



# IR THERMOGRAPHIC INSPECTION DIGITAL REALTY TRUST DATACENTER

<b>CLIENT :</b>  <b>DIGITAL REALTY TRUST</b>  <b>Digital Realty Trust Singapore</b> 29A International Business Park	Site Address:	XXX Data Center
	Date of Inspection:	XXX June 2011
	Inspection Commissioned By:	 be first to inspire

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## What is Infrared?

### Thermography and Infrared Light

Infrared light or Thermography is the use of an infrared imaging and measurement camera to "see" and "measure" thermal energy emitted from an object. Thermal, or infrared energy, is light that is not visible because its wavelength is too long to be detected by the human eye; it's the part of the electromagnetic spectrum that we perceive as heat. Unlike visible light, in the infrared world, everything with a temperature above absolute zero emits heat. Even very cold objects, like ice cubes, emit infrared.

### Infrared Imaging

The higher the object's temperature, the greater the IR radiation emitted. Infrared allows us to see what our eyes cannot. Infrared thermography cameras produce images of invisible infrared or "heat" radiation and provide precise non-contact temperature measurement capabilities. Nearly everything gets hot before it fails, making infrared cameras extremely cost-effective, valuable diagnostic tools in many diverse applications. And as industry strives to improve manufacturing efficiencies, manage energy, improve product quality, and enhance worker safety, new applications for infrared cameras continually emerge.

### Why use infrared?

A picture says a thousand words; infrared thermography is the only diagnostic technology that lets you instantly visualize and verify thermal performance. FLIR's infrared cameras show you thermal problems, quantify them with precise non-contact temperature measurement, and document them automatically in seconds with professional easy-to-create IR reports.

### Infrared for Predictive Maintenance

Nearly everything that uses or transmits power gets hot before it fails. Cost effective power management is critical to maintaining the reliability of your electrical and mechanical systems. And today, no one would argue that infrared thermography is one of the most effective proven predictive maintenance (PM) technology available to quickly, accurately and safely locate problems prior to failure. Finding and fixing a poor electrical connection before a component fails can save you the much greater costs associated with manufacturing downtime, production losses, power outages, fires and catastrophic failures.

## IR Cameras for Mechanical & Electrical Applications

The use of thermography has revolutionized predictive maintenance inspection programs for virtually all types of industries.

- A thermal imaging camera is a reliable non- contact instrument which is able to scan and visualize the temperature distribution of entire surfaces of machinery and electrical equipment quickly and accurately.
- Thermography programs have contributed to substantial cost savings for our customers around the world.
- Utilities depend on thermography to avoid costly failures in power generation, transmission and distribution as infrared cameras help find anomalies before trouble strikes and service is affected
- **For Critical Utilities, failure is not an option. That's why infrared thermography has become the core of utility predictive maintenance programs around the world.**

## IR camera specification & Thermographer Particulars

### IR Camera's Specification

Make of Camera : FLIR  
Model : T360



### Imaging Performance

Field of View (FOV) / Close Focus Limit : 25° x 19° / 0.4 m  
 Thermal Sensitivity (NETD mK) : 60 mK @ +30° C  
 Detector Type : Focal Plane Array (FPA), microbolometer  
 IR Resolution : 320 x 240 pixels  
 Spectral Range : 7.5 to 13 μm  
 Digital Zoom and Pan/focus : 1 – 4x continuous auto & manual focus  
 IFOV (with 25° lens) : 1.36 mRad  
 Accuracy : +/- 2° C or +/- 2% of reading

### Thermographer's Particulars

Name : EDDIE LOW SOON HONG  
 Level of Certification : Infrared Thermographer Level 1  
 License Nos. : 2011SG10N007

**Project Background**

Client : XXXXXX  
 Site Address : XXXXXX  
 Inspection Date : XXXXXX

Equipment Schedule:

Item	Equipment – Distribution Board	Location
1	CRAC DB	Level 4, CRAC Room
2	DB UPS	Level 4, Equipment Room
3	EMSB	Level 4, Equipment Room
4	MSB	Level 4, Equipment Room
5	ESS MSBD L4	Level 4, Main Panel
6	MSBD L4	Level 4, Main Panel
7	PDU 1A	Level 4, Datacenter
8	PDU 1B	Level 4, Datacenter

**RATING FOR PRIORITIZE REPAIR WORKS**

This report includes the rating for those objects (abnormal) that had been scanned and appropriate action need to be taken. For those that are normal condition, the rating is “Normal”. Maintenance personnel may use this rating to prioritize those objects that need to be repair.

**Table Of Rating:**

Normal	N.A.	Normal Condition
Low	15°C – 30°C	Schedule Check Needed
Medium	30°C – 50°C	Monitoring the Situation Needed
High	> 50°C	Corrective Action Needed
N.A.	N.A.	No Load Or Not Operating
N.A.A.		No Load But Abnormal

When the thermographer provides a quantitative infrared inspection (measuring temperature), the temperature severity ratings are averaged to give you a recommended average repair priority rating. These repair ratings will help you to prioritize your maintenance servicing, and take note that the failure curves of many electrical and mechanical components are not linear and predictable. Therefore, the soonest to carry out investigation and repair all reported abnormal will minimize the failure and down time of operations. After repaired, it should be re-inspected to ensure that the potential problem has been corrected.

Type of Reporting used .... Qualitative or Quantitative

## APPENDIX A – Scanning Reports

### Photo & Identification – CRAC Distribution Board



Location	(Level 4, CRAC Room)
Equipment	CRAC DB
Nom load	100%
Actual load	75%
Rating	( Medium )
Recommendation	Monitor
Atmospheric Temperature	22.0°C
Area1 Min. Temperature	21.9°C
Area1 Max Temperature	33.8°C
Spot 1 Temperature	33.3°C

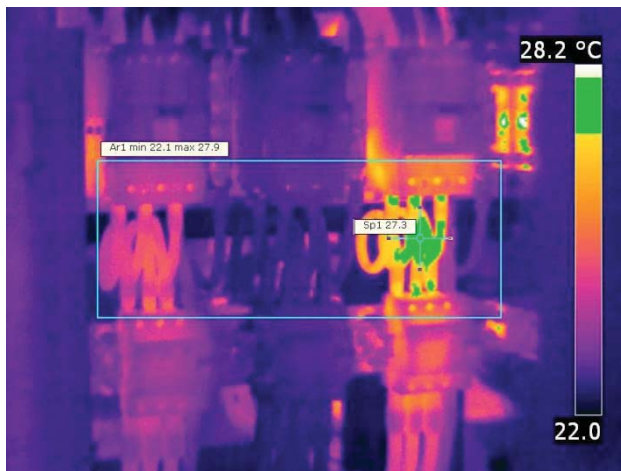
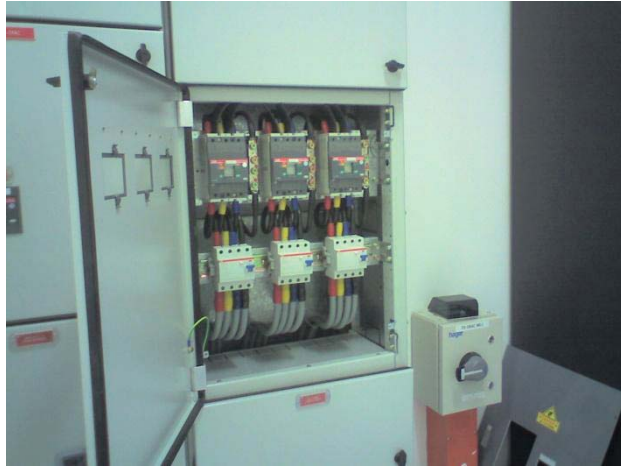
### Analysis & Comments:

During 75% load, the above thermal scan picture indicates that the relays temperature (33.8°C max) are higher than the ambience temperature but it is within the acceptable range of working condition as electromagnet component does generate heat during operation.

### Recommendation (if any):

Action: To monitor the temperature.

**Photo & Identification – CRAC Distribution Board**



Location	(Level 4, CRAC Room)
Equipment	CRAC DB
Nom load	100%
Actual load	75%
Rating	(Low)
Recommendation	Monitor
Atmospheric Temperature	22.0°C
Area1 Min. Temperature	22.1°C
Area1 Max Temperature	27.9°C
Spot 1 Temperature	27.3°C

**Analysis & Comments:**

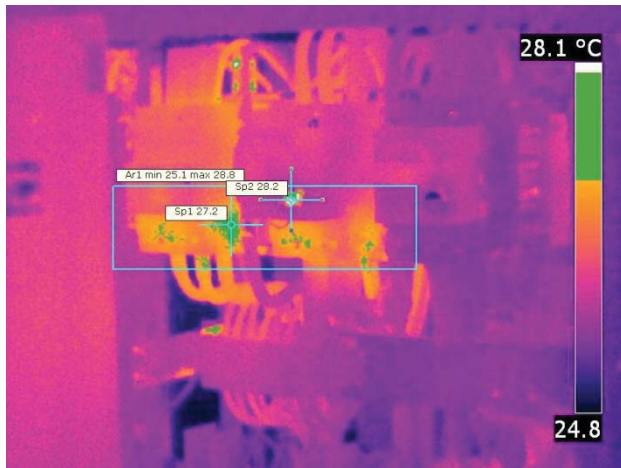
During 75% load, the above thermal scan picture indicates higher temperature (27.3°C) on CRAC 3 breaker than the surrounding, is due to the CRAC is in operation mode. The temperature shown is within the acceptable range.

**Recommendation (if any):**

Action: To monitor the temperature.



**Photo & Identification – UPS Distribution Board**



Location	(Level 4, Equipment Room)
Equipment	UPS DB
Nom load	100%
Actual load	30%
Rating	(Low)
Recommendation	Monitor
Atmospheric Temperature	22.0°C
Area1 Min. Temperature	25.1°C
Area1 Max Temperature	28.8°C
Spot 1 Temperature	27.2°C
Spot 2 Temperature	28.2°C

**Analysis & Comments:**

During 30% load, the above thermal scan picture indicates that the breakers temperature (25.1°C to 28.8°C) are within the acceptable range.

**Recommendation (if any):**

Action: To monitor the temperature.



**Photo & Identification – Fan Coil Unit Board**



Location	(Level 4, Equipment Room)
Equipment	FCU Board
Nom load	100%
Actual load	50%
Rating	(Medium)
Recommendation	Monitor
Atmospheric Temperature	22.0°C
Area 1 Min. Temperature	27.0°C
Area 1 Max. Temperature	42.8°C
Area 2 Min. Temperature	29.4°C
Area 2 Max. Temperature	46.3°C
Area 3 Min. Temperature	28.1°C
Area 3 Max. Temperature	47.3°C

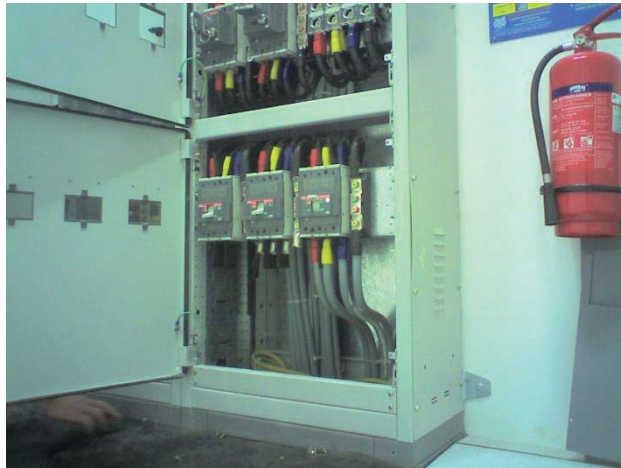
**Analysis & Comments:**

During 50% load, the above thermal scan picture indicates 3 hot area. Area 1 – step down transformer which has max temperature of 42.8°C, Area 2 – relays max temperature at 46.3°C, and Area 3 – terminal block max temperature at 47.3°C.

**Recommendation (if any):**

Action: To monitor the temperature of Area 2 and Area 3.

**Photo & Identification – MSB Distribution Board**



Location	(Level 4, Equipment Room)
Equipment	MSB
Nom load	100%
Actual load	75%
Rating	(Low)
Recommendation	Monitor
Atmospheric Temperature	22.0°C
Area1 Min. Temperature	25.7°C
Area1 Max Temperature	29.6°C
Spot 1 Temperature	28.2°C
Line 1 Min. Temperature	26.5°C
Line 1 Max. Temperature	29.0°C
Line 2 Min. Temperature	27.1°C
Line 2 Max. Temperature	27.8°C

**Analysis & Comments:**

During 75% load, the above thermal scan picture indicates that the breakers (CRAC) temperature (25.7°C to 29.6°C) are within the acceptable range.

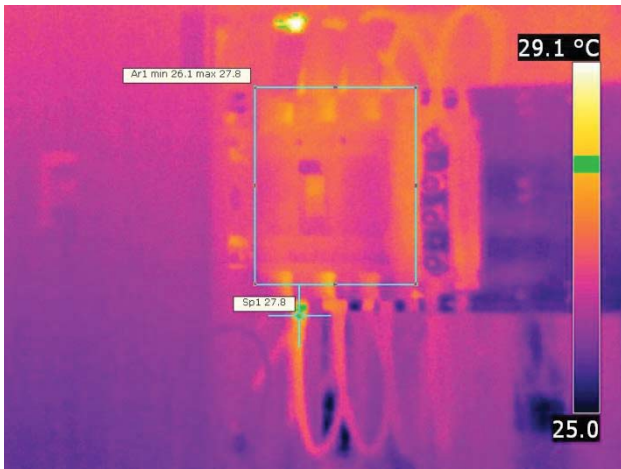
**Recommendation (if any):**

Action: To monitor the temperature.

**Photo & Identification – ESS Main Supply Board Distribution (ESS MSBD L4)**



Location	Level 4, Front Reception
Equipment	ESS MSBD L4
Nom load	100%
Actual load	30%
Rating	(Low)
Recommendation	Monitor
Atmospheric Temperature	23.5°C
Area1 Min. Temperature	26.1°C
Area1 Max Temperature	27.8°C
Spot 1 Temperature	27.8°C



**Analysis & Comments:**

During 30% load, the above thermal scan picture indicates that the breakers temperature (26.1°C to 27.8°C) and Spot 1 – cable terminal temperature (27.8°C) are within the acceptable range.

**Recommendation (if any):**

Action: To monitor the temperature.

**Photo & Identification – Main Supply Board Distribution (MSBD)**



Location	Level 4, Front Reception
Equipment	MSBD
Nom load	100%
Actual load	60%
Rating	(Medium)
Recommendation	Monitor
Atmospheric Temperature	23.5°C
Line 1 Min. Temperature	36.6°C
Line 1 Max. Temperature	41.1°C
Line 2 Min. Temperature	30.9°C
Line 2 Max. Temperature	40.9°C
Spot 1 Temperature	41.4°C
Spot 2 Temperature	37.2°C



**Analysis & Comments:**

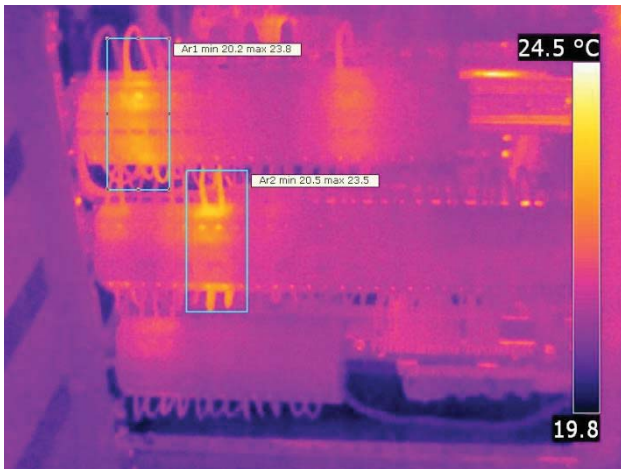
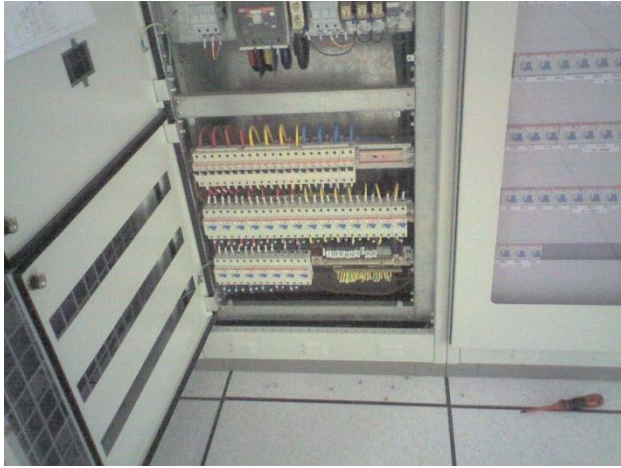
During 60% load, the above thermal scan picture indicates that the Spot 1- breaker temperature (41.4°C) and Spot 2 – cable terminal (37.2°C) are within the acceptable range.

**Recommendation (if any):**

Action: To monitor the temperature.



**Photo & Identification – Power Distribution Unit 1A**



Location	Level 4, Datacenter
Equipment	PDU 1A
Nom load	100%
Actual load	40%
Rating	(Low)
Recommendation	Monitor
Atmospheric Temperature	23.5°C
Area 1 Min. Temperature	20.2°C
Area 1 Max. Temperature	23.8°C
Area 2 Min. Temperature	20.5°C
Area 2 Max. Temperature	23.5°C

**Analysis & Comments:**

During 40% load, the above thermal scan picture indicates that some breakers has higher load than the others. Area 1 – breaker temperature (20.2°C to 23.8°C) and Area 2 – breaker temperature (20.5°C to 23.5°C). Both breakers temperature are within the nominal range of operating.

**Recommendation (if any):**

Action: To monitor the temperature and the load distribution.

## INSPECTION SUMMARY

This inspection was conducted on 2<sup>nd</sup> June 2011 and completed on the same day. The objects are mainly Electrical Distribution Board (DB). There is 1 unit of CRAC DB, 2 units of DB UPS, 1 unit of EMSB, 1 unit of MSB, 1 unit of FCU Board, 1 unit of ESS MSBD L4, 1 unit of MSBD L4, 1 unit of PDU 1A, 1 unit of PDU 1B, 1 unit of PDU 2A (unused), and 1 unit of PDU 2B (unused).

The list of equipments that were inspected is listed below. There are 3 items recorded as Medium in this report which requires attention on.

S/N.	Equipment	Location	Rating
1	CRAC DB	Level 4, CRAC Room	Medium
2	DB UPS	Level 4, Equipment Room	Low
3	FCU Board	Level 4, Equipment Room	Medium
4	EMSB	Level 4, Equipment Room	Normal
5	MSB	Level 4, Equipment Room	Low
6	ESS MSBD L4	Level 4, Main Panel (Reception)	Low
7	MSBD L4	Level 4, Main Panel (Reception)	Medium
8	PDU 1A	Level 4, Datacenter	Low
9	PDU 1B	Level 4, Datacenter	Normal
10	PDU 2A	Level 4, Datacenter	N.A.
11	PDU 2B	Level 4, Datacenter	N.A.