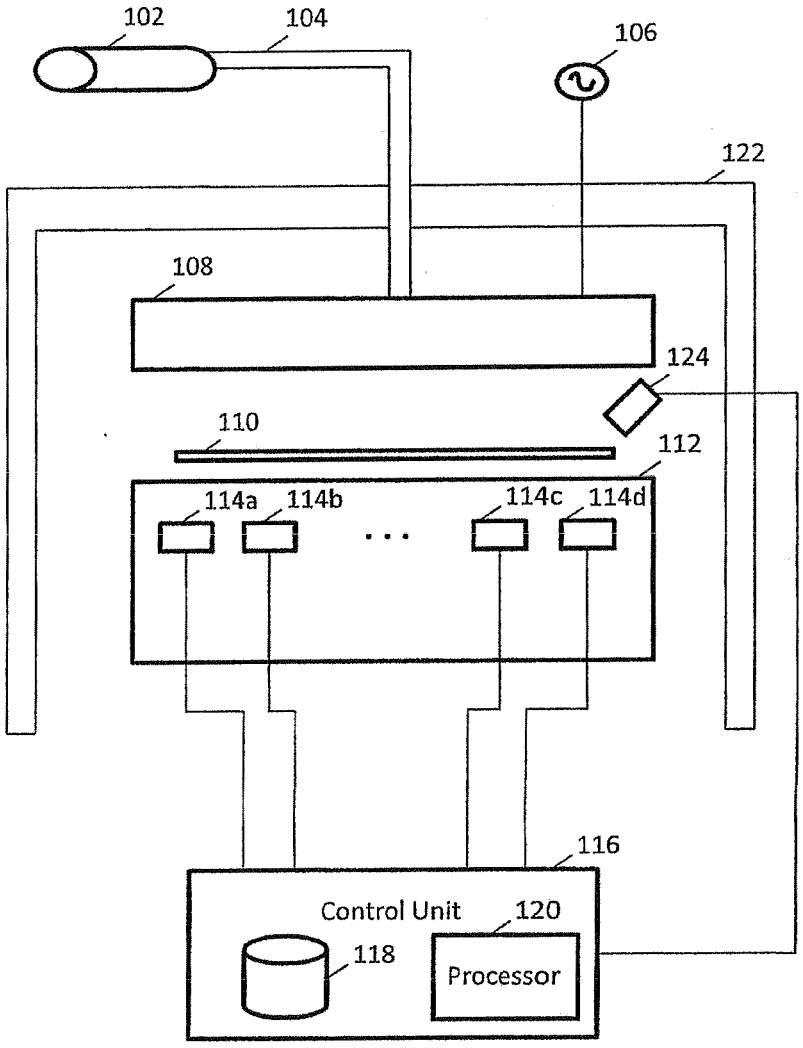

102
104
106
122
108
124
110
112
114a
114b
114c
114d
116
Control Unit
120
118
Processor

FIG. 1

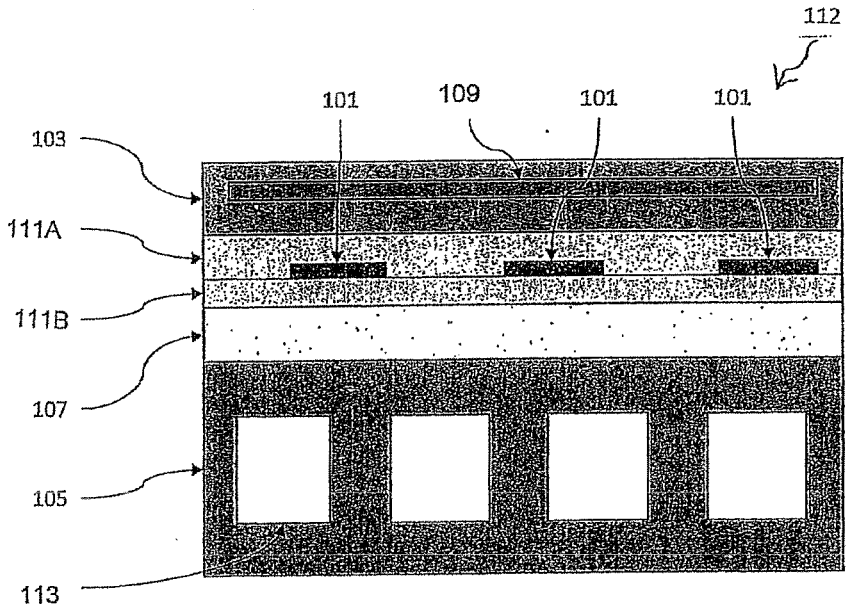


FIG. 2

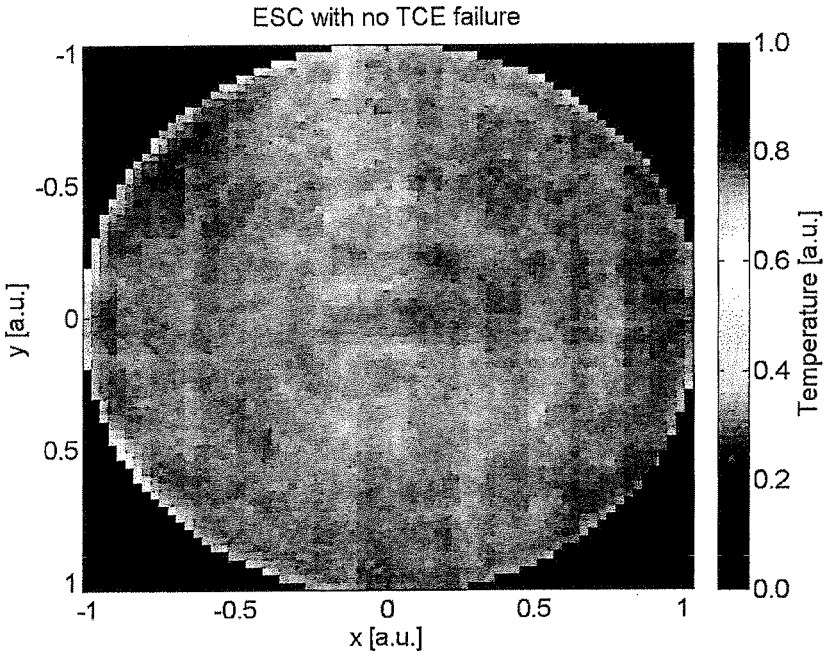

ESC with no TCE failure
-1
-0.5
0
0.5
1
y [a.u.]
-1
-0.5
0
0.5
1
x [a.u.]
1.0
0.8
0.6
0.4
0.2
0.0
Temperature [a.u.]

FIG. 3A

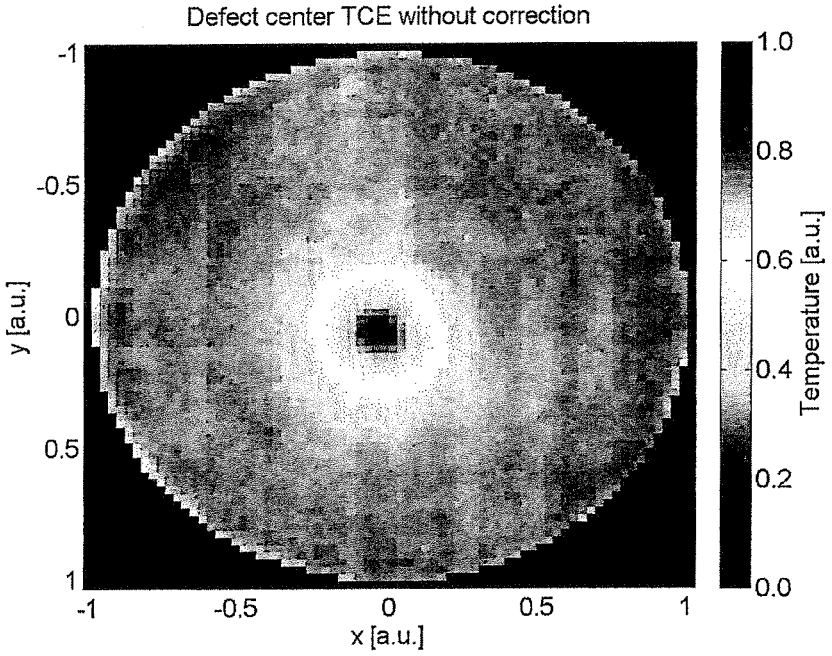

Defect center TCE without correction
-1
-0.5
0
0.5
1
y [a.u.]
-1
-0.5
0
0.5
1
x [a.u.]
1.0
0.8
0.6
0.4
0.2
0.0
Temperature [a.u.]

FIG. 3B

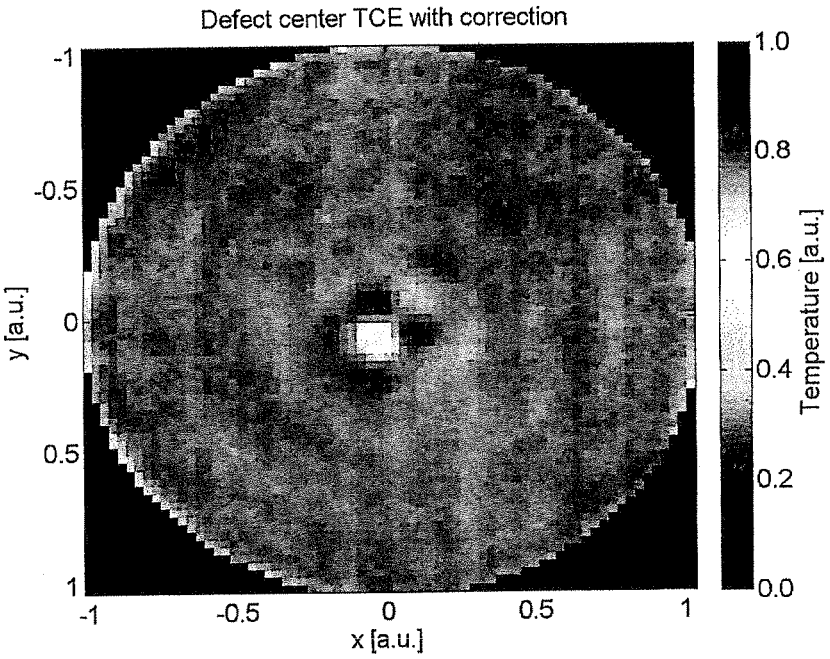

Defect center TCE with correction
-1
-0.5
0
0.5
1
y [a.u.]
-1
-0.5
0
0.5
1
x [a.u.]
1.0
0.8
0.6
0.4
0.2
0.0
Temperature [a.u.]

FIG. 3C

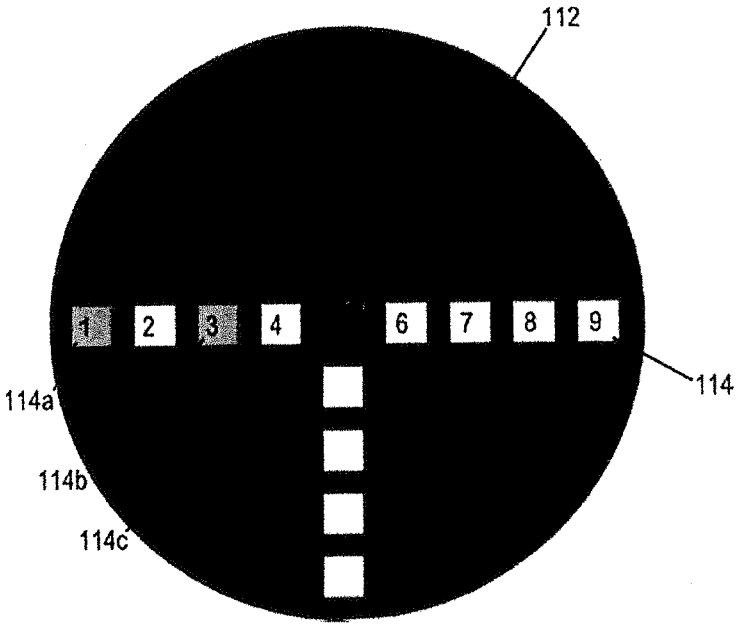

112
1
2
3
4
6
7
8
9
114
114a
114b
114c

FIG. 4

Without Compensation

	Min. [a.u.]	Mean [a.u.]	Max. [a.u.]	σ [a.u.]
No Failure	0.75	0.82	0.89	0.01
Edge TCE Failure	0.00	0.80	0.88	0.08
Mid TCE Failure	0.33	0.80	0.89	0.05
Center TCE Failure	0.50	0.81	0.89	0.04

FIG. 5A

With Compensation

	Min. [a.u.]	Mean [a.u.]	Max. [a.u.]	σ [a.u.]
No Failure	0.75	0.82	0.89	0.01
Edge TCE Failure	0.45	0.81	1.00	0.02
Mid TCE Failure	0.62	0.83	0.92	0.02
Center TCE Failure	0.71	0.83	0.89	0.01

FIG. 5B

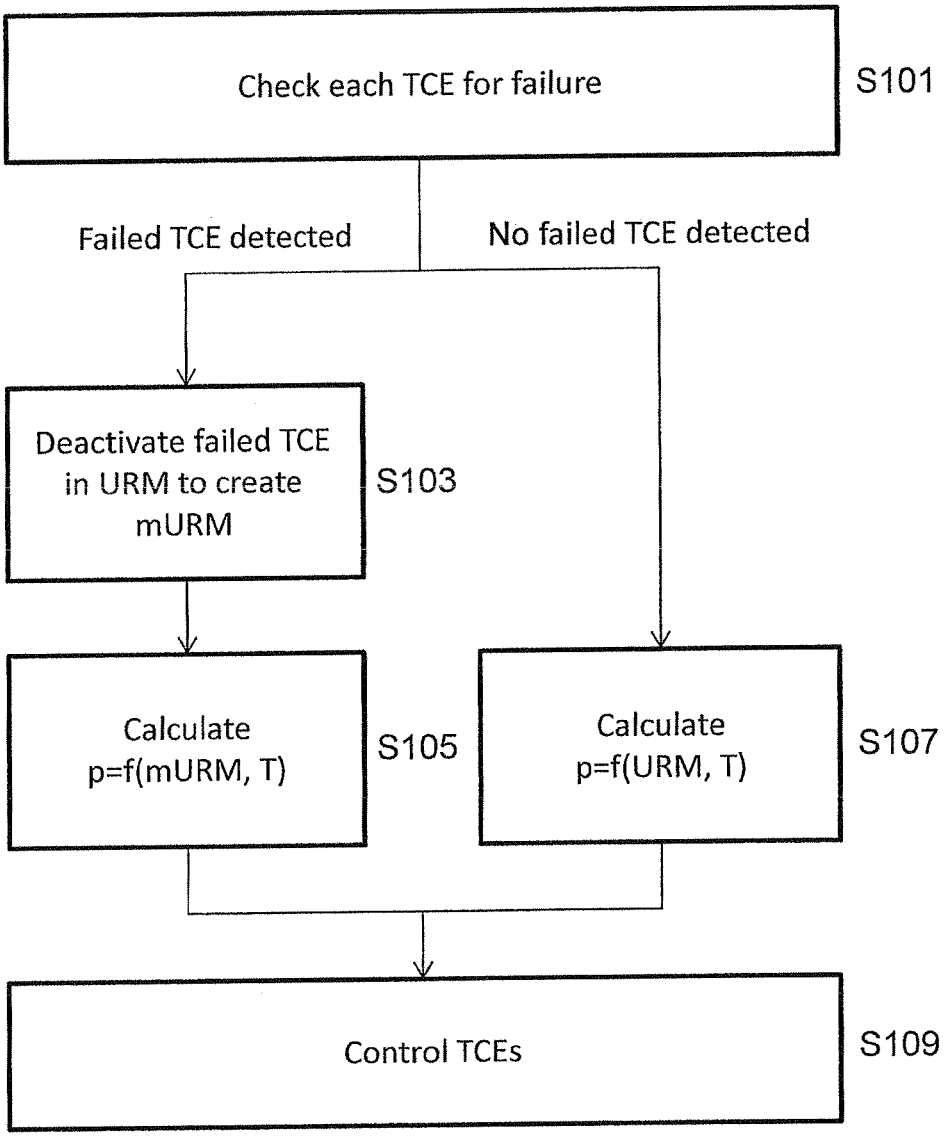

Check each TCE for failure
S101
Failed TCE detected
No failed TCE detected
Deactivate failed TCE in URM to create mURM
S103
Calculate p=f(mURM, T)
S105
Calculate p=f(URM, T)
S107
Control TCEs
S109

FIG. 6

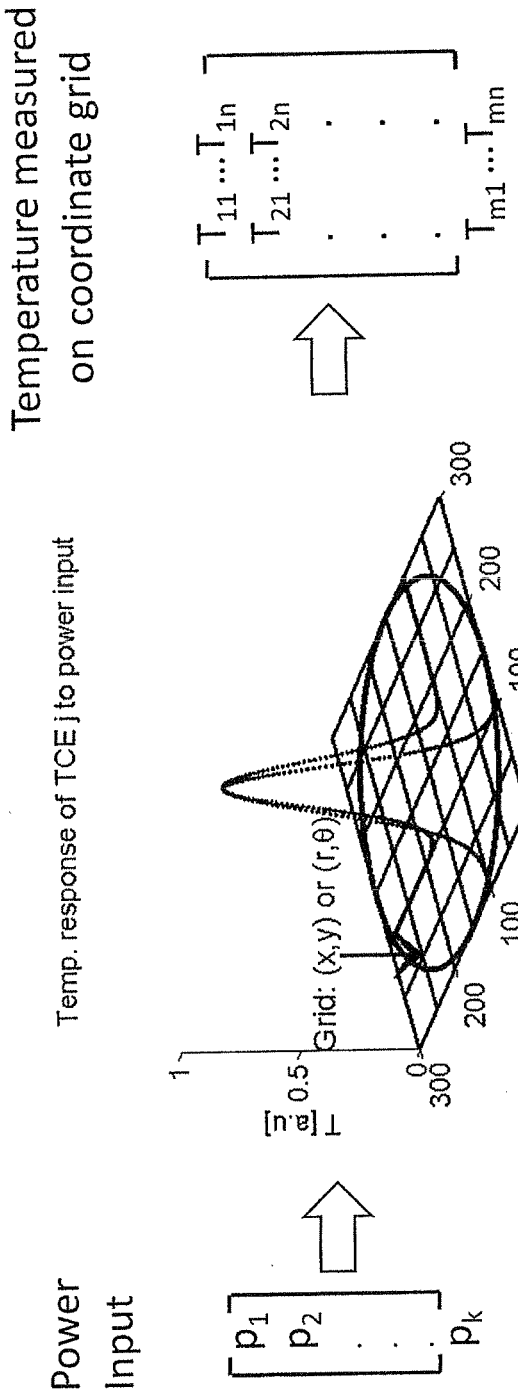
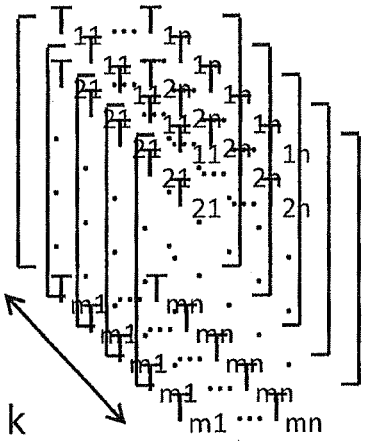

Power Input
p_1
p_2
p_k
Temp. response of TCE j to power input
T [a.u]
Grid: (x,y) or (r,θ)
y [a.u]
x [a.u]
Temperature measured on coordinate grid
$T_{11} \ldots T_{1n}$
$T_{21} \ldots T_{2n}$
$T_{m1} \ldots T_{mn}$

FIG. 7



3-Dimensional
Size: m*n*k

FIG. 8A

$$\begin{bmatrix} T_{11,1} \cdots T_{1n,1}, T_{21,1} \cdots T_{2n,1}, \cdots, T_{m1,1} \cdots T_{mn,1} \\ T_{11,2} \cdots T_{1n,2}, T_{21,2} \cdots T_{2n,2}, \cdots, T_{m1,2} \cdots T_{mn,2} \\ \cdot \quad \cdot \\ \cdot \quad \cdot \\ \cdot \quad \cdot \\ T_{11,k} \cdots T_{1n,k}, T_{21,k} \cdots T_{2n,k}, \cdots, T_{m1,k} \cdots T_{mn,k} \end{bmatrix}$$

2-Dimensional
Size: (m*n)*k

FIG. 8B

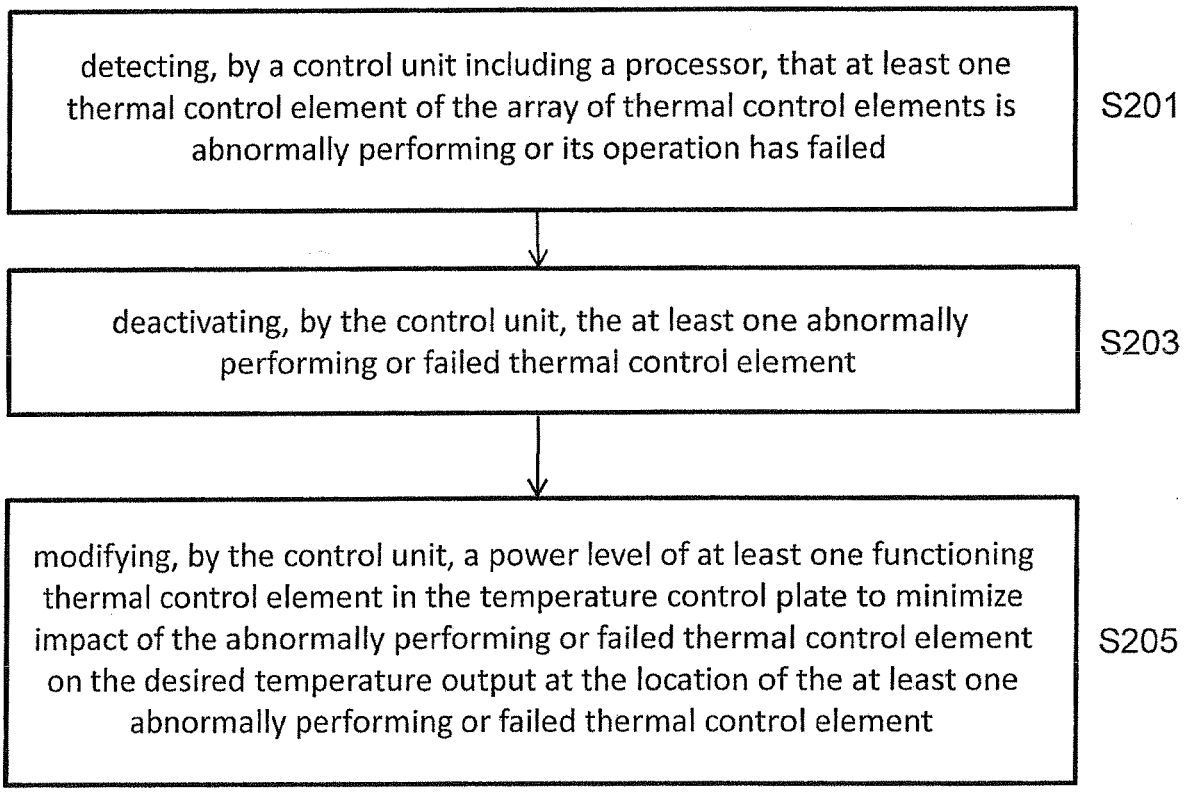

detecting, by a control unit including a processor, that at least one thermal control element of the array of thermal control elements is abnormally performing or its operation has failed
S201
deactivating, by the control unit, the at least one abnormally performing or failed thermal control element
S203
modifying, by the control unit, a power level of at least one functioning thermal control element in the temperature control plate to minimize impact of the abnormally performing or failed thermal control element on the desired temperature output at the location of the at least one abnormally performing or failed thermal control element
S205

FIG. 9