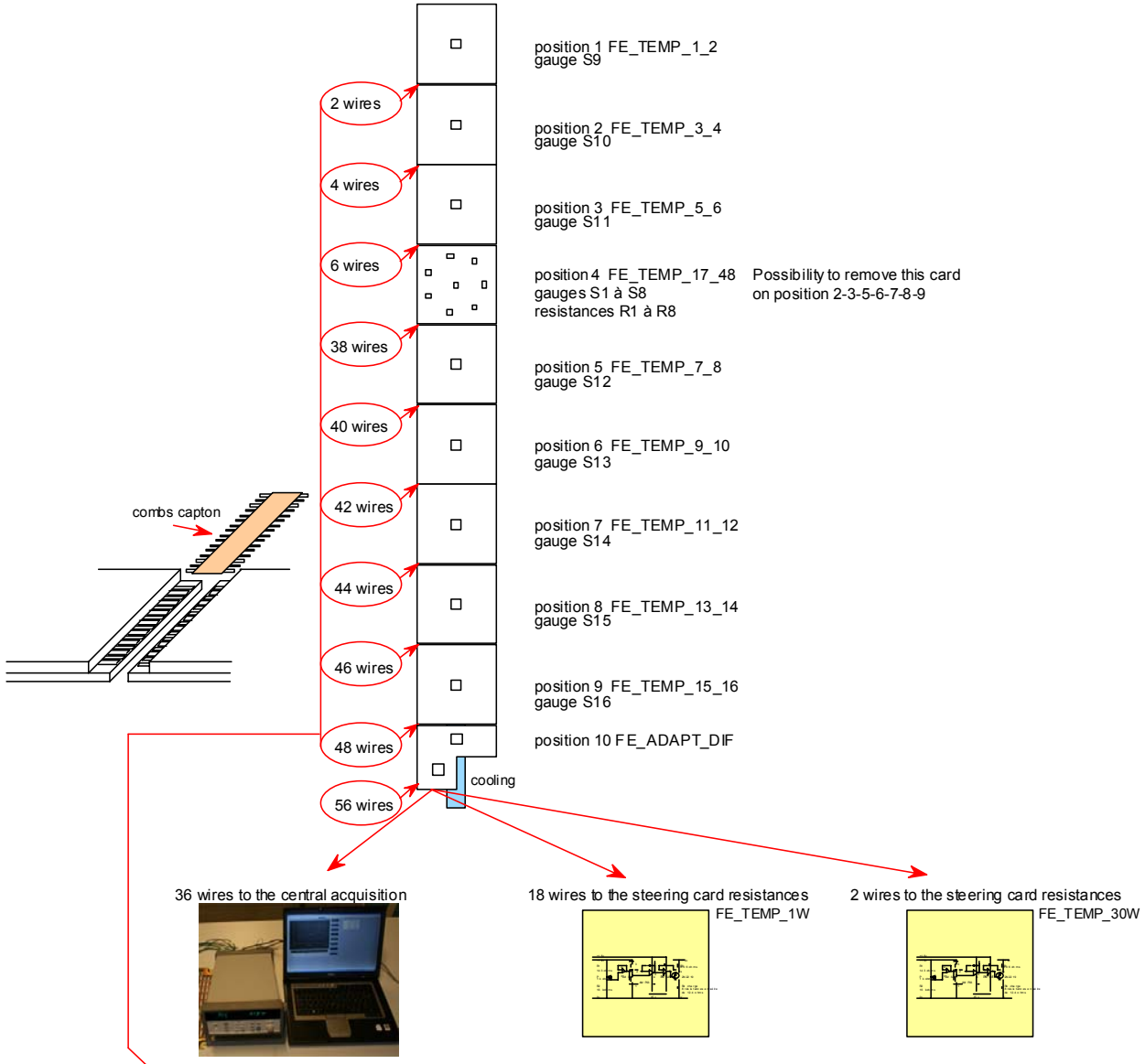


Steering resistance system

Temperature acquisition system



Cards assembling in slab model

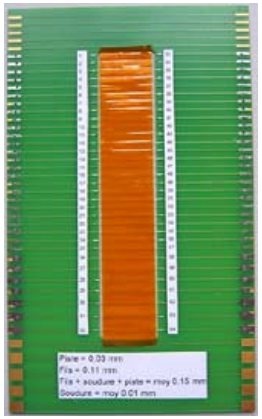


To achieve the interconnections between the PCBs, we use kapton combs

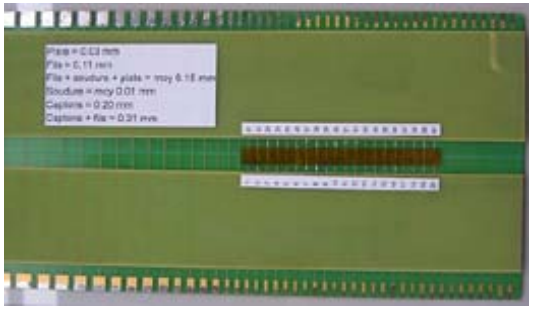
Tests of kapton combs

The combs are made by positioning the wires on a layer of kapton scotch and covered by another layer of kapton scotch.
Then the wire are solder alternately starting with wire n° 1 and n° 10, 20, 2, 11, 21…
Soldering iron used: Weller ws50 at 350°C
The temperature is controlled step by step with PT100 placed on the top and on the bottom (wafers side)

Step 1
Comb 20 ways
Kapton width = 19 mm
Wire = 0.25 mm
Track = 0.03 mm
Wire + solder + track = moy 0.29 mm
Solder = moy 0.01 mm



Step 2
Comb 32 ways
Kapton width = 19 mm
Wire = 0.11 mm
Track = 0.03 mm
Wire + solder + track = moy 0.15 mm
Solder = moy 0.01 mm



Step 3
Comb 20 ways
Kapton width = **5 mm**
Wire = 0.11 mm
Track = 0.03 mm
Wire + solder + track = **moy 0.15 mm**
Solder = moy 0.01 mm
T max relieved on the top = **45.6 °C**
T max relieved on the lower side wafers = **42.5 °C**

Documents annexes
Steering card for resistances

Resistors load

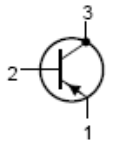
Parameters	Value parameter
Enclosure type	0805
Technologie	Thin Film
Value of resistance	12,4Ω
Tolerance resistance	±0.1%
Rated power at 70 °C	0.1W
Temperature coefficient	±10 ppm/°C
Using temperature	-55°C à +125°C
Power use	100 V (max.)
Tension overload	200 V (max.)
Length	2mm
Width	1,25mm

Resistance R3

Parameters	Value parameter
Enclosure type	0805
Technologie	Thin Film
Value of resistance	8,06Ω
Tolerance resistance	±0.1%
Rated power at 70 °C	0.125W
Temperature coefficient	±10 ppm/°C
Using temperature	-55°C à +125°C
Power use	100 V (max.)
Tension overload	200 V (max.)
Length	2mm
Width	1,25mm

R2= resistance 16K OHM 0.1% 10PPM 0805
R1=143Ω resistance 0805 143R 0.1% 15PPM

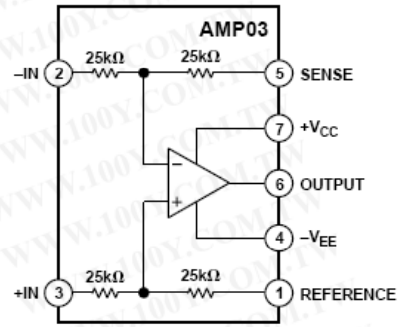
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–60	V
V_{CEO}	collector-emitter voltage	open base			
	2N2907		–	–40	V
	2N2907A		–	–60	V
I_C	collector current (DC)		–	–600	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	400	mW
h_{FE}	DC current gain	$I_C = -150$ mA; $V_{CE} = -10$ V	100	300	
f_T	transition frequency	$I_C = -50$ mA; $V_{CE} = -20$ V; f = 100 MHz	200	–	MHz
t_{off}	turn-off time	$I_{Con} = -150$ mA; $I_{Bon} = -15$ mA; $I_{Boff} = 15$ mA	–	300	ns



2N2907

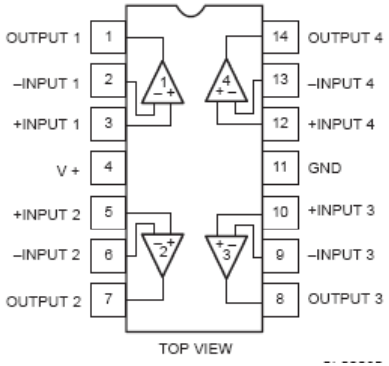
Analog Devices AMP03

Parameter	Symbol	Conditions	AMP03F Min	AMP03F Typ	AMP03F Max	AMP03B Min	AMP03B Typ	AMP03B Max	AMP03G Min	AMP03G Typ	AMP03G Max	Units
Offset Voltage	V_{OS}	V_{CM} = 0 V	–400	10	400	–700	20	700	–750	25	750	µV
Gain Error		No Load, V_{IN} = ±10 V, R_S = 0 Ω		0.00004	0.008		0.00004	0.008		0.001	0.008	%
Input Voltage Range	IVR	(Note 1)	±10			±10			±10			V
Common-Mode Rejection	CMR	V_{CM} = ±10 V	85	100		80	95		80	95		dB
Power Supply Rejection Ratio	PSRR	V_S = ±6 V to ±18 V		0.6	10		0.6	10		0.7	10	µV/V
Output Swing	V_O	R_L = 2 kΩ	±12	±13.7		±12	±13.7		±12	±13.7		V
Short-Circuit Current Limit	I_{SC}	Output Shorted to Ground	+45/–15			+45/–15			+45/–15			mA
Small-Signal Bandwidth (–3 dB)	BW	R_L = 2 kΩ		3			3			3		MHz
Slew Rate	SR	R_L = 2 kΩ	6	9.5		6	9.5		6	9.5		V/µs
Capacitive Load Drive Capability	C_L	No Oscillation		300			300			300		pF
Supply Current	I_{SY}	No Load		2.5	3.5		2.5	3.5		2.5	3.5	mA

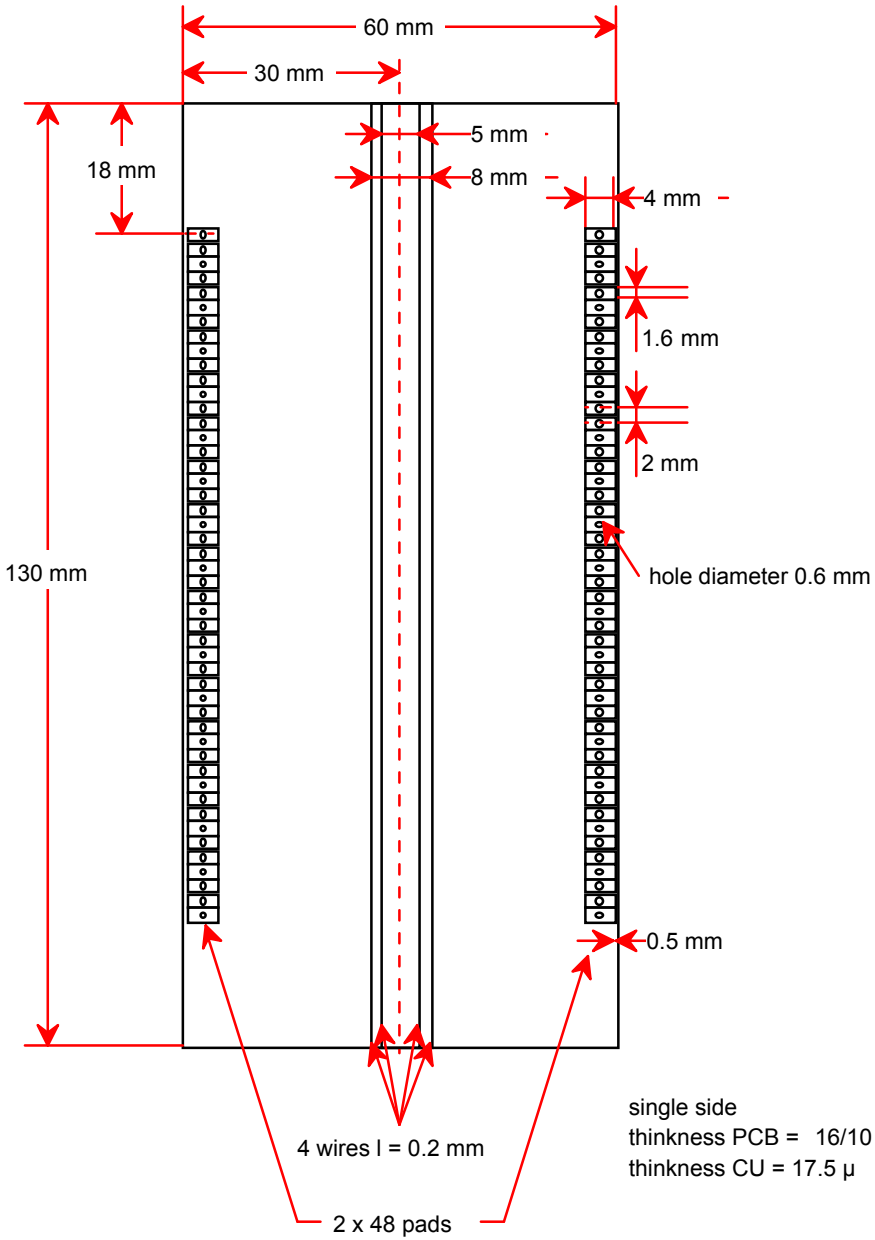


LM324

SYMBOL	PARAMETER	RATING	UNIT
V_{CC}	Supply voltage	32 or ±16	V_{DC}
V_{IN}	Differential input voltage	32	V_{DC}
V_{IN}	Input voltage	–0.3 to +32	V_{DC}
P_D	Maximum power dissipation, T_{amb} = 25 °C (still-air) [1] N package D package DH package	 1420 1040 762	 mW mW mW
	Output short-circuit to GND one amplifier[2] V_{CC} < 15 V_{DC} and T_{amb} = 25 °C	Continuous	
I_{IN}	Input current (V_{IN} < –0.3 V) [3]	50	mA
T_{amb}	Operating ambient temperature range LM324/324A LM224 SA534 LM2902 LM124	 0 to +70 –25 to +85 –40 to +85 –40 to +125 –55 to +125	 °C °C °C °C °C
T_{stg}	Storage temperature range	–65 to +150	°C
T_{sld}	Lead soldering temperature (10 sec max)	230	°C



Creation of a special card for making combs



Control temperature
Gauge Vishay temperature Sensors

GAGE PATTERN AND DESIGNATION Approximate Size Shown See Note 1	DIMENSIONS (inches / millimeters)					
	GAGE LENGTH	OVERALL LENGTH	GRID WIDTH	OVERALL WIDTH	MATRIX Length	MATRIX Width
ETG-50A/Option E ETG-50A/Option W ETG-50B/Option E ETG-50B/Option W 50A/E 50B/E Opt W Feature	0.060	0.148	0.100	0.100	0.28	0.20
	1.52	3.76	2.54	2.54	7.0	4.8
	0.125	0.235	0.125	0.125	0.33	0.19
	3.18	5.97	3.18	3.18	8.3	4.7
WTG-50A **WTG-50A/Option W** **WTG-50B** **WTG-50B/Option W** 50A 50B Opt W Feature	0.060	0.148	0.100	0.100	0.28	0.20
	1.52	3.76	2.54	2.54	7.0	4.8
	0.125	0.235	0.125	0.125	0.33	0.19
	3.18	5.97	3.18	3.18	8.3	4.7
WWT-TG-W200B-050 For weldable temperature sensor, see appropriate datasheet.	0.20	(shim length) 0.71	0.200	(shim width) 0.43	0.52	0.26
	5.08	18.03	5.08	10.92	13.1	6.6

50B/E

Acknowledgments

A Thiebault to manage temperatures

M Quentin for carrying out the solder on the capton combs

M Gaspard for the current generator

J Fleury for schemas

D Cuisy for the CAO

M Lacroix