

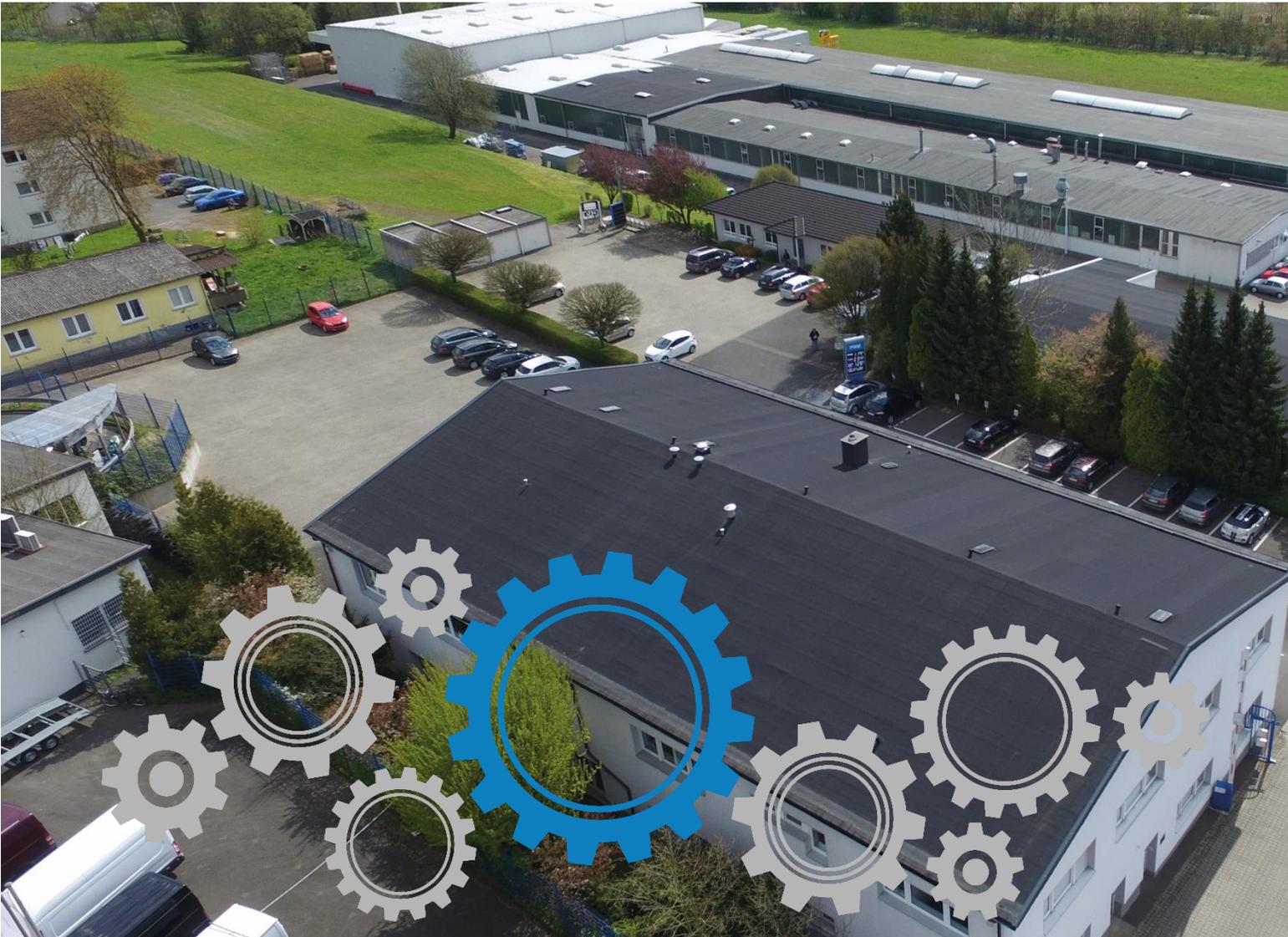
PWM[®]

PWM SMD LED DIGITS

QUALITY, LIFETIME, TEST
PROCEDURES

At home in Germany, present around the world.

PWM[®]



/ Leading manufacturer of
electronic price displays

/ Since 1984 market leader

/ Family owned company
with high quality focus

/ R&D and production in
Bergneustadt/Germany

/ All under one roof and highly
automated



Product portfolio



/ Electronic price displays

/ Full-Colour LED displays

/ Digital signage

/ Digital guideposts

/ Cloud based technology

/ Cloud based services

/ IP67 certified digit technology



Electronic price displays



Digital Signage & Full-Colour LED displays

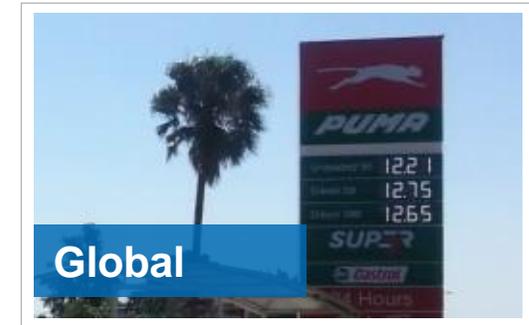
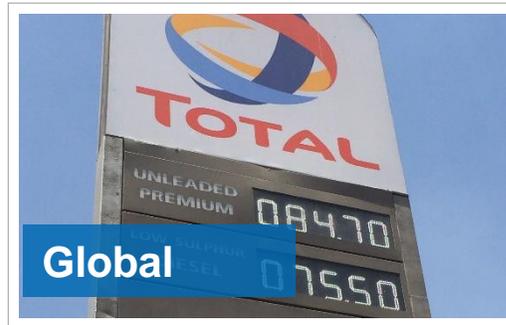
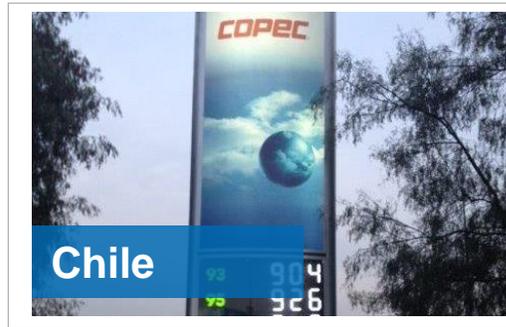


IP67 certified digit technology



Cloud based technology and services

PWM Price Signs all over the World





Testing at PWM



Why we test thoroughly



Cold and humidity

Heat and dust

Water and voltage

PWM strives for longevity of products; Not only to achieve maximum customer satisfaction but also to contribute to sustainability.



While in data sheets the specified lifetime of a LED is only tested under laboratory conditions, there are many factors that can shorten the lifetime of a LED in an outdoor environment. A few of them include:

- (Over-) Voltage
- Humidity
- Chemical influences (e.g. sulfur)
- ESD-damages
- Temperature
- Incorrect storage
- Construction
- UV-Radiation
- Other

To avoid damages or minimize life-shortening factors, PWM's LED signs are specially protected.



Climate chamber



External wall / 45 ° inclined



Field tests / external use

Goal: Comparability between theoretical reflections of the lifetime of a SMD LED and practical tests in an outdoor environment

1. Climate chamber

85/85-Test:

- 85 °C and 85 % humidity
- Extreme positive und negative temperatures
- Degradations measurement

Results

- The digits degrade around 30 %.
- No malfunction with standard digits.

Simulating climate and lifetime conditions focussed on temperature and humidity



Junction – Stress test:

- Temperature close to junction temperature of the LED (5 °C below the junction temperature stated in the datasheet)
- No additional humidity, constant high temperature
- Degradations measurement

Results

- The digits degrade around 42 %.
- No malfunction with standard digits.

2. External wall / 45° inclined



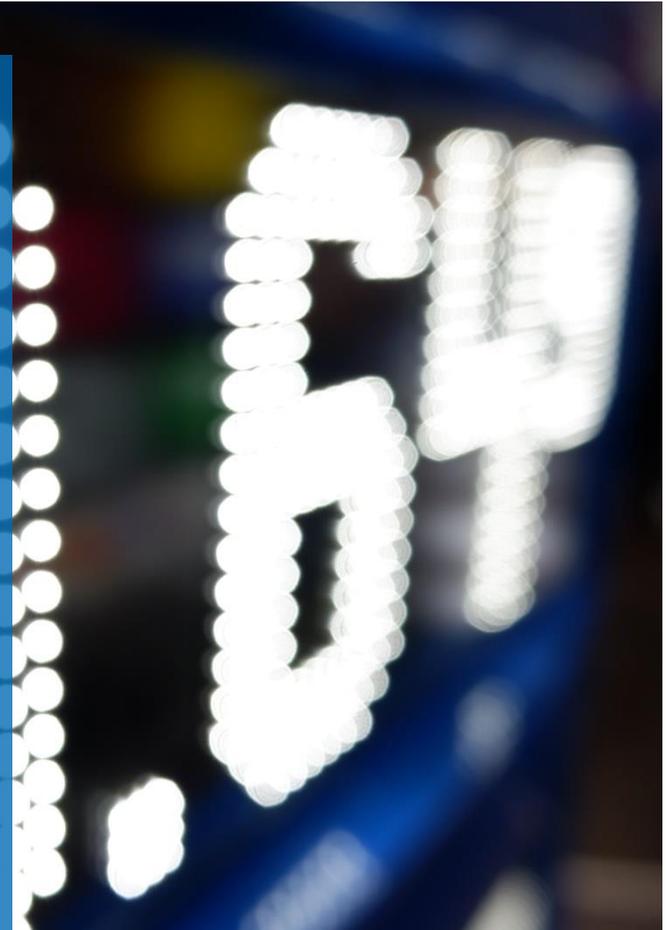
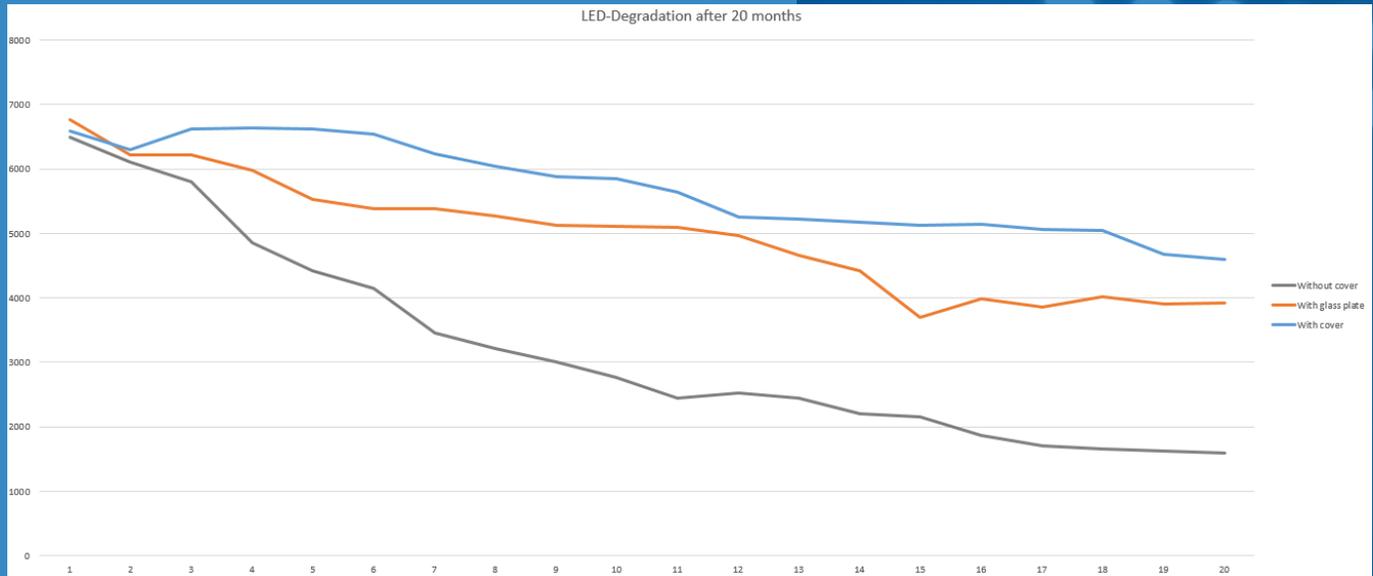
Test conditions:

- / 45° inclined towards the sun (outdoor)
- / Digits with and without acrylic pane or with glass
- / All digits are actively triggered during test (continuous operation)
- / All digits are tested with maximum brightness (100%)
- / Every month a new digit of current production is being added.



Test conditions:

- / Illuminance [Lux]
- / PWM – designed measurement box
- / Comparative measurement
- / Monthly measurement → Evaluation of degradation



- Degradation after 20 months with acrylic pane approx. 25%
- Degradation after 20 months with glass pane approx. 40%
- Degradation after 20 months without pane approx. 70%

Results: Without pane, LEDs start failing already after 3 months. With pane, no failure of LEDs. Pane is essential for these types of LED. PWM's acrylic pane has an UV-absorption of ca. 98 % and is an effective way to protect the LEDs from UV radiation.

Y-axis: illuminance in LUX
X-axis: months of testing

3. Field tests / external use

What degradation has to be expected in daily operation?

Automatic brightness adjustment via light sensor to 4 % by night and up to 100 % under full sun exposure.
Measurements taken at 100 % brightness at delivery and measured in regular defined intervals after installation.

Results

- The digits degrade around 18 % within 20 months.
- No malfunction with standard digits.



There are two reports that are necessary to be able to project the lifetime of a LED: The LM-80 report and the TM-21 report.

LM-80: This is a testing procedure with a typical running-time of 6,000 hours. The lumen degradation at three different operating temperatures (55 °C, 85 °C and a third manufacturer defined temperature) is being measured.

TM-21: This is a calculation procedure taking the resultant measurements of the LM-80 report to project LED lifetime projections.

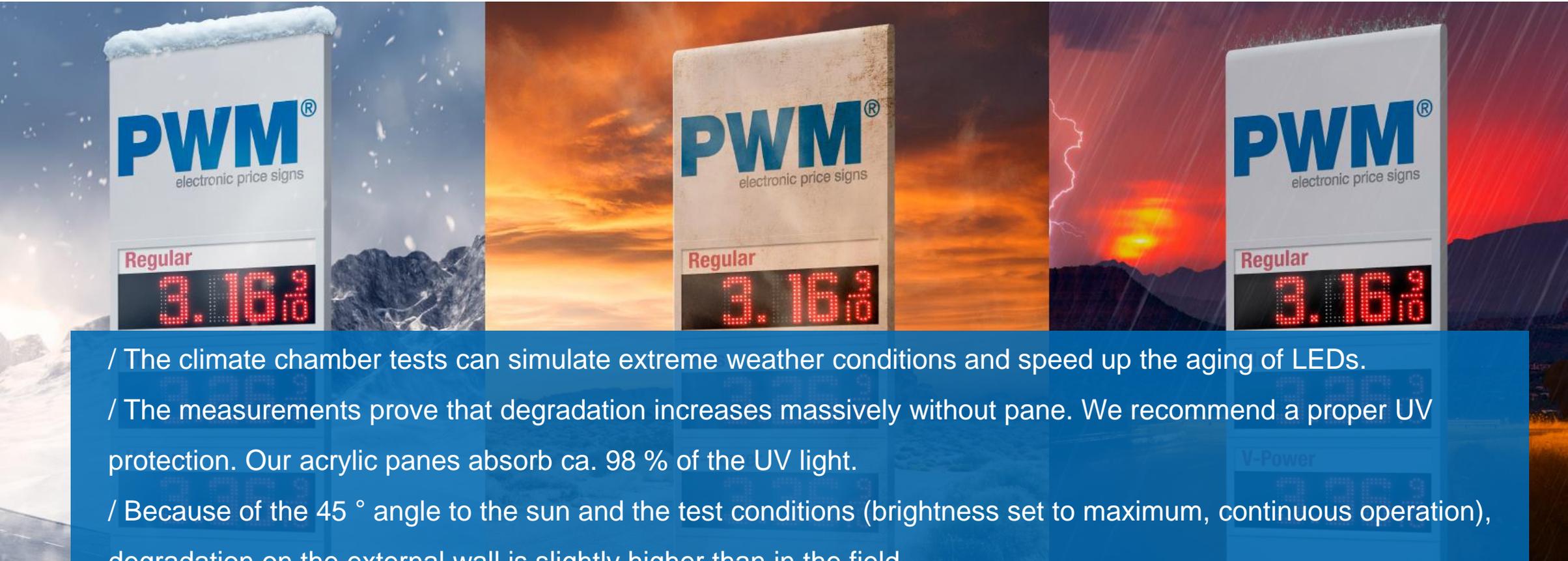
LM-80 + TM-21 = lifetime projection of a LED

For PWM modules the LM-80 / TM-21 results are as follows:

Calculated L70(6,000): 85,000 h, 25 °C ➡ At 25 °C, the tested LEDs produce 70 % of the initial light output after 85,000 h

Calculated L70(6,000): 80,000 h, 55 °C ➡ At 55 °C, the tested LEDs produce 70 % of the initial light output after 80,000 h

Calculated L70(6,000): 69,000 h, 85 °C ➡ At 85 °C, the tested LEDs produce 70 % of the initial light output after 69,000 h



- / The climate chamber tests can simulate extreme weather conditions and speed up the aging of LEDs.
- / The measurements prove that degradation increases massively without pane. We recommend a proper UV protection. Our acrylic panes absorb ca. 98 % of the UV light.
- / Because of the 45 ° angle to the sun and the test conditions (brightness set to maximum, continuous operation), degradation on the external wall is slightly higher than in the field
- / Although only white LEDs have been mentioned, all of the named tests are applied to other LEDs as well

PWM[®]

**The future has
already started.**

Thank you very much
for your attention.

