Granite Corp
"Mechanical Contractors"

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Date: 03/21/17

Schlotterbeck Block
117 Preble Street
Portland, Me

SUBMITTAL COVER SHEET

Mechanical
23 00 00 Control Components for Heat Pumps

Date: June 4, 2016

Contractor:

Landry/French Construction
160 Pleasant Hill Road
Scarborough, Maine 04074

Architect:

Goduti/Thomas
44 Oak Street
Portland, Me 04101

Engineer:

Mechanical Systems Engineers
Royal River Center, Unit 10B
10 Forest Falls Road
Yarmouth, Maine 04096

I changed this over to a PDF to show the Owner but this exports like this in an Excel Sheet

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Start Date	Nb of Days	A/C Type	Undistributed Power Amount	Period Type
20100130	30	0	0	201002

A/C Unit No	Indoor Unit Name	Cap. Code	Daytime Used Pwr	Nighttime Used Pwr	Daytime Idle Pwr	Nighttime Idle Pwr	Gas Amount
0	'RECEPT A	&H70	1506173	0	0	0	0
1	'RECEPT B	&H70	612525	0	0	0	0
2	'RECEPT C	&H70	210817	0	0	0	0
4	'102	&H70	400088	0	0	0	0
5	'103	&H70	306520	0	0	0	0
6	'104	&H70	655428	0	0	0	0
8	'105	&H70	239534	0	0	0	0
9	'106a	&H70	1541032	0	0	0	0
10	'106b	&H70	90300	0	0	0	0
12	'CONFER	&H8c	953934	0	0	0	0
13	'OFFICE D	&H70	262432	0	0	0	0
14	'ROOM 115	&H38	312753	0	0	0	0
16	'OFFICE A	&H70	86598	0	0	0	0
17	'OFFICE B	&H70	62539	0	0	0	0
18	'OFFICE C	&H70	213148	0	0	0	0
20	'COPY	&H38	115511	0	0	0	0
21	'MEETING	&H38	152777	0	0	0	0
22	'113&114	&H38	67746	0	0	0	0
23	'VERNE	&H70	784132	0	0	0	0
25	'COMMER A	&H70	42108	0	0	0	0
26	'COMMER B	&H70	1898206	0	0	0	0
29	'BREAK CA	&H8c	537546	0	0	0	0
30	'BREAK TR	&H8c	417542	0	0	0	0
32	'TRAIN A	&H70	54248	0	0	0	0
33	'TRAIN B	&H38	1391122	0	0	0	0
34	'TRAIN C	&H70	17517	0	0	0	0
36	'LIVING	&H47	29199	0	0	0	0
37	'KITCHEN	&H38	69385	0	0	0	0
38	'BED	&H24	14175	0	0	0	0
53	'Con 101	&H24	7750	0	0	0	0
54	'Abe102	&H24	5502	0	0	0	0
55	'Open103	&H24	5639	0	0	0	0
56	'Chad104	&H24	7874	0	0	0	0

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Power Proportional Distribution (PPD)

Individual Power Billing for Multi-tenant Applications

PPD Concept and Technology

BACnet/LON Interface (DMS502B71, DMS504B71)

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absolute comfort™

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Power Proportional Distribution (PPD)

- Individual Power Billing for Multi-tenant Applications
  - Power Proportional Distribution (PPD) option
  - Available on the Intelligent Touch Controller and Intelligent Manager
  - Apportions total outdoor unit power consumption among indoor units
  - Results output through web access option as Excel .csv files

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Power Proportional Distribution (PPD)

- PPD Concept and Technology
  - Based on calculated demand from each indoor unit
  - Utilizes variables including suction air temperature and EEV pulses
  - Mathematically calculated based on indoor unit coefficient
  - Operating pressures, temperatures and piping length affect overall accuracy
  - Daikin does not predict PPD accuracy due to field conditions and installation

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Power Proportional Distribution (PPD)

- Power Meter Selection and Application
  - Normally open pulse output (semiconductor relay)
  - 1 pulse per 1 kW signaling
  - 40 – 400 millisecond pulse duration
  - SQUARE D PowerLogic® energy meter approved vendor

	When metering an entire distribution panel, only Daikin air conditioning units must be served from this panel. Meter selection is based upon total equipment **MCA** (Minimum Circuit Amps) served by the panel.
	As an alternative, individual outdoor units can be metered. Equipment cost, installation labor and complexity are higher with this approach. Meter selection is based upon the units **MCA** rating.
	Metering of Daikin indoor units is optional, however not required. It is generally assumed that indoor unit power consumption is captured with the tenants sub-metered electrical service (lights, plugs, appliances).

***PPD function not available for FXOQ or RA units with KRP928B2S DIII-net adapter.**

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Power Proportional Distribution (PPD)

- Application to Daikin Multi-Zone Controllers
  - PPD with the Intelligent Touch Controller
  - Three Pi (pulse input) points on the I-Touch Controller
  - Three additional Pi points provided by the DIII-Net Plus Adapter

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Power Proportional Distribution (PPD)

- Application to Daikin Multi-Zone Controllers
  - PPD with the Intelligent Manager III multi-zone control platform
  - Each IPU can accommodate up to 20 pulse inputs (DAM602A71 and DAM602A72)
  - The Master IPU will reserve internal Pi1 for the power failure signal

* Master IPU (IPU-1) reserves Pi1 for power failure signal and thus is only capable of 19 power meter pulse inputs. All other IPUs are capable of the full 20 power meter inputs.

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Power Proportional Distribution (PPD)

1. Description

The Power Proportional Distribution (PPD) feature supplies the user with a reasonably calculated apportionment of the total power consumption by the Daikin air-conditioning system to individual indoor units in the system. Because input to the PPD includes measured pulses in the refrigerant system and because the air-conditioning system includes a number of variables, including operating temperatures and pressures, piping length, heat exchange rates and others, no meter-type apportionment of individual users' consumption can be made. However, the PPD feature provides an apportionment methodology that uses highly advanced technology as applied to the many variables in an air-conditioning system.

The intent of PPD is to apportion total outdoor unit power consumption back into the respective indoor units that are served by those outdoor units. In other words, for each indoor unit that is exchanging heat, either in the cooing mode or heating mode, its operation is supported by a condensing unit that is consuming energy. PPD mathematically calculates each indoor units portion of that outdoor units total power consumption based upon it return air temperature, electronic expansion valve position and baseline values determined by the factory. PPD is compatible with Daikin VRV 2-pipe heat pump technology and VRV 3-pipe heat recovery technology.

2. Application and Design

The quantity and specification for the kWh meter on a PPD project will depend upon the equipment type, the expectation for PPD results and the configuration of the line voltage electrical wiring that is servicing the VRV condensing units.

To control costs and reduce overall complexity, the optimum situation is the application of the kWh meter to the electrical distribution panel (breaker panel) that is serving the Daikin outdoor units. In this case, the overall power consumption of several outdoor units can be captured by a single kWh meter – a reduction of cost and installation / commissioning complexity. The caveat to this approach is the requirement that the panel in question must not serve any other equipment or ancillary devices in the facility. Otherwise, a kWh meter would have to be specified and applied to each individual outdoor unit. Daikin AC strongly recommends that project managers and project engineers consider the electrical distribution system design at the earliest stages of project design to ensure that deployment, installation and commissioning of the equipment is feasible and within reasonable budget allowances. PPD and the accompany hardware and software requirements is a multi-tenant billing solution that demands an acute engineering focus.

The Daikin indoor units (FCU's) power consumption is not considered in the PPD results unless it is specifically required that this information is incorporated into the PPD solution. In this case, kWh meters would again be required on the panel(s) serving ONLY Daikin FCU's. Otherwise, it is generally assumed that indoor unit power consumption – which is relatively insignificant unless you are applying high CFM ducted units – is captured as part of the tenant sub-metering for internal power consumption (i.e. lights, plugs, appliances.)

Outdoor units for Daikin VRV 2-pipe heat pump, VRV 3-pipe heat recovery and single phase VRV-S systems can be provided power from the same electrical distribution panel from a PPD perspective unless the owners requires capabilities for benchmarking performance from the range of technology applied on his project. This rule does not supersede or otherwise modify the electrical requirements as mandated by national, state and local codes. Primary electrical system design principals still apply and take precedence over any guidance provided by Daikin AC with regards to PPD.

<u>PPD Application with an Intelligent Touch Controller</u>

An Intelligent Touch Controller can accommodate up to three (3) Pi's (pulse inputs) from the power meters. In actual application, these power meters must be measuring power consumption from condensing units that are serving indoor units that are under management by the Intelligent Touch controller to which the power meter is associated. In the case of having several condensing units on the project, it is possible to sub-meter the entire panel that is serving those condensing units as long as 1) there are no other devices being served power by that distribution panel and 2) the

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condensing units are serving refrigerant to the indoor units that are under management by the Intelligent Touch Controller that is receiving that power meters pulse input.

The Intelligent Touch Controller can natively accommodate up to 3 pulse inputs. That number rises to 6 pulse inputs whenever a DIII-Net Plus Adapter option (DCS601A72) is added to the Intelligent Touch Controller.

Internal PPD results are stored within the Intelligent Touch Controller for up to 12 months.

PPD Application with Intelligent Manager III

The Daikin Intelligent Manager III multi-zone control architecture is based on the application of Intelligent Processing Units (IPU's) which serve as the hardware interface to the Daikin VRV air conditioning apparatus. A project may include from one to four total IPU's with two or four DIII-Net communication buses depending upon the scope of work, equipment quantity (VRV condensing units and indoor units), building geometry and control requirements. Intelligent Manager III systems are offered in packages that are selected based upon each individual projects specifications. Each sub IPU can accommodate a total of 20 pulse inputs (Pi). The primary IPU reserves Pi-1 for the power loss input signal and allows for the integration of up to 19 power meter pulse signals. Power meter pulse inputs to any respective IPU must be associated with a management point that exists within the same IPU.

Due to the applied nature and commissioning requirements of the Intelligent Manager III control system, this product is designed, engineered and commissioned by Daikin AC for each project. This includes the design and commissioning of the PPD option when applied to the Intelligent Manager III system.

Internal PPD results are temporarily stored within the Intelligent Manager III IPU's for up to 2 days and subsequently written to the PC hard drive for permanent storage.

Power Meter Specifications

The pulse output from the power meters will terminate directly to the Pi (pulse inputs) on the Intelligent Touch Controller. There are three (3) pulse inputs on a Daikin Intelligent Touch Controller. The output from the power meters must meet the following specification:

* Must be a non-voltage, normally open, momentary contact closure. This is usually a semi-conductor switched output. On the Square D PowerLogic series energy meters it is referred to as an Opto-FET output. (Non mechanical relay type. FET is a Field Effect Transistor.)

* Must provide an output of 1 pulse per 1 kW of consumption. This pulse (again the closure of the FET gate), must have a duration or width of 40 – 400 milliseconds.

Daikin AC has tested and approved for application either one of the two following power meter products:

1. Square D PowerLogic series energy meter
(http://www.powerlogic.com/product.cfm/c_id/1/sc_id/6/p_id/24)

2. Veris Industries Hawkeye 8163 series energy meter
(http://www.veris.com/product.asp?idMainCategory=45&idCategory=227&idProduct=112)

3. Setup and Commissioning

At this time, configuration and commissioning of PPD when applied with either the Intelligent Touch Controller or the Intelligent Manager III multi-zone controller products is facilitated by Daikin AC engineering personnel including representatives of Daikin AC's control engineering group or Daikin AC's field service force.

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4. PPD Calculation Results and Billing

The PPD results will not include the indoor units power consumption, which would include the fan of the fan-coil unit and the power consumed by the onboard electronics. It is generally assumed that this power consumption is accounted for in the tenants or end-users sub-metered power for their internal usage. However, it is a PPD option to sub-meter the indoor unit power consumption and include the pulses in the power group configuration of the software. With this approach, the PPD results will include both outdoor and indoor units. Just remember that the PPD output results (the Excel .csv files) will not be inclusive of indoor unit power consumption unless the indoor units have been specifically sub-metered with the pulse inputs having been configured in the power group setups.

PPD Data Output and Accounting

The HVAC system administrator should be aware that they will get relatively raw data output as a result of PPD data retrieval. This means a series of Excel .csv (comma separated values) files indicating individual indoor units and their respective watt-hour power consumption data over various blocks of time. Organization, formatting, compilation and presentation of this data in an end-user billable format is the sole responsibility of the building owner.

5. Exclusions

- PPD Technology is not compatible with the Daikin family of RA and RA Multi (single-split and multi-split) air conditioning heat pump products.
- Daikin does not make any claims to or guarantees of any specific metric of performance or accuracy of the PPD technology as the variable nature of installation integrity, quality (field installation) and conformance to design requirements (VRV system application and engineering) can vary significantly from project to project and are often outside the control of Daikin AC.

6. Technology and Application Diagrams

Concept:

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PPD Calculation Logic:

Logic-1

Every 20 sec for each indoor unit

Calculate temporary power consumption index → **Sum up**

- Rated power consumption of outdoor unit for this indoor unit (Cooling/Heating)
- Return air temperature
- EEV Thermo-step (from the opening ratio of the electronic expansion valve)
- Coefficient of the indoor unit

【For cooling】

Temporary power consumption index

$$= \text{Cooling rated outdoor unit power consumption for this indoor unit} \times \frac{(a1 + a2 \times \text{Suction air Temp.})}{10} \times \text{Themo step}$$

Note: a1, a2, 10 are fixed factors.

Fixed value depends on the indoor unit capacity

Every 1 hour

A •Power consumption of outdoor units during 1 hour (← kWh pulse)

B •Sum of temporary power consumption index of indoor unit in 1 hour

Divide A into each indoor unit with proportion of B

PPD Result

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PPD Calculation Logic Continued

The Daikin outdoor units will consume a small amount of energy even when the connected load is satisfied and not demanding any cooling or heating capacity. This energy consumption comes from the compressor crankcase heaters and the small amount of energy required to power the control PCB. The following diagrams detail how this small amount of energy is considered in the PPD calculation and output data.

Logic-2

When the outdoor unit has stopped during 1 hour in total

Fixed value is assigned to indoor units connected to the stopped outdoor unit

The value is decided by the model of the indoor unit

Logic-3

When all outdoor units have stopped during the calculation period

Power consumption of the outdoor unit is divided by coefficient of each indoor unit

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PPD Calculation Logic Continued

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PPD Indoor Unit Power Consumption

The Daikin indoor units (FCU's) power consumption is not considered in the PPD results unless it is specifically required that this information is incorporated into the PPD solution. In this case, kWh meters would again be required on the panel(s) serving ONLY Daikin FCU's. Otherwise, it is generally assumed that indoor unit power consumption – which is relatively insignificant unless you are applying high CFM ducted units – is captured as part of the tenant sub-metering for internal power consumption (i.e. lights, plugs, appliances.)

Accessing PPD Data Results

The HVAC system administrator should be aware that they will get relatively raw data output as a result of PPD data retrieval. This means a series of Excel .csv (comma separated values) files indicating individual indoor units and their respective watt-hour power consumption data over various blocks of time. Organization, formatting, compilation and presentation of this data in an end-user billable format is the sole responsibility of the building owner.

Accessing PPD Results Data for the Intelligent Touch Controller

PPD results data (Microsoft Excel .csv files) can be accessed directly through the device through a download to a user supplied PCMCIA memory card slot or can be accessed through the web option available for the Intelligent Touch Controller. The web option is highly recommended owing to the efficiency and convenience of this method as well as the ability to retrieve the data from an offsite location.

Accessing PPD Results Data for the Intelligent Manager III

PPD results data (Microsoft Excel .csv files) for an Intelligent Manager III application can be accessed directly through the Intelligent Manager's local PC user interface or can be retrieved through the web access option that is available for the Intelligent Manager III product family.

Example Screenshot of PPD Data Access via Web Access Option (Internet Explorer® Version 7.0 shown)

In/Unit Name	Used Power	Idling Power
RECEPT A	79.676	0.000
RECEPT B	43.051	0.000
RECEPT C	50.934	0.000
102	31.487	0.000
103	84.200	0.000
104	35.506	0.000
105	81.052	0.000
106a	99.384	0.000
106b	7.687	0.000
CONFER	69.307	0.000
OFFICE D	93.727	0.000
ROOM 115	43.466	0.000
OFFICE A	23.757	0.000
OFFICE B	45.139	0.000
OFFICE C	63.886	0.000
COPY	1.667	0.000
MEETING	188.103	0.000
113&114	49.946	0.000
VERNE	99.521	0.000
COMMER A	31.339	0.000
COMMER B	150.563	0.000
1:2-11	0.000	0.000
BREAK CA	119.284	0.000
BREAK TR	84.077	0.000
TRAIN A	49.804	0.000
TRAIN B	151.288	0.000
TRAIN C	27.606	0.000
LIVING	19.405	0.000
KITCHEN	25.702	0.000
BED	0.819	0.000

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Example Screenshot of Microsoft Excel® .csv PPD Data Output – 5 Day Date Range

Microsoft Excel - (2008-08-27) PPD EXAMPLE for DACA Carrollton TX - 20080818_20080822

	A	B	C	D	E	F	G	H
1	Start Date	Nb of Days	A/C Type	Undistributed Power Amount	Period Type			
2	20080818	5	0	0	0			
3								
4	A/C Unit No	In/Unit Name	HP Code	Daytime Used Pwr	Nighttime Used I	Daytime Idle Pwr	Nighttime Idle Pwr	Gas Amount
5	0	'RECEPT A	70	79676	0	0	0	0
6	1	'RECEPT B	70	43051	0	0	0	0
7	2	'RECEPT C	70	50934	0	0	0	0
8	4	'102	70	31487	0	0	0	0
9	5	'103	70	84200	0	0	0	0
10	6	'104	70	35506	0	0	0	0
11	8	'105	70	81052	0	0	0	0
12	9	'106a	70	99384	0	0	0	0
13	10	'106b	70	7687	0	0	0	0
14	12	'CONFER	8c	69307	0	0	0	0
15	13	'OFFICE D	70	93727	0	0	0	0
16	14	'ROOM 115	38	43466	0	0	0	0
17	16	'OFFICE A	70	23757	0	0	0	0
18	17	'OFFICE B	70	45139	0	0	0	0
19	18	'OFFICE C	70	63886	0	0	0	0
20	20	'COPY	38	1667	0	0	0	0
21	21	'MEETING	38	188103	0	0	0	0
22	22	'113&114	38	49946	0	0	0	0
23	23	'VERNE	70	99521	0	0	0	0
24	25	'COMMER A	70	31339	0	0	0	0
25	26	'COMMER B	70	150563	0	0	0	0
26	27	'1:2-11	70	0	0	0	0	0
27	29	'BREAK CA	8c	119284	0	0	0	0
28	30	'BREAK TR	8c	84077	0	0	0	0
29	32	'TRAIN A	70	49804	0	0	0	0
30	33	'TRAIN B	38	151288	0	0	0	0
31	34	'TRAIN C	70	27606	0	0	0	0
32	36	'LIVING	47	19405	0	0	0	0
33	37	'KITCHEN	38	25702	0	0	0	0
34	38	'BED	24	819	0	0	0	0
35								

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Example Screenshot of Microsoft Excel® .csv PPD Data Output – Hourly Example

Microsoft Excel - (2008-08-27) PPD EXAMPLE for DACA Carrollton TX - HOURLY

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	PPD Hourly Data (Wh)															
2	Note:	Date and Time mean the calculation time of PPD.														
3		The value of 3:00 is a result between the calculation time just before 3:00 and 3:00.														
4	'RECEPT A	'RECEPT B	'RECEPT C	'1:1-03	'102	'103	'104	'1:1-07	'105	'106a	'106b	'1:1-11	'CONFER	'OFFICE D	'ROOM 11	'1:1-15
5	0	0	0	-1	0	0	0	-1	0	0	0	-1	0	0	0	-1
6	2008.8.18	1:00														
7	42	42	42	0	42	42	42	0	42	42	42	0	53	42	26	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	2008.8.18	2:00														
12	42	42	42	0	42	42	42	0	42	42	42	0	53	42	26	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	2008.8.18	3:00														
17	42	42	42	0	42	42	42	0	42	42	42	0	53	42	26	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	2008.8.18	4:00														
22	42	42	42	0	42	42	42	0	42	42	42	0	53	42	26	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	2008.8.18	5:00														
27	42	42	42	0	42	42	42	0	42	42	42	0	53	42	26	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	2008.8.18	6:00														
32	42	42	42	0	42	42	42	0	42	42	42	0	53	42	26	0
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	2008.8.18	7:00														
37	42	42	42	0	0	0	738	0	42	42	42	0	53	42	26	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	2008.8.18	8:00														
42	1306	1353	207	0	1613	1053	1171	0	1578	230	902	0	1873	1372	793	0
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	2008.8.18	9:00														
47	851	21	0	0	1615	1575	596	0	815	583	42	0	366	990	536	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0