



# PLETICS UPDATE: OFFICE IMAGING DEVICES

CALPLUG WORKSHOP

UC IRVINE

APRIL 22, 2024

# TEST METHODOLOGY

- **Conforms to ENERGY STAR Test Method for Determining Imaging Equipment Energy Use – November 2018**

- **TEC Calculation for Printers, Fax Machines, Digital Duplicators with Print Capability, and MFDs with Print Capability**

$$TEC_{2018} = \left[ 5 \times \left( E_{JOB\_DAILY} + (2 \times E_{FINAL}) + \left[ 24 - \frac{N_{JOBS}}{16} - (2 \times t_{FINAL}) \right] \times \frac{E_{SLEEP}}{t_{SLEEP}} \right) + 48 \times \frac{E_{SLEEP}}{t_{SLEEP}} \right]$$

Where:

- TEC<sub>2018</sub> is the typical weekly energy consumption for printers, digital duplicators with print capability, and MFDs with print capability, expressed in kilowatt-hours (kWh) and rounded to the nearest 0.01 kWh for reporting;
- E<sub>JOB\_DAILY</sub> is the daily job energy, as calculated per Equation 5, in kWh;
- E<sub>FINAL</sub> is the final energy, as measured in the test procedure, converted to kWh;
- N<sub>JOBS</sub> is the number of jobs per day, as calculated in the test procedure,
- t<sub>FINAL</sub> is the final time to Sleep, as measured in the test procedure, converted to hours;
- E<sub>SLEEP</sub> is the Sleep energy, as measured in the test procedure, converted to kWh; and
- t<sub>SLEEP</sub> is the Sleep time, as measured in the test procedure, converted to hours.

# TEST EQUIPMENT

<b>RMS Voltage Accuracy</b>	<b>0.5% up to 14 Amp continuous; up to 1.0% over 14 Amp when equipment being monitored is at 100% duty cycle</b>
<b>RMS Current Accuracy</b>	0.5% up to 14 Amp continuous; up to 1.0% over 14 Amp when equipment being monitored is at 100% duty cycle
<b>Active Power Accuracy</b>	0.5% up to 14 Amp continuous; up to 1.0% over 14 Amp when equipment being monitored is at 100% duty cycle
<b>Active Energy Accuracy</b>	0.5% up to 14 Amp continuous; up to 1.0% over 14 Amp when equipment being monitored is at 100% duty cycle
<b>Power Factor Accuracy:</b>	$\pm 0.02$

- Test equipment consisted of the Onset HOB0 Plug Load Data Logger (UX120-018) and the compatible HOB0ware software installed on a connected laptop
- HOB0 logger is plugged in between the device and the building wall outlet, thereby collecting information about the current flowing through it. The device records six separate metrics: watts (W), watthours (Wh), power factor (PF), voltage (V), current (A), and apparent power (VA).



# FREESTANDING COLOR MULTIFUNCTION DEVICES

## Selected Devices and Manufacturer Provided Information

UUT	Speed (ppm)	Advertised Power Consumption	Energy Star TEC (kWh/wk)
Large Color MFD 1	60	Active: <1,584 W; LPM: 0.59W Auto Off: N/A	0.762 (mfr.) 0.89 (Energy Star)
Large Color MFD 2	55	Active: 787 W avg. LPM:95 W avg. Auto Off: 1.2 W avg.	0.81 (Energy Star)
Large Color MFD 3	31	Active: < 1,300 W; Sleep Mode: 0.65W	0.37 (Mfr; Energy Star)
Large Color MFD 4	36	Active: <750 W LPM: <82 W Auto Off: <4 W	0.52 (Energy Star)
Large Color MFD 5	55	Active: 787 W avg. LPM:95 W avg. Auto Off: 1.2 W avg.	0.81 (Energy Star)



# FREESTANDING COLOR MULTIFUNCTION DEVICES

## Measured Energy Consumption

UUT	Active Average (W)	Sleep Average (W)	Off Energy (W)	TEC (kWh/wk)
Large Color MFD 1	22.63	8.926	0.849	2.35
Large Color MFD 2	22.0	5.85	0.43	1.87
Large Color MFD 3	8.44	6.67	0.31	1.43
Large Color MFD 4	20.96	2.36	0.27	1.42
Large Color MFD 5	36.38	7.6	0.34	3.51

## Measured Time to Sleep

UUT	Time to Sleep (Hrs)	Final Time to Sleep (Hrs)
Large Color MFD 1	0.11	0.1
Large Color MFD 2	0.08	0.03
Large Color MFD 3	6	2.83
Large Color MFD 4	7.5	1.0
Large Color MFD 5	1.0	0.5

# FREESTANDING MONOCHROME MULTIFUNCTION DEVICES

## Selected Devices and Manufacturer Provided Information

UUT	Speed (ppm)	Advertised Power Consumption	Energy Star TEC (kWh/wk)
Large Mono MFD 1	40	Active: < 1500 W	0.55 (Energy Star)
Large Mono MFD 2	40	Active: 2.7W (avg) Sleep: 1W (avg)	2.87

# FREESTANDING MONOCHROME MULTIFUNCTION DEVICES

Measured Energy Consumption

UUT	Active Average (W)	Sleep Average (W)	Off Average (W)	TEC (kWh/wk)
Large Mono MFD 1	21.41	30.91	0.01	5.7
Large Mono MFD 2	41.71	7.11	3.31	3.86

Measured Time to Sleep

UUT	Time to Sleep (Hrs)	Final Time to Sleep
Large Mono MFD 1	0.02	0.02
Large Mono MFD 2	1.0	20

# DESKTOP LASER MULTIFUNCTION DEVICES

Selected Devices and Manufacturer Provided Information

UUT	Speed (ppm)	Advertised Power Consumption	ENERGY STAR TEC
Desktop Laser MFD 1	40	583 watts (Print/Copy), 9.1 watts (Ready), 2.7 watts (Sleep), 0.7 watts (Auto-On/Auto-Off, via USB connectivity), 0.1 watts (Shutdown or Off)	
Desktop Laser MFD 2	22	361 watts (active printing), 7.8 watts (ready), 0.8 watts(sleep), 0.05 watt (Manual-Off), 0.05 (Auto-off/Manual-on), 0.06 watt(Auto-Off/Wake on LAN) [2]	0.25
Desktop Laser MFD 3	22	361 watts (active printing), 7.8 watts (ready), 0.8 watts(sleep), 0.05 watt (Manual-Off), 0.05 (Auto-off/Manual-on), 0.06 watt(Auto-Off/Wake on LAN) [2]	0.25
Desktop Laser MFD 4	35	Maximum: Approx. 1610 W Standby: Approx. 24 W Sleep Mode: Approx. 1 W	0.34
Desktop Laser MFD 5	25	430 W active 75 W ready 10.1 W Sleep 1.2 W Deep Sleep 0.02 W Power Off	



# DESKTOP LASER MULTIFUNCTION DEVICES

## Measured Energy Consumption

UUT	Active Average (W)	Sleep Average (W)	Off Average (W)	TEC (kWh/wk)
Desktop Laser MFD 1	7.5	0.55	0.04	0.4
Desktop Laser MFD 2	5.45	3.05	0.04	0.64
Desktop Laser MFD 3	5.19	2.5	0.03	0.59
Desktop Laser MFD 4	5.46	0.68	0.07	0.4
Desktop Laser MFD 5	12.61	0.84	0.00	0.47

## Measured Time to Sleep

UUT	Time to Sleep (Hrs)	Final time to sleep (Hrs)
Desktop Laser MFD 1	0.25	4.0
Desktop Laser MFD 2	0.016	4.0
Desktop Laser MFD 3	0.016	4.0
Desktop Laser MFD 4	0.016	0.016
Desktop Laser MFD 5	0.016	4.0

# DESKTOP LASER PRINTERS

Selected Devices and Manufacturer Provided Information

UUT	Speed ppm)	Advertised Power Consumption	ENERGY STAR TEC
Desktop Laser Printer 1	55	780 watts (printing), 15.3 watts (ready), 3.1 watts (sleep), < 0.1 watts (Auto Off/Manual On), < 0.1 watts (Manual Off) [3]	0.6
Desktop Laser Printer 2	32	780 watts (printing), 15.3 watts (ready), 3.1 watts (sleep), < 0.1 watts (Auto Off/Manual On), < 0.1 watts (Manual Off) [3]	1.36
Desktop Laser Printer 3	28	Active: 570 W Ready: 17.6 W Sleep: 2.4 W Auto-off: 0.6 W Off: 0.05 W	
Desktop Laser Printer 4	35	570 watts (Printing), 7.3 watts (Ready), 1.68 watts (Sleep), 0.1 watts (Off)	

# DESKTOP LASER PRINTERS

## Measured Energy Consumption

UUT	Active Average (W)	Sleep Average (W)	Off Average (W)	TEC (kWh/wk)
Desktop Laser Printer 1	11.37	1.71	1.91	0.72
Desktop Laser Printer 2	21.70	0.18	0.01	1.01
Desktop Laser Printer 3	10.38	2.33	0.02	0.87
Desktop Laser Printer 4	7.19	3.46	0.07	0.85

## Measured Time to Sleep

UUT	Time to Sleep (Hrs)	Time to Sleep Final (Hrs)
Desktop Laser Printer 1	0.05	0.01
Desktop Laser Printer 2	0.5	0.5
Desktop Laser Printer 3	1.0	8.0
Desktop Laser Printer 4	1.0	2.0

# INKJET COLOR MULTIFUNCTION DEVICES

Selected Devices and Manufacturer Provided Information

UUT	Speed (ppm)	Advertised Power Consumption	Energy Star OM (W)
Inkjet MFD 1	15	N/A	1.67
Inkjet MFD 2	19	27.0W Copying (0.9W Standby)	1.17
Inkjet MFD 3	25	Active: 22 W Power Off: 0.2 W	0.88
Inkjet MFD 4	35	Active: 20 W Ready: 3.5 W Sleep: 1.2 W Off: 0.2 W	0.94
Inkjet MFD 5	22	N/A	1.08

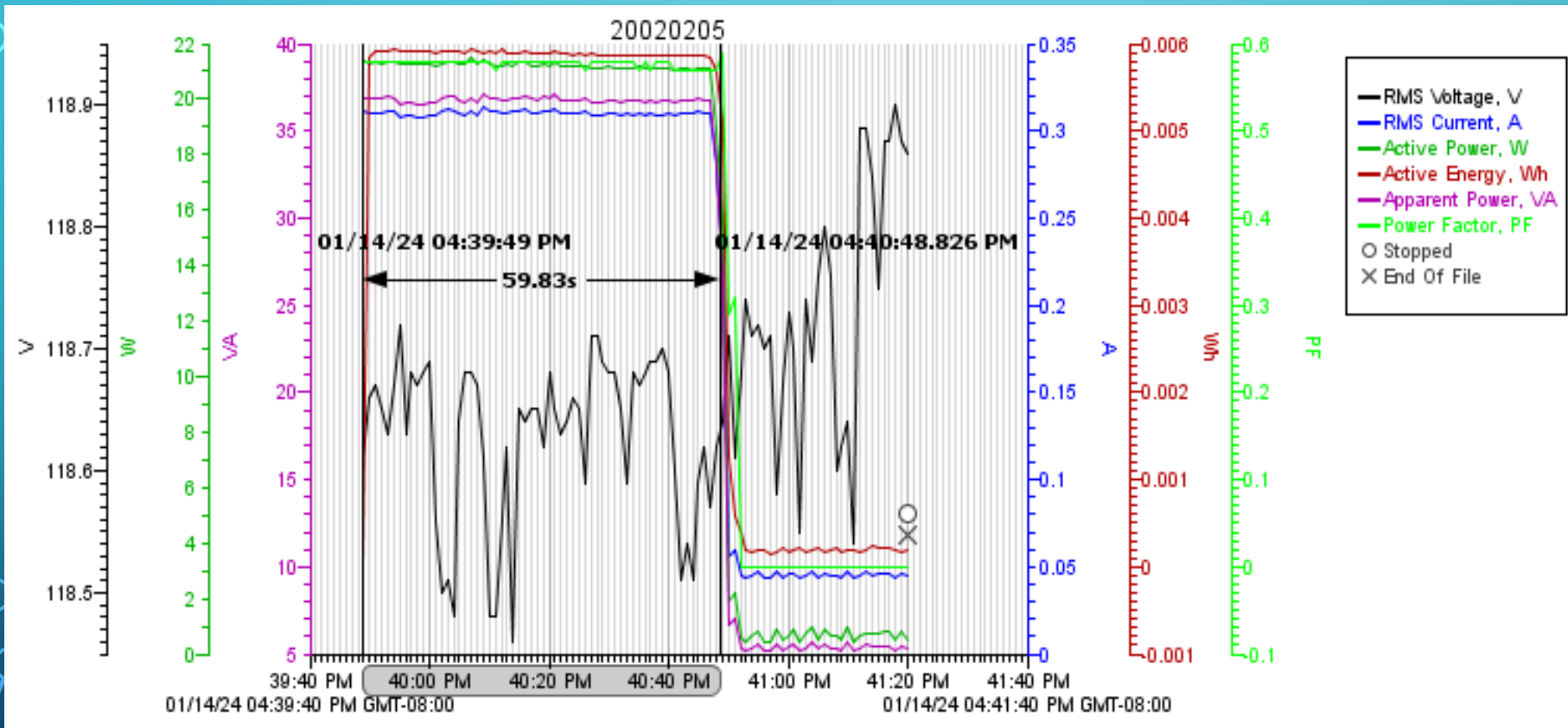


# INKJET COLOR MULTIFUNCTION DEVICES

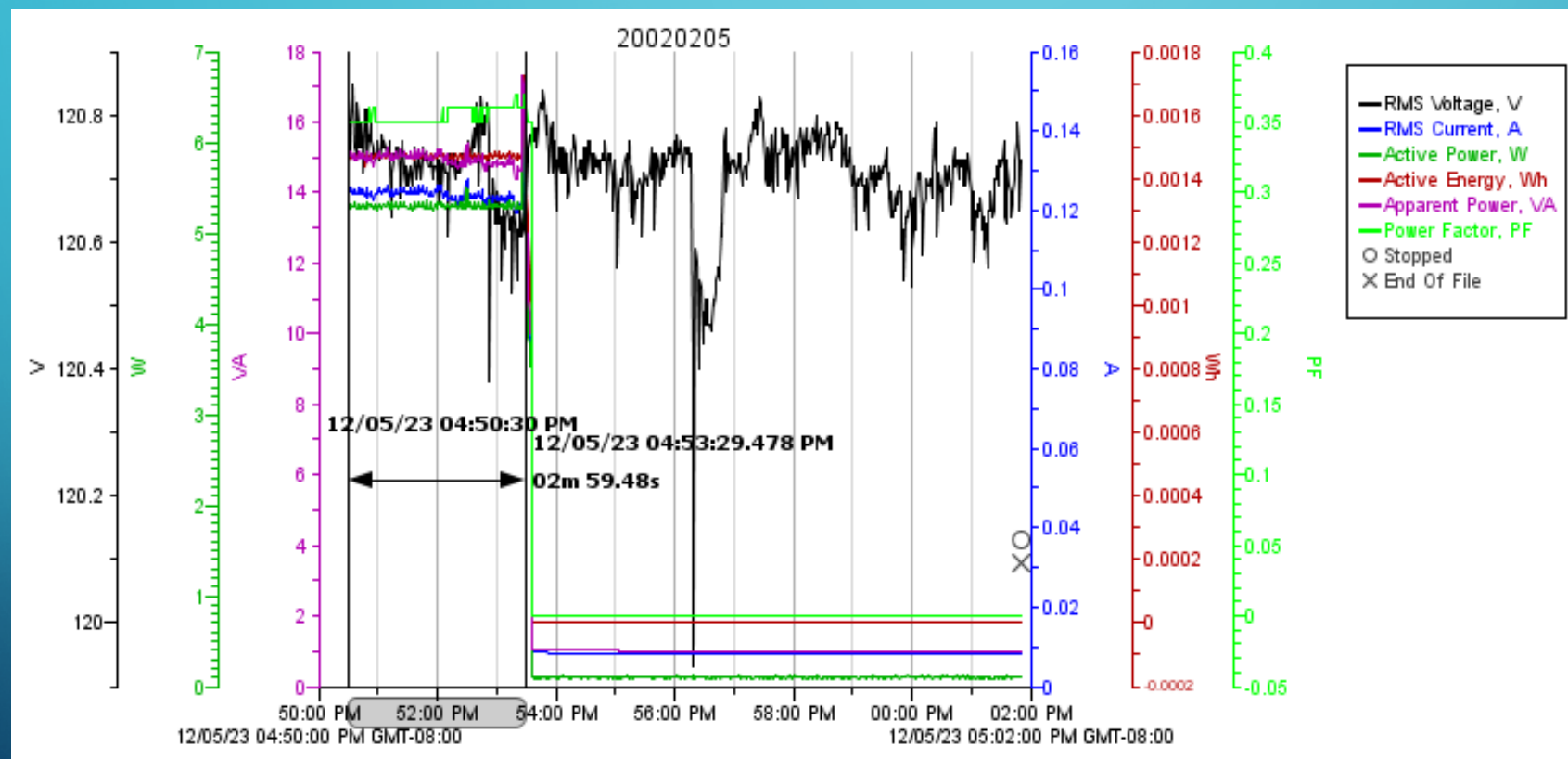
Measured Energy Consumption, Sleep Average (OM) and TEC

UUT	Active Average (W)	Sleep Average (W)	Off Average (W)	TEC (kWh/wk)
Inkjet MFD 1	1.04	2.28	0.1	0.4
Inkjet MFD 2	1.20	0.30	0.16	0.11
Inkjet MFD 3	0.96	0.93	0.07	0.23
Inkjet MFD 4	0.59	1.0	0.04	0.18
Inkjet MFD 5	1.20	1.98	0.04	0.36

# SAMPLE: TRANSITION TO SLEEP



# SAMPLE: AUTO OFF



# OVERALL FINDINGS

- Freestanding Color MFDs:
  - All devices were within published ranges for active and off modes.
  - The devices exhibited higher than advertised low power mode energy usage, leading to higher TEC values compared to ENERGY STAR database.
  - Two devices also took longer than 5 hours to enter low power/sleep.
- Freestanding Monochrome MFDs:
  - One device exhibited unusually high active and off energy usage, and did not enter sleep mode in the final time-to-sleep measurement.



# OVERALL FINDINGS (CONT.)

- Desktop Laser MFDs:
  - Two devices exhibited higher than advertised low power mode energy usage.
  - Time-to-sleep conformed to settings.
- Desktop Laser Printers:
  - All devices were within advertised ranges for all measurements.
  - Time-to-sleep conformed to settings.
- Inkjet Color MFDs:
  - One device showed higher than advertised OM.
  - All other devices were within advertised ranges.

## OVERALL FINDINGS (CONT.)

- Preliminary analysis suggests that excessive energy usage during low power/sleep may be due in part to internet connectivity interference (e.g., re-activation of ports)
- Some devices did not enter the final low-power to off sequence in a timely manner (4+ hours)
- We are currently analyzing data to observe trends in building power factor

# PRELIMINARY RECOMMENDATIONS

- Develop an ENERGY STAR test method to characterize effects of internet connectivity on imaging device energy usage during active and low power modes. Test devices with internet connectivity for interference in entering progressive low power/sleep modes.
- Ship products with automatic standby modes enabled.
- Non-Code Recommendations:
  - Uniform labeling of energy consumption metrics for easier consumer comparison across products



# THANK YOU!

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## **CALPLUG**

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