

MSHP vs Baseboard Electric

Direct Performance Comparison
April 2016

David Adams, P. Eng.

Overview of Study Case

- 10 year old home, registered R2000 construction, located in St. John's region
- 2 story, approximately 4000ft²
 - Entire house temperature maintained at 22C, day and night, including developed basement and in-house garage (20C for garage)
 - Night setback not used since MSHP installed
- Initially built with baseboard heaters (20kW installed)
- Retrofitted with MSHP in Nov 2012 with additional units installed in Nov 2014.
 - 3 outdoor units, each with 2 indoor heads
 - Panasonic CU-2E18NBU outdoors, CS-E12NKUAW indoors
 - Baseboard heaters not used since Nov 2014
- Summer air conditioning available
- Installed MSHP heating capacity
 - 18kW rated (8C), 3 x 6kW
 - 20200Btu of heating each
 - Rated input 1.6kW each for COP of 3.75 at full load
 - Capacity reduces to 9.3kW @ -15C, 3 x 3.3kW
 - Rated input 1.4kW each for COP of 2.2 at full load
- Maximum installed heating demand
 - 20.0kW - Baseboard heaters
 - 4.8kW - MSHP (3 x 1.6kW)

Heating Equipment Comparison

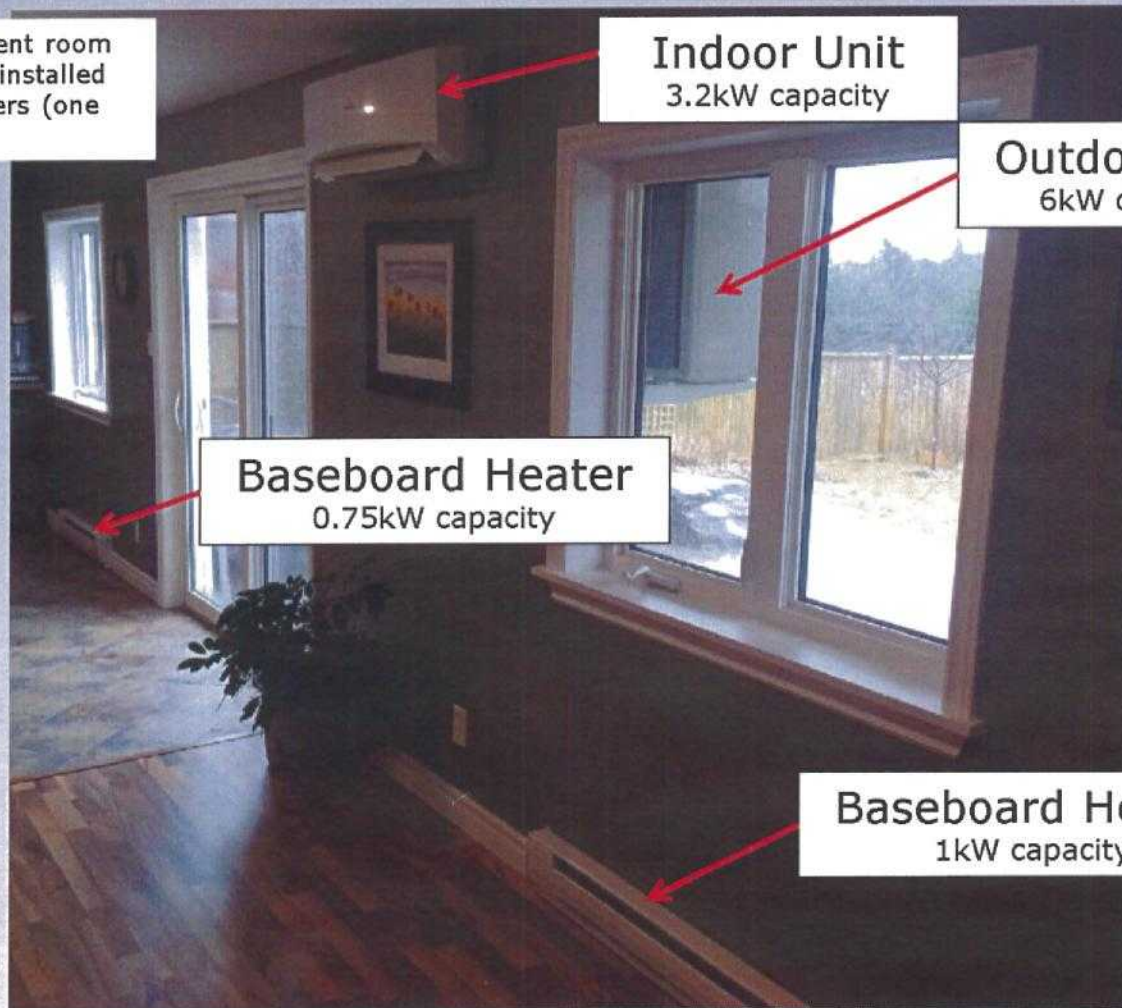
This is a basement room with 2.75kW of installed baseboard heaters (one not shown)

Indoor Unit
3.2kW capacity

Outdoor Unit
6kW capacity

Baseboard Heater
0.75kW capacity

Baseboard Heater
1kW capacity



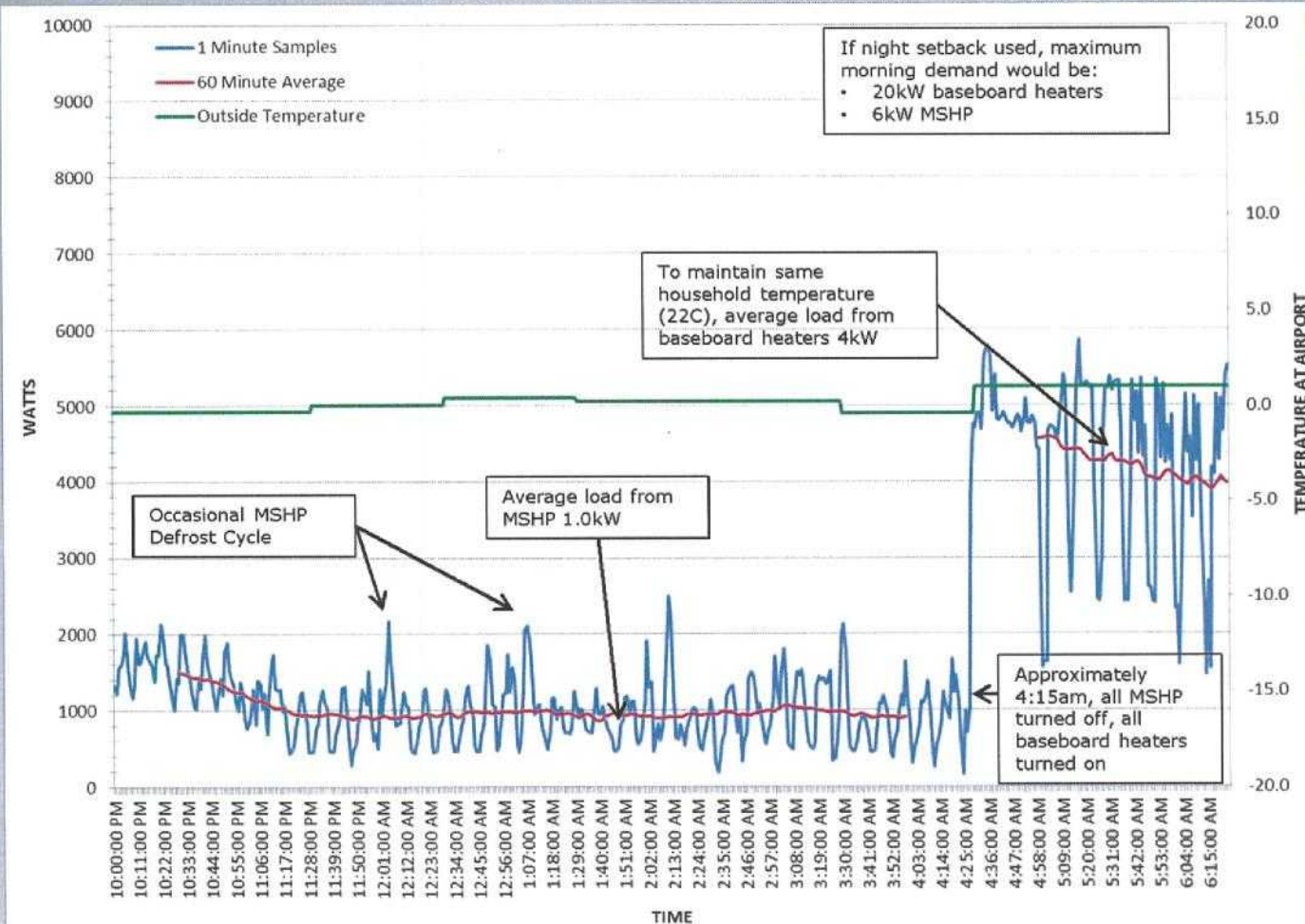
Control of Heaters

- MSHP operated in full auto mode. The following features are not used:
 - Quiet mode
 - Manual indoor fan speed control
 - Manual control of indoor louver direction
- Night setback not used for MSHP or electric baseboard heaters
- Electrical baseboard heaters controlled from electronic thermostats

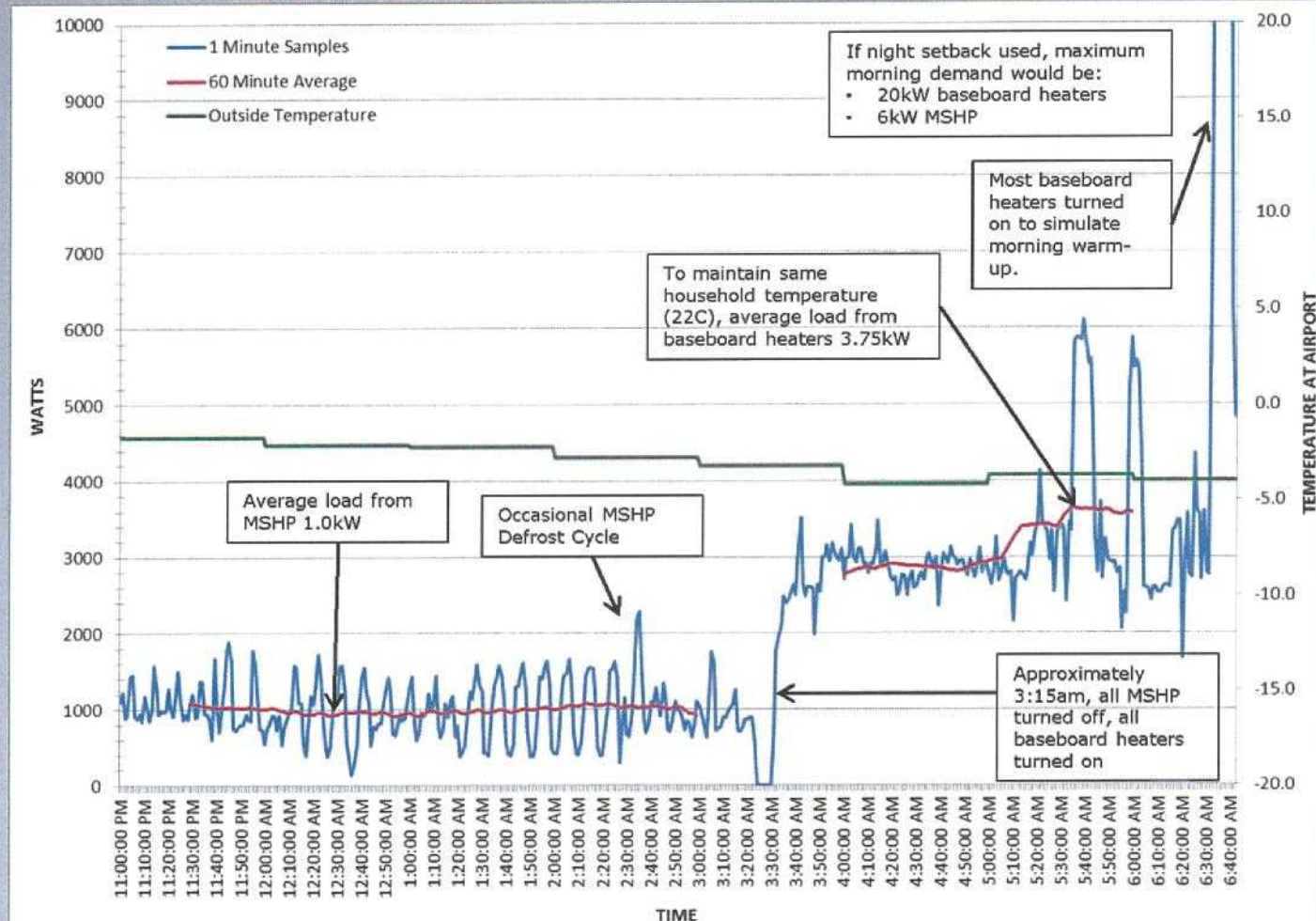
Testing Setup

- Home power monitoring system from Efergy
 - Measures current at main panel breaker (both wires) and multiplies by system voltage
 - System records power at 1 minute intervals
- Testing conducted at night (11pm-6am)
 - No effect from sun or household activities
 - All major appliances off, including hot water tank
- Heating 100% from MSHP for part of the night then switched to 100% electric baseboard heaters for the remainder
- Tests conducted during April:
 - Night of 7th 0C overnight (heaters first, then MSHP)
 - Night of 11th -3C overnight (heaters first, then MSHP)
 - Night of 6th -8C overnight (MSHP first, then heaters)

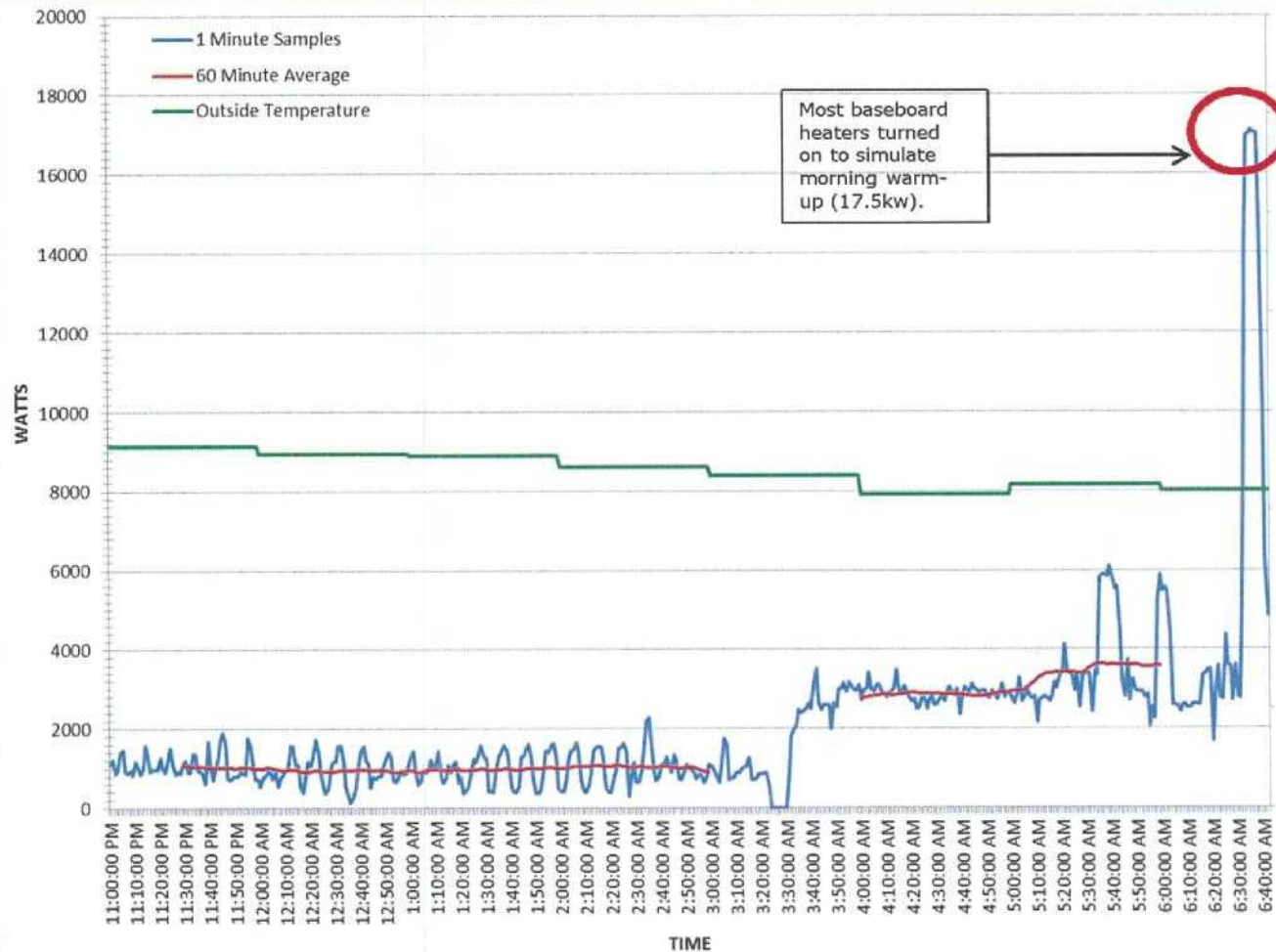
OC Performance Graph



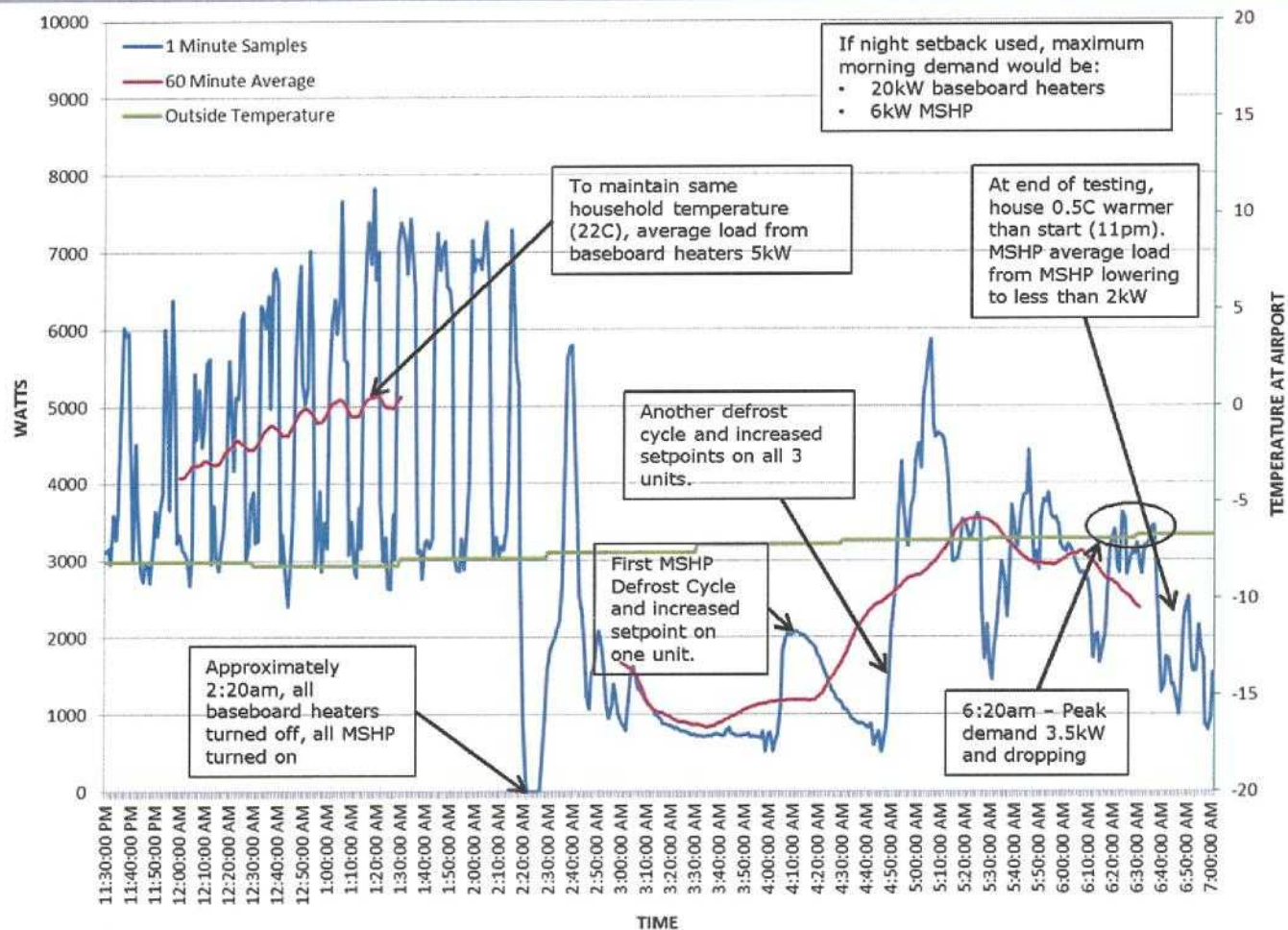
-3C Performance Graph



Morning Warmup



-8C Performance Graph



Results Summary

- Heating requirements to maintain entire house at 22C (red line)

Outside Temperature	Wind Speed (km/hr)	House Heating Requirements	Baseboard Heater Load	MSHP Load	MSHP COP
0C,	25-40	4.0kW	4.0kW	1.0kW	4.0
-3C	5-25	3.5kW	3.5kW	1.0kW	3.5
-8C,	40-55	5.0kW	5.0kW	2.0kW	2.5

- Peak Demand (blue line)

Outside Temperature	Baseboard Heater	MSHP	Demand Savings
0C	5.9kW	2.5kW	3.4kW
-3C	6.0kW	2.5kW	3.5kW
-8C	7.8kW	3.5kW*	4.3kW

* 3.5kW taken at 6:20am after house temperature increased to 22.5C.

Conclusions

- MSHP whole house systems can be installed to heat house efficiently by sizing units for low temperature extremes:
 - 2:1 – MSHP COP at low temperature extremes
 - 4:1 – MSHP COP at 0C
- Performance at 0C:
 - 75% lower – MSHP energy use vs electrical baseboard
 - 60% lower – peak demand of MSHP vs electrical baseboard heaters
- Maximum MSHP heating demand always lower than electric baseboard heaters
- Defrost cycles have little effect on system efficiency, household comfort
- Night setback should not be use with MSHP system

Backup Material

- MSHP Nameplate
- MSHP Specifications
- MSHP Operating Curves
- Efergy Metering System

MSHP Nameplate

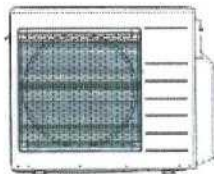
- Outdoor unit

Panasonic	
MULTI-SPLIT AIR CONDITIONER	
Model No. CU-2E18NBU	
FOR USE WITH INDOOR :	
CS-E9NKUAW	
CS-E12NKUAW	
208/230V~ 60Hz 1PH	
	COOLING HEATING
CAPACITY	16700Btu/h 20200Btu/h
CURRENT	7.6/6.9A 9.0/8.1A
POWER INPUT	1450/1450W 1850/1850W
THE CAPACITY, CURRENT AND POWER INPUT ARE NOMINAL RATINGS FOR THIS UNIT CONNECTED TO:	
CS-E12NKUAW X 2	
FOR OTHER COMBINATIONS, REFER TO MANUAL.	
TOTAL FAN MOTOR (S)	0.75 FLA
COMPRESSOR	12.8 FLA 12.8 LRA
MIN. CIRCUIT AMPACITY	20A
MAX. OVERCURRENT PROTECTION	25A
DESIGN PRESSURE	
HI 460 , LO 238	psig
REFRIGERANT R410A	
FACTORY CHARGED	67.8oz

MSHP Specifications

Service Manual

Air Conditioner



Outdoor Unit
CU-2E18NBU

Please file and use this manual together with the service manual for Model No. CS-43NRUAW/CS-42LRUAW/Order No. PHAAM1111BES1.

WARNING

This service information is designed for experienced repair technicians only and is not designed for use by the general public. It does not contain warnings or cautions to advise non-technical individuals or potential dangers in attempting to service a product. Products powered by electricity should be serviced or repaired only by experienced professional technicians. Any attempt to service or repair the product or products dealt with in this service information by anyone else could result in serious injury or death.

PRECAUTION OF LOW TEMPERATURE

In order to avoid frostbite, be assured of no refrigerant leakage during the installation or repairing of refrigerant circuit.

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2. Specifications

2.1 CU-2E18NBU

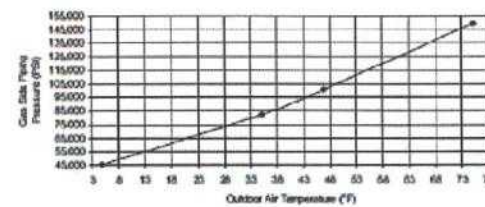
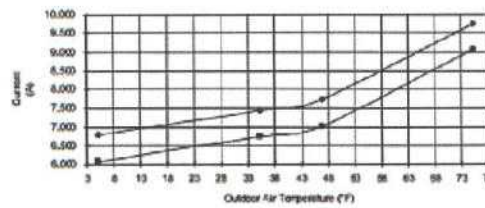
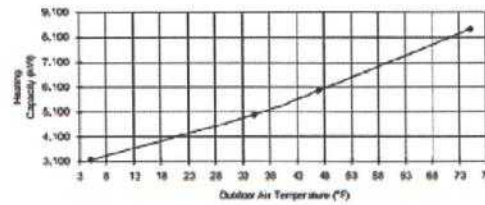
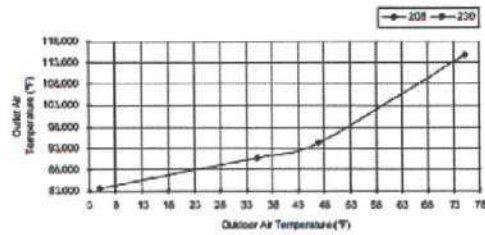
Item	Unit	OUTDOOR UNIT
Model Unit Combination		3.2kW + 3.2kW
Power Source		1 Phase, 208 ~ 230V, 50/60 (Power supply from outdoor unit)
Cooling Operation	Capacity	kW
		18708 (7200 ~ 20000)
	BTU/h	7.8 ~ 8.5
		1.42 (0.39 ~ 1.84)
	Running Current	kW
		3.37 (0.39 ~ 3.18)
	Electrical Data	BTU/hV
		11.10 (14.45 ~ 10.85)
Heating Operation	Capacity	kW
		5.94 (2.91 ~ 7.28)
	BTU/h	20308 (7200 ~ 24680)
		9.0 ~ 8.1
	Running Current	kW
		1.85 (0.42 ~ 2.29)
	Electrical Data	YkW
		3.21 (0.52 ~ 3.14)
Maximum Current	BTU/hV	10.10 (17.15 ~ 10.75)
		49
	Sound Pressure Level	dB-A
		63
	Sound Power Level	dB
		63
	Maximum Current	A
		12.8
	Starting Current	A
		19.8
Dimension	Maximum Circuit Ampacity	A
		20
	Height	mm (inch)
		795 (31.57)
	Width	mm (inch)
		875 + 95 (34.59/32 + 3.74)
	Depth	mm (inch)
		329 (12.9)
Net Weight	Net Weight	kg (lb)
		99 (152)
	Connection orifice	3 + 1 (5/8) 1/2 1/4"
		3 + 25 (9.8 + 82.0)
Refrigerant Pipe Diameter	Pipe Length Range (1 room)	m (ft)
		60 (194.0)
	Maximum Pipe Length (Total Room)	m (ft)
		8.25 (14)
	Liquid Side	mm (inch)
		9.52 (3/8)
	Gas Side	mm (inch)
		9.52 (3/8)
Compressor	Type	Hermetic Motor
		DC Brushless (4-poles)
	Motor Type	1.35
		Propeller Fan
Air Circulation	Type	DC Brushless (4-poles)
		60
	Motor Type	Propeller Fan
		60
	Rated Output	W
		570
	Fan Speed	High
		570
Heat Exchanger	Type	Plate fin configuration forced draft type
		Copper
	Tube Material	Aluminum
		378
	Fin Material	Aluminum
		378
	Round Stage	378
		19

MSHP Operating Curves

• Heating Characteristic

[Condition] Room temperature: 68°F (DBT)
 Operation condition: High fan speed
 Piping Length: 24.6ft
 Compressor Freq: Fh

B) Indoor unit capacity: Heating (3.2 + 3.2: CS-E12NKUAW + CS-E12NKUAW), service mode frequency = 63Hz



Efergy Power Monitoring

- <http://efergy.com/ca/>

