

## Circuit breakers – Thermal tripping

### **Disclaimer**

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### **Nuisance tripping:**

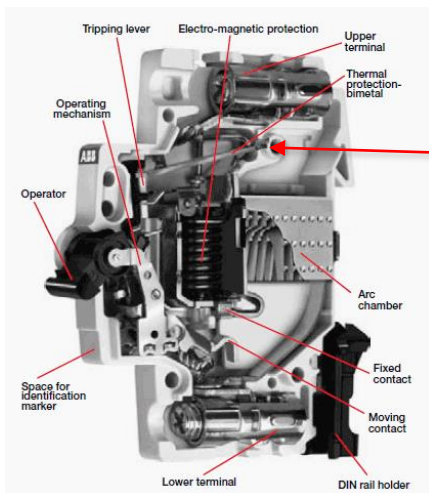
There are occasions where for no apparent reason, the AC breaker protecting a solar inverter will randomly trip, with no obvious cause. Error code 010 will be displayed.

It is normally assumed to be an inverter fault.

However, this is rarely the case.

### **Thermal tripping:**

Circuit breakers are designed to trip under multiple circumstances which also includes a thermal trip mechanism.

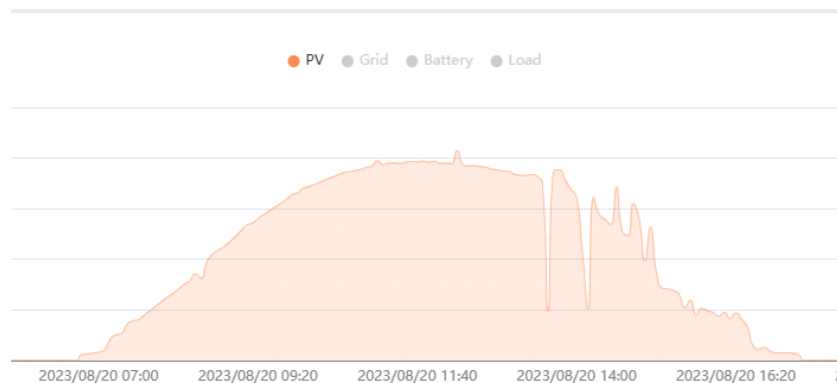


Thermal trip (Bi-Metal strip) will trip the breaker if there is too much heat.

Picture 1 – The internal mechanism

Under normal circumstances, circuit breakers will only occasionally be exposed to large currents as devices are switched on and off.

However, in the case of solar inverters, they can be running at maximum power for several hours of the day.



Picture 2 – Typical output curve from a PV system

**Thermal derating:**

Miniature Circuit Breakers (MCB) also have a thermal derating. This means in high ambient temperatures (i.e. in direct sun, mounted with other MCB, or in an enclosed space) they will not work as efficiently. Most are calibrated for 30°C ambient. The below is an extract from a manufacturer’s manual.

Temperature Correction							
In (A)	30°C	35°C	40°C	45°C	50°C	55°C	60°C
0.5	0.5	0.47	0.45	0.4	0.38	-	-
1	1	0.95	0.9	0.8	0.7	0.6	0.5
2	2	1.9	1.7	1.6	1.5	1.4	1.3
3	3	2.8	2.5	2.4	2.3	2.1	1.9
4	4	3.7	3.5	3.3	3	2.8	2.5
6	6	5.6	5.3	5	4.6	4.2	3.8
10	10	9.4	8.8	8	7.5	7	6.4
16	16	15	14	13	12	11	10
20	20	18.5	17.5	16.5	15	14	13
25	25	23.5	22	20.5	19	17.5	16
32	32	30	28	26	24	22	20
40	40	37.5	35	33	30	28	25
50	50	47	44	41	38	35	32
63	63	59	55	51	48	44	40
80	80	76	72	68	64	60	56
100	100	95	90	85	80	75	70

no. of units n	K
n = 1	1
2 ≤ n < 4	0.95
4 ≤ n < 6	0.9
6 ≤ n	0.85

*Example: Five circuit breakers are to be installed inside an enclosure in a switchroom which has an average ambient air temperature of 35°C. Each circuit breaker will be required to supply a continuous current of 20A. From Table 15 we would select a circuit breaker which has a rated current of 25A at 30°C and 23.5A at 35°C. This takes care of the switchroom ambient air temperature of 35°C, but we also have to take into account the grouping factor of five continuously loaded breakers mounted together in one enclosure. Table 16 gives us a grouping factor K of 0.9. We then apply this grouping factor to the rated current at 35°C which gives us a circuit breaker rated current of  $23.5 \times 0.9 = 21.15A$  in the specified conditions.*

Please consult your MCB manufacturers manual for more information.

### **Inverter currents:**

On a sunny day, an inverter may be pushing out peak output for several hours of the day.

A 5 kW inverter for example will push in excess of 21 Amps continuously through its protecting breaker and AC cable.

During hot weather in particular, if the MCB is in a typical switchboard, it will have no ventilation each side, and has less capacity to dissipate the heat, and a high ambient temperature exists in the enclosure. It will often eventually trip from overheating.



Picture 3 – Typical fully loaded switchboard (Courtesy of Clipsal)

**Solution:**

Sungrow recommends that in these cases, mount the protective device in its own enclosure with air gap around the MCB to allow thermal cooling.



Picture 4 – MCB in a 2-pole enclosure

*\*Always refer to the wiring rules and appropriate standards when sizing a protective device.*

**References:**

[https://download.hager.com/hagergroup.co.uk/files\\_download/Hager\\_Product\\_Information/2007Catalogue/2007/3ProtectionDevices.pdf](https://download.hager.com/hagergroup.co.uk/files_download/Hager_Product_Information/2007Catalogue/2007/3ProtectionDevices.pdf)

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If the issue still persists, please take photos testing on site and contact Sungrow Service Department on 1800 786 476 or email to [service@sungrowpower.com.au](mailto:service@sungrowpower.com.au).