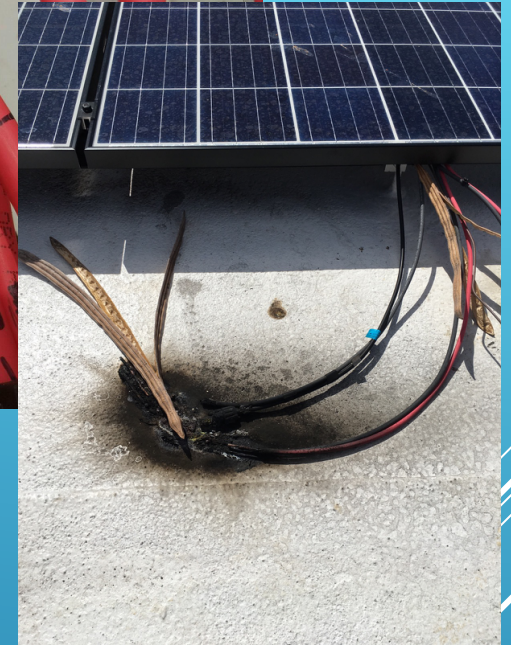
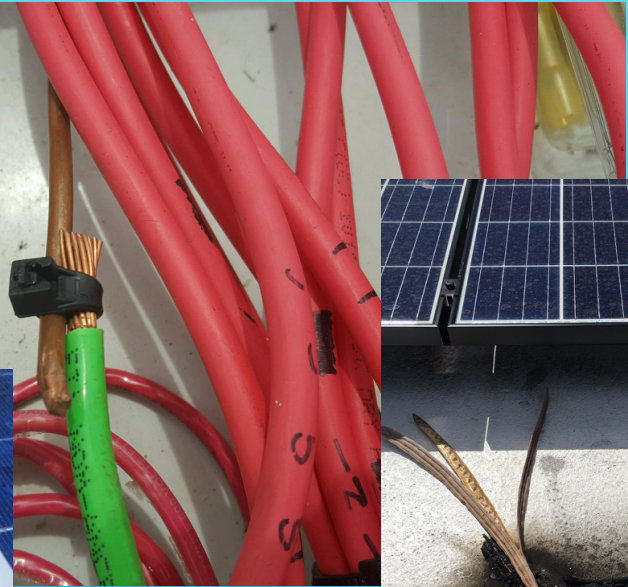


IDENTIFYING ISSUES ON PHOTOVOLTAIC SYSTEMS USING THERMAL IMAGING

There is more than meets the eye
when doing a PV system inspection-

Fred Brooks, CEM, CEA Level II
Certified Thermographer



PHOTOVOLTAIC SYSTEM INSPECTIONS & MAINTENANCE HAS COME TO THE FOREFRONT OF OUR INDUSTRY WE HAVE ALL SEEN SOMETHING THAT MAKES YOU WONDER "SO YOU THOUGHT THIS WAS GOING TO BE A GOOD IDEA?"

Common PV Maintenance Practices

Visual Inspections

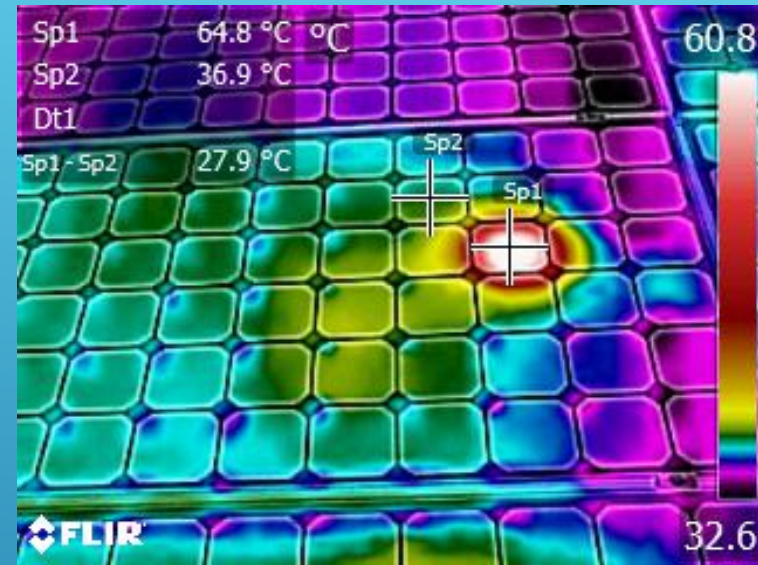
Monitoring

String Level Testing

Cleaning

Inverter Cleaning and Filter Changes

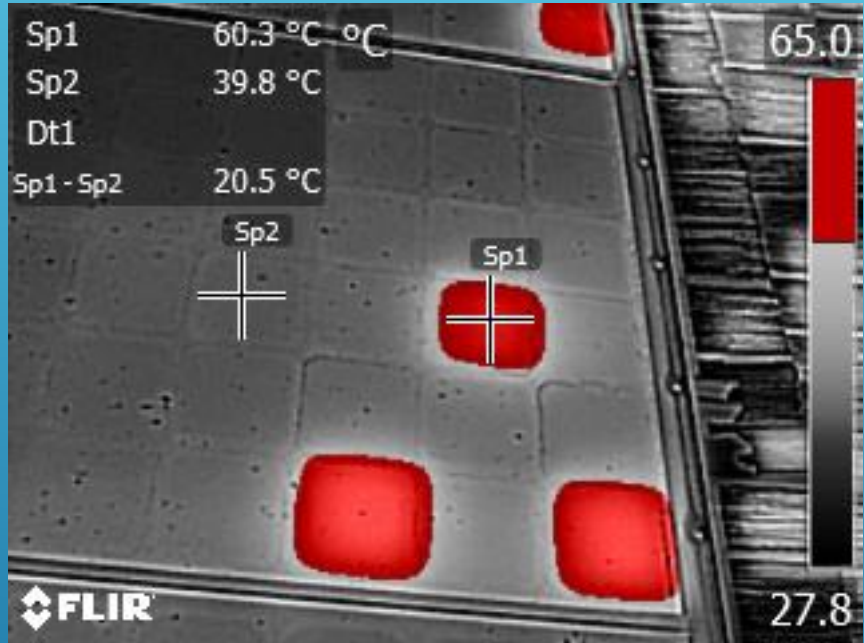
- ▶ Thermal Imaging the common practice of the future



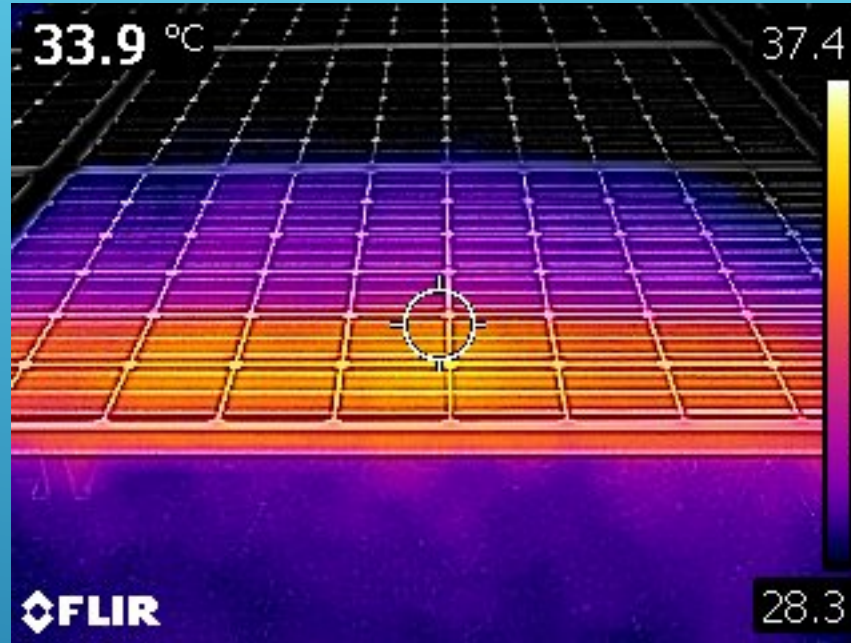
- ▶ Set yourself apart – see beyond

COMMON (WELL NOT ALWAYS SO COMMON) AND BETTER PV MAINTENANCE PRACTICES

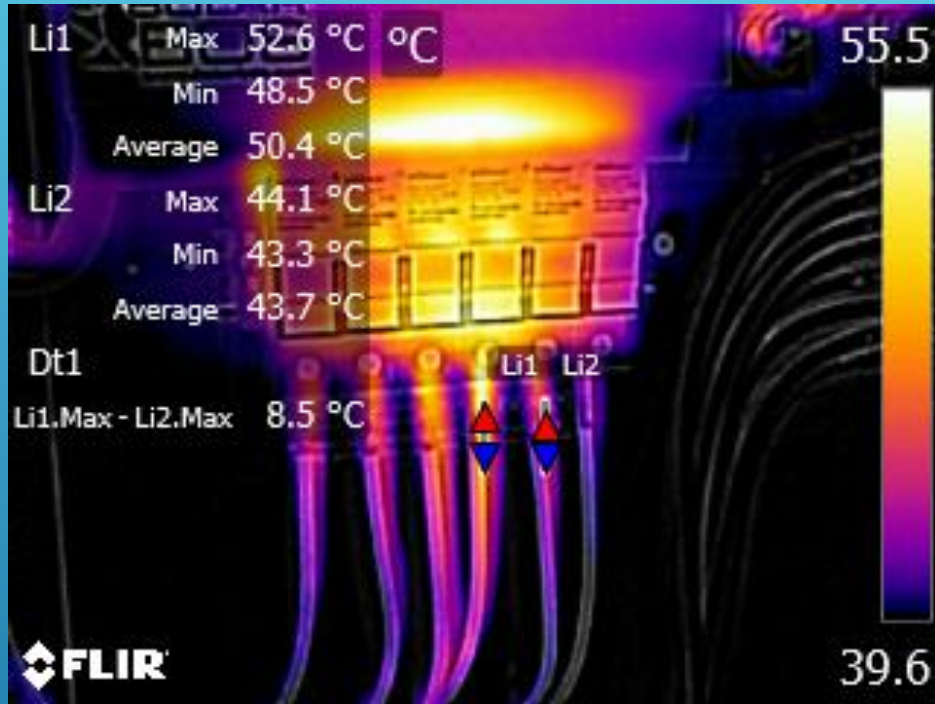
► Hot Spots



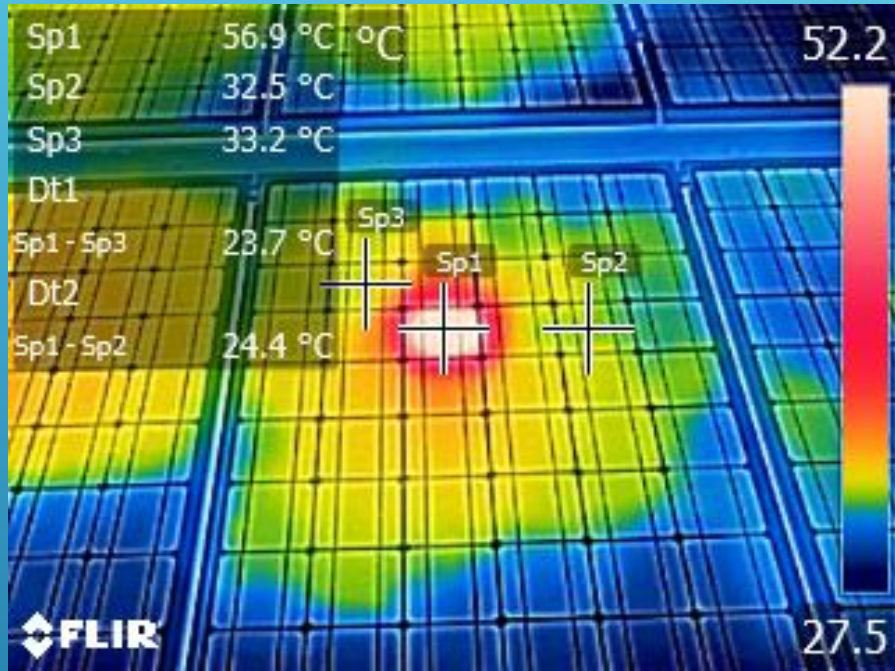
► Diode Issues



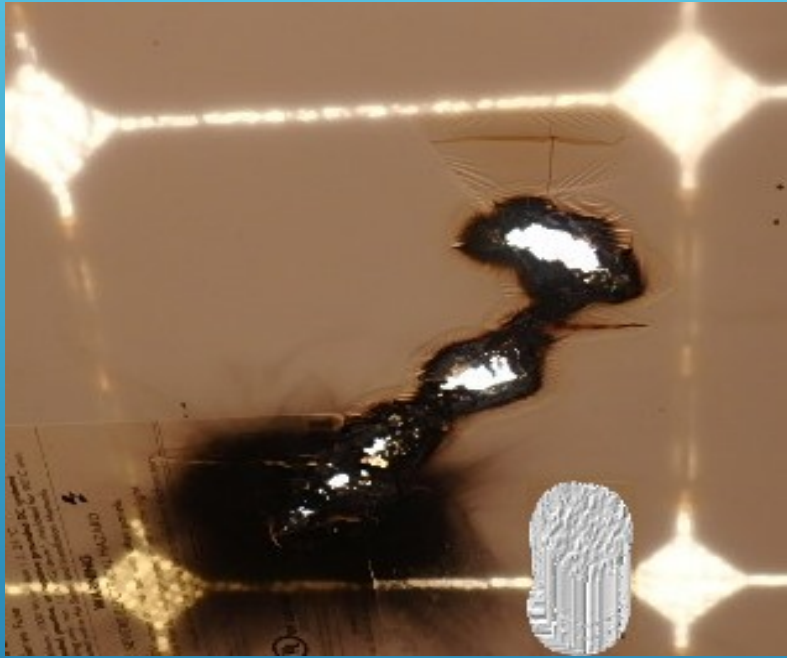
TO BE ABLE TO SEE THE HEAT SIGNATURE CAN REALLY SHOW YOU WHAT IS GOING ON – SEEING IS BELIEVING



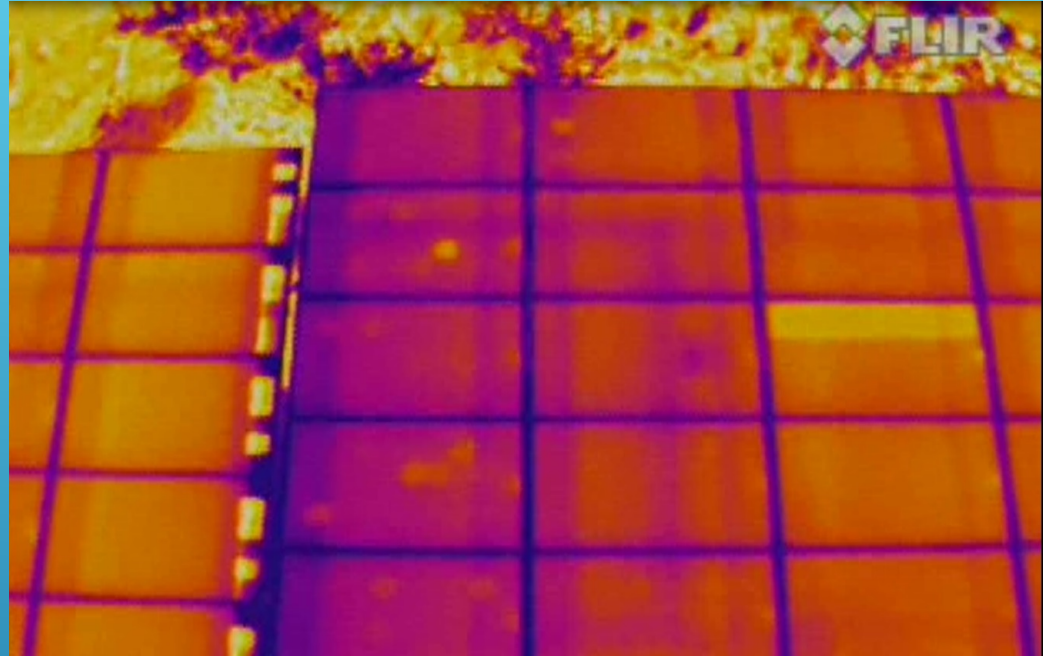
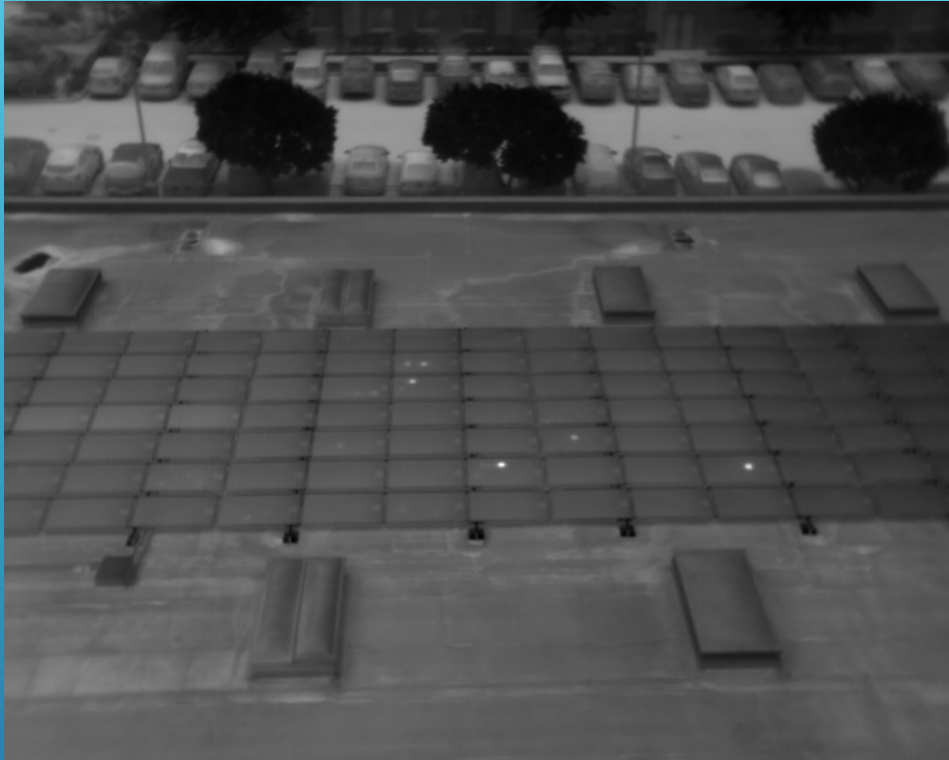
COMBINER BOXES AND INVERTERS – ARE THE STRINGS TORQUED PROPERLY ARE THE INVERTERS VENTING PROPERLY OR ARE THEY WORKING AT ALL?



YOU CAN IDENTIFY THINGS YOU WOULD NOT NORMALLY SEE



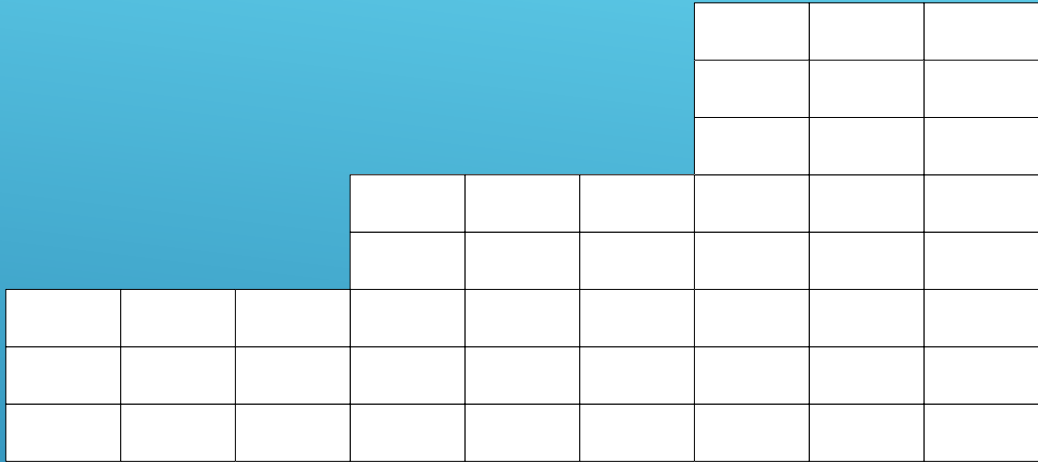
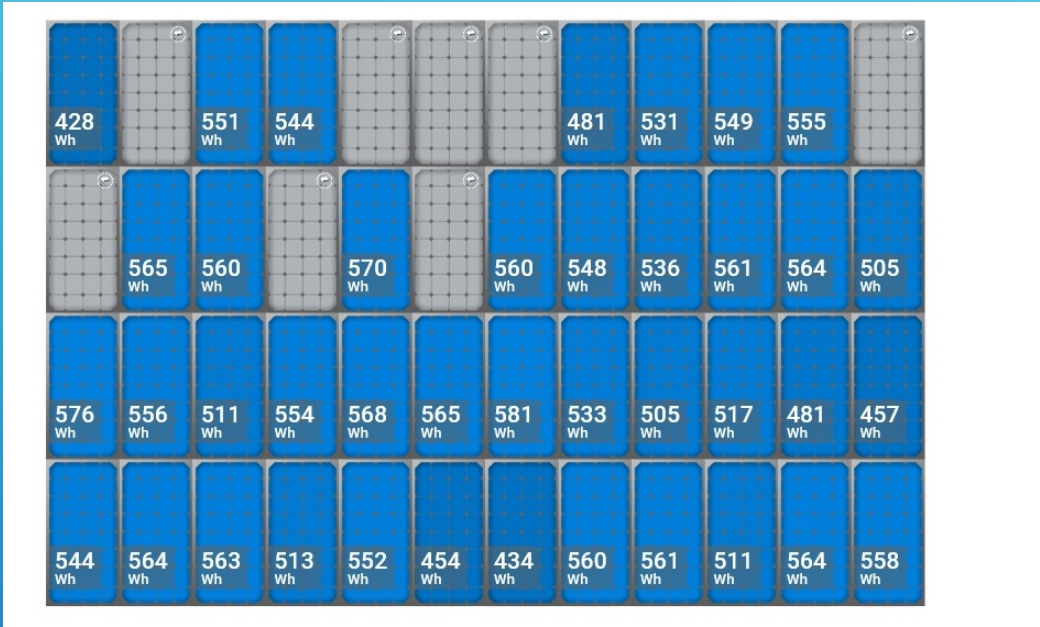
YES THIS DOES HAPPEN AND SO HOT SPOTS
ARE SOMETHING TO THINK ABOUT



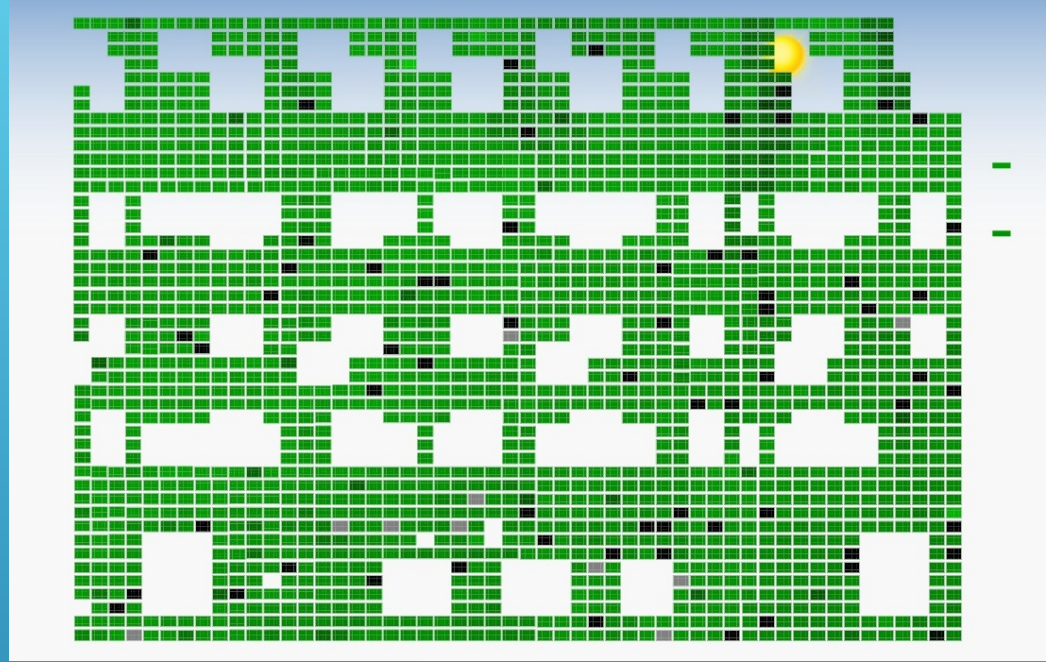
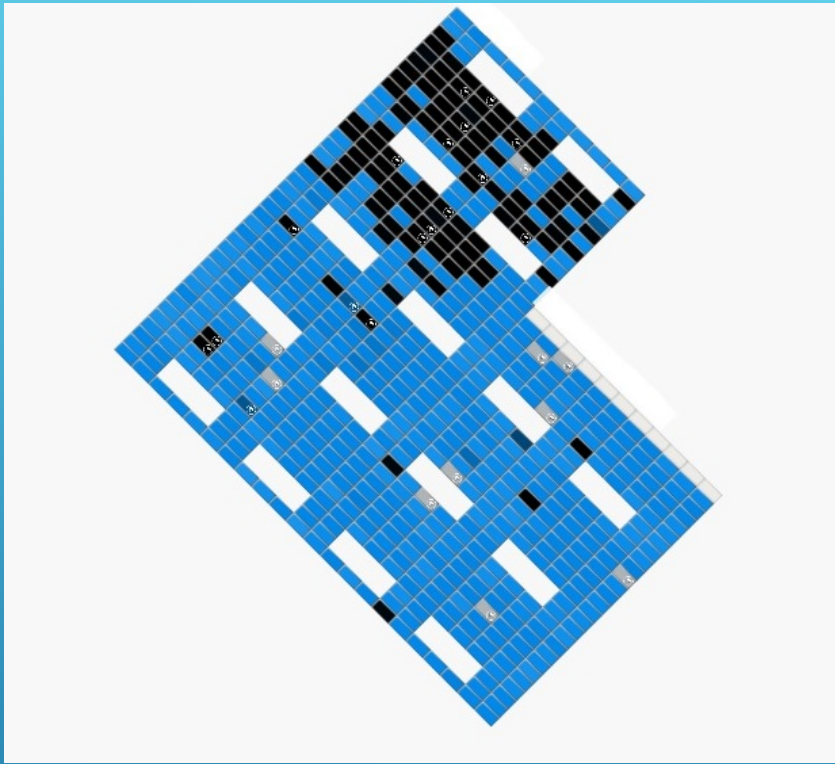
DRONES HELP US ON BIG SITES TO
IDENTIFY ISSUES FAST

- ▶ One of the items we have found that has become a great time saver and quick answer solutions and we find of one of the greatest benefits is when you have the great job of going to a site and you have to do an optimizer swap out or a micro inverter swap out.
- ▶ This is one of the best advantages we have found and this is what I want to focus on for this subject
- ▶ We know it is easy you just go on the map and get it taken care of-
- ▶ That is if you did the install and know the map is correct

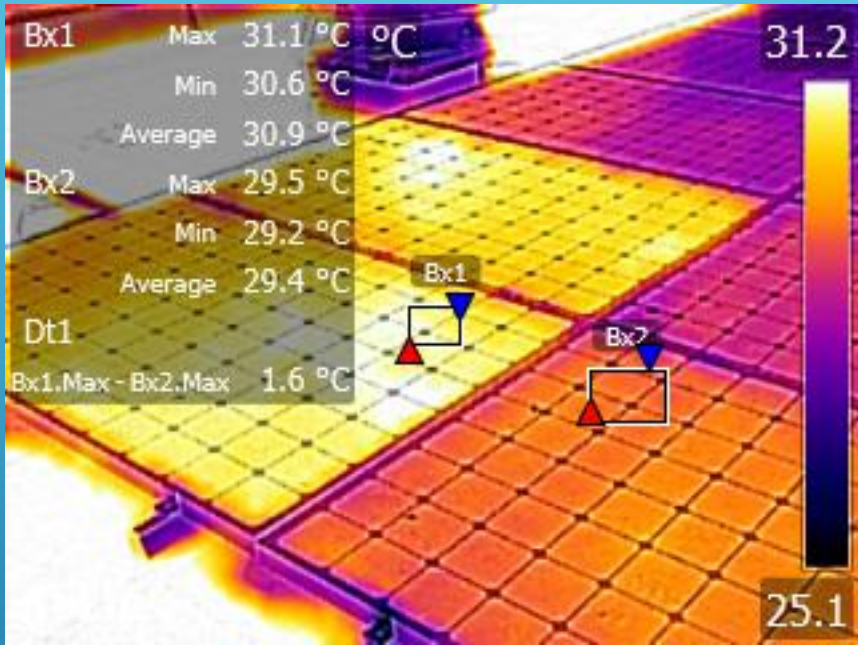
A MAJOR ADVANTAGE OF THERMAL SCANNING OF A PV SYSTEM



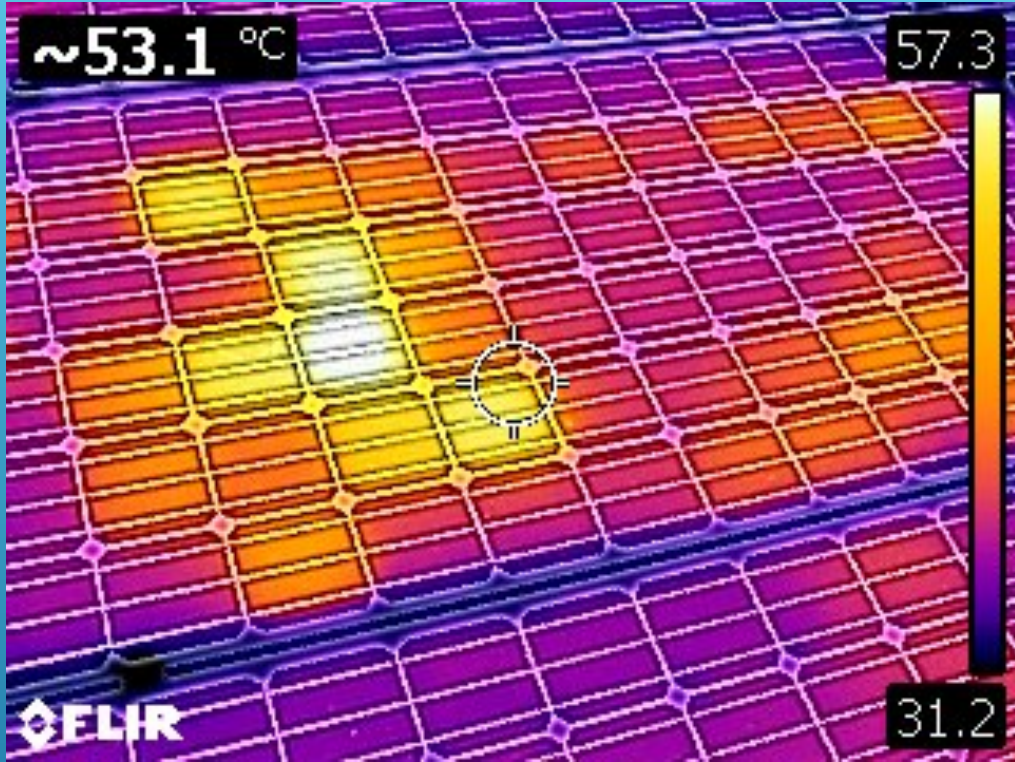
THIS WAS THE LAYOUT WE GOT THERE AND
FOUND THIS WAS REALLY THE LAYOUT ON
THE ROOF



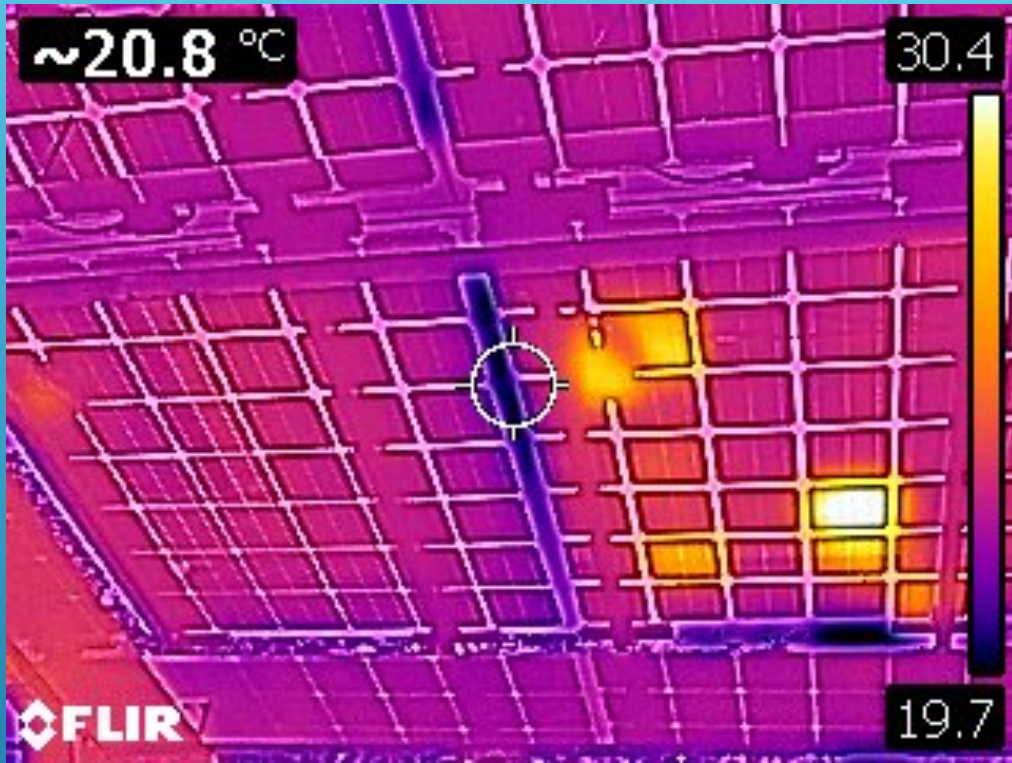
HOW ABOUT WHEN YOUR SITE IS ONE OF THESE AND YOU ARE THE MAINTENANCE COMPANY AND YOUR INSTALLER WENT OUT OF BUSINESS AND YOU QUICKLY REALIZE THE MAP IS WRONG- A LOT OF WHACK A MOLE GUESSING CAN TAKE PLACE



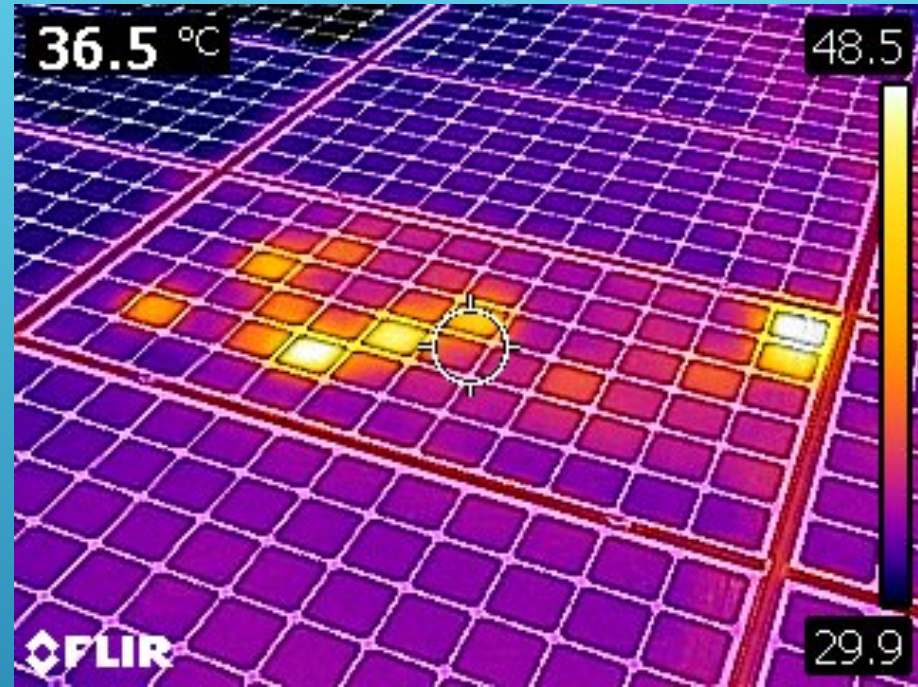
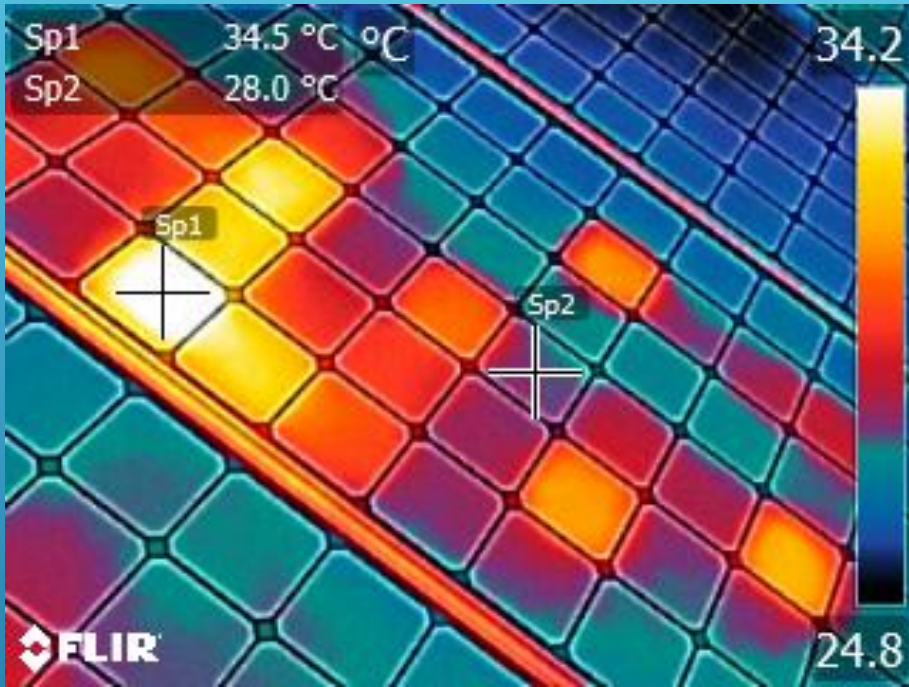
FOUND IT- WITH A DIFFERENTIAL TEMPERATURE OF 1.6°C – NOT PLUGGED IN FOUND THIS DURING A COMMISSIONING CHECK



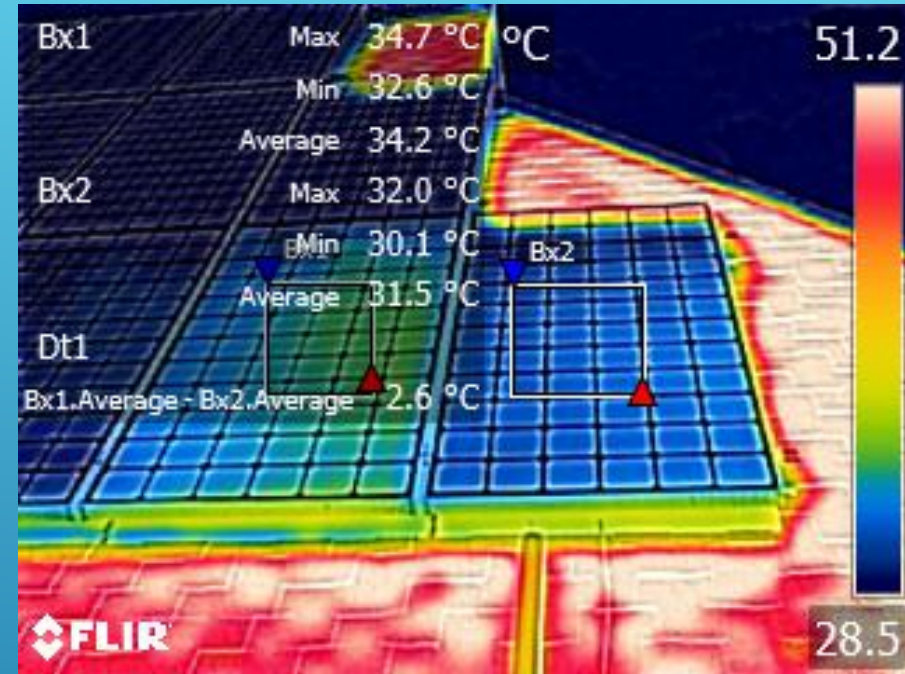
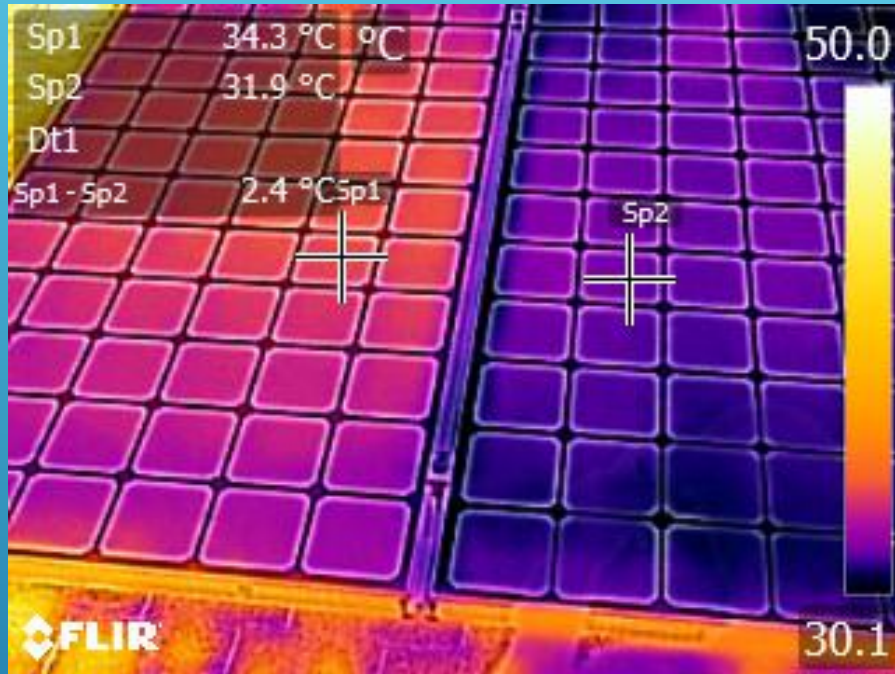
FOUND THIS ONE IN THE MIDDLE WAS
MAPPED FOR A CORNER LOCATION



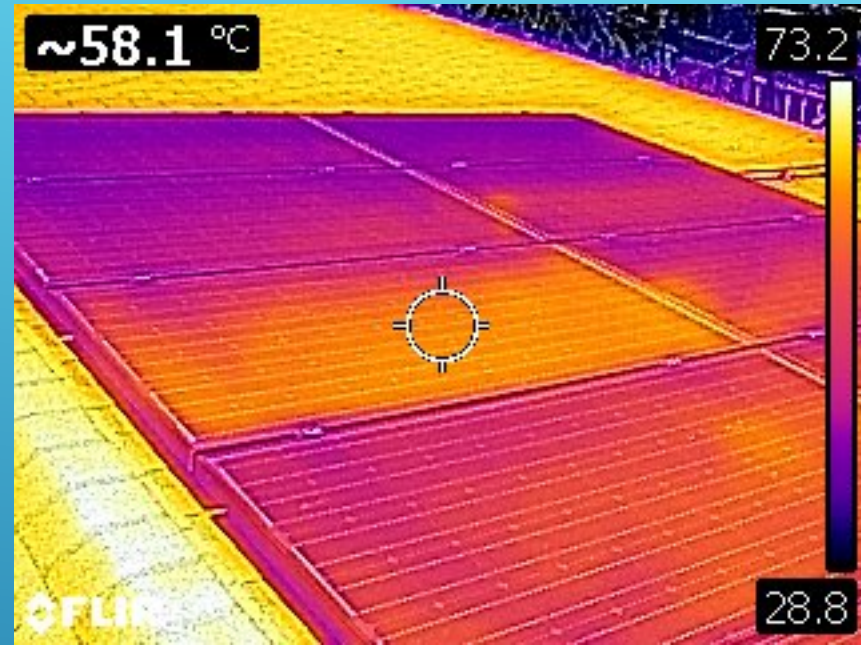
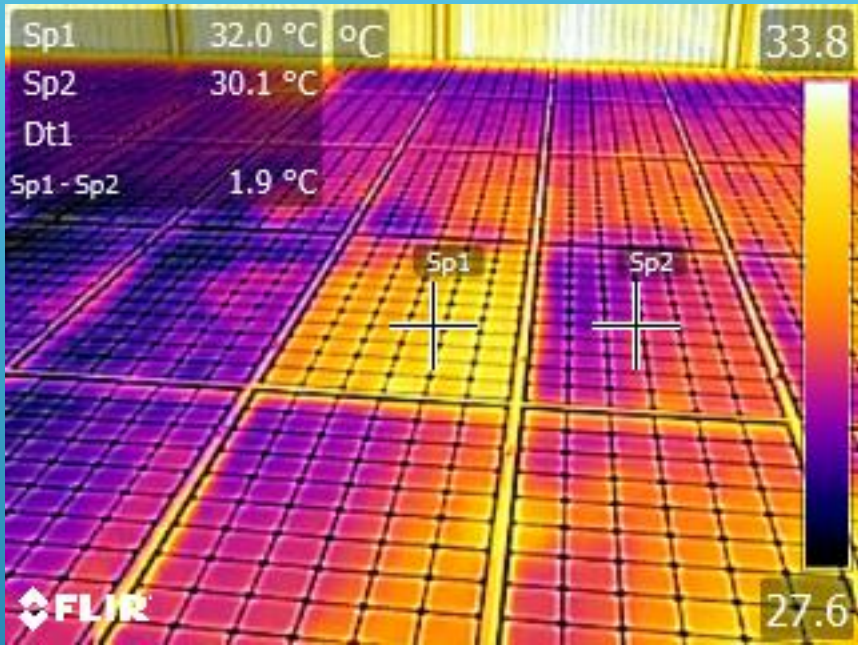
FROM UNDERNEATH OPTIMIZER FAILED
SIGNATURE ON THE PANEL GAVE IT AWAY-
THE MAP WAS NOT EVEN A MAP



CAN PICK THEM OUT- YOU KNOW
THERE IS AN ISSUE



MINOR DIFFERENCES IN TEMPERATURE
THESE ARE JUST 2.4° AND 2.6°C



THESE ARE JUST A COUPLE OF MORE THAT WE FOUND ON UNMAPPED PROPERLY SYSTEMS

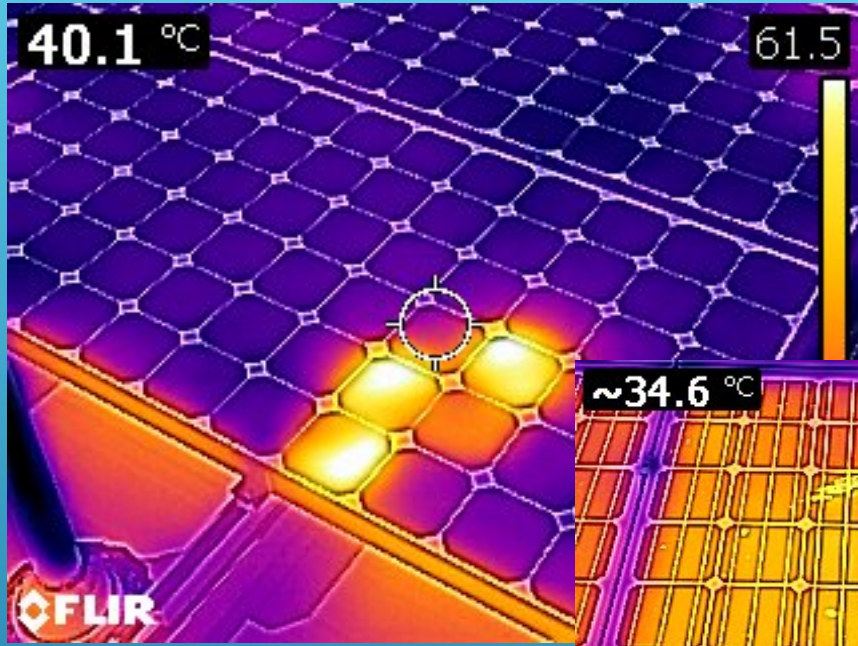
- ▶ This is a great tool to add to your O&M services and to help you on many aspects of the PV industry
- ▶ This like all tools needs to be learned to use but can be done
- ▶ With your pv knowledge and to add this it is a great and usable tool
- ▶ With all pv issues we need to understand our findings

SOME INFORMATION TO KNOW



- ▶ System design is needed
- ▶ Panel manufacturer and type
- ▶ Your irradiance
- ▶ If the system is off you will not be able to get a good scan
- ▶ The scan can help identify if something is not working but we are not focusing on that, that is another step
- ▶ Understand the parameters and how to use the thermal camera is a necessity
- ▶ Take a thermal imaging training course- like all other aspects of a professional get the proper training as there is really a lot more to it then just looking at a picture.

INFORMATION TO KNOW



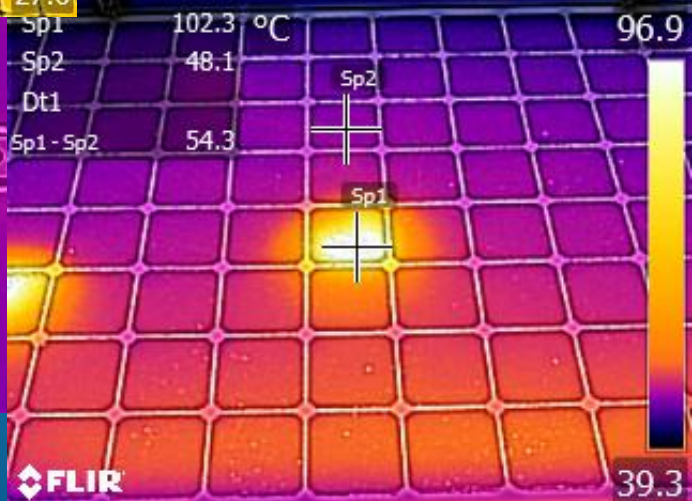
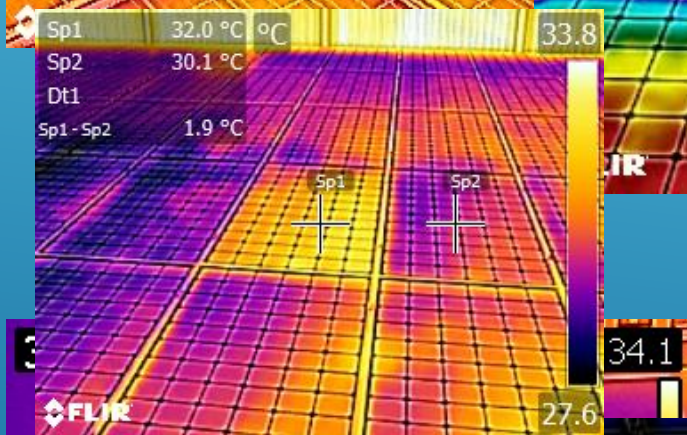
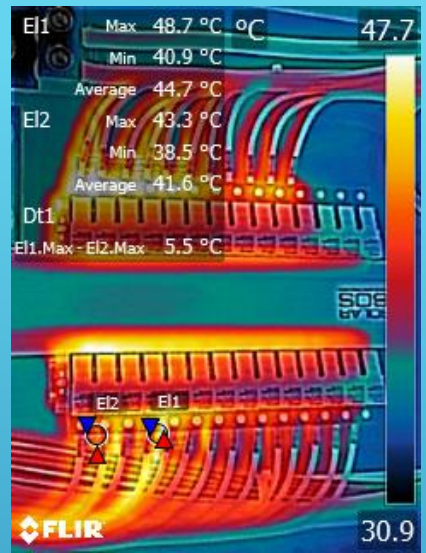
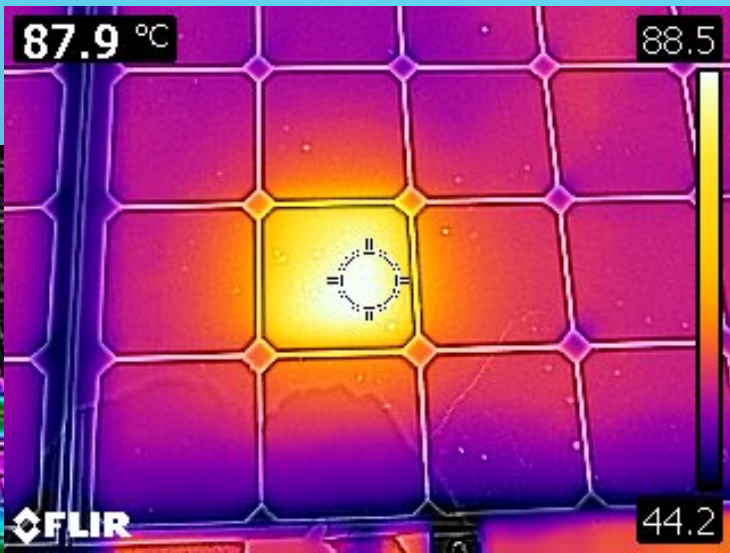
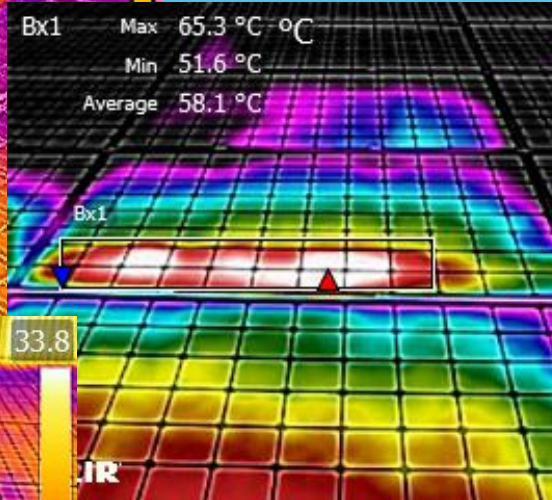
- ▶ We were told this has to be a major issue but the panel does not seem to have a problem –
- ▶ We asked for the digital images as we had an idea of what they were

UNDERSTANDING OF THE WHOLE OF THE SYSTEMS IS CRITICAL



- ▶ Keep a clear picture in your head, it is good to see an anomaly but understand it
- ▶ The bird poop and the shadow from the vent caused the anomalies-

UNDERSTAND THE WHOLE SCENE



- ▶ I want to take a moment to thank everyone here for allowing me to speak for a moment on a subject that I find remarkable and has incredible value
- ▶ Thank all the great people at ASES 2018 and all the people at the event to make it possible
- ▶ Want to say thank you to Randy Corey who told me that I need to get my thermal imaging certification that has led me down this amazing journey in O&M and

THANK YOU

A decorative graphic consisting of several parallel white lines of varying lengths, slanted diagonally from the bottom right towards the top right, set against a blue background.

- ▶ Contact information
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- ▶ www.pacificpanelcleaners.com
- ▶ 808-772-4705
- ▶ Questions and Answers-

