

Multi-Tenant Design Guidelines

Introduction

With the new incentives available today there has never been a better time to install solar. Incentives are provided by city, state, and federal programs in the form of rebates, tax credits, tax deductions, and depreciation allowances.

Installing individual Photovoltaic systems for each tenant has been very challenging prior to the availability of the micro-inverter. A string inverter requires that a number of PV modules be connected in series in order to satisfy the input voltage requirements. The length of these series strings could be 8 to 12 modules depending on the module selected. Shading any portion of the series string reduces the power output of the entire string dramatically. String inverters smaller than 2000 watts are not available, so providing individual systems for each tenant would require considerable amounts of roof space.

The Enphase Micro-Inverter System provides a number of advantages. The concept of one inverter per PV module allows each PV module to be power tracked individually. This enables PV modules to be installed in all the available roof space without the usual shading constraints. This provides the maximum flexibility when designing the system since any amount of modules per tenant can now be supported.

The intent of this document is to provide design and installation recommendations for multi-tenant grid-tied photovoltaic installations using the Enphase Micro-Inverter System.

1. Insure array sizes meet minimum requirements.

Rebate programs often have minimum size requirements. For example, to participate in the California Solar Initiative (CSI) rebate program, the minimum size for each system is 1 kW CEC-AC. To calculate the CEC-AC system rating:

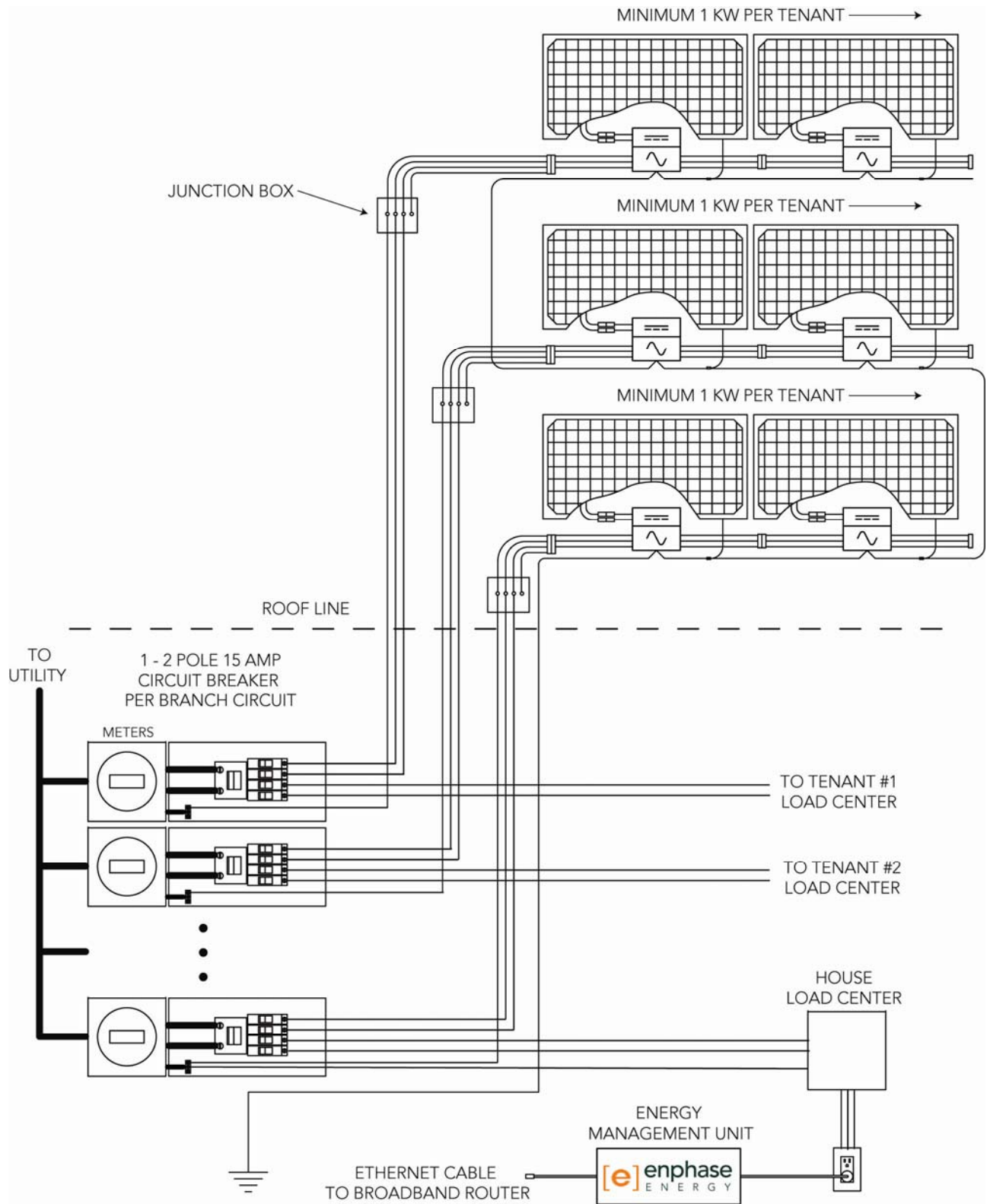
Quantity of modules x CEC DC power rating of the module
x CEC inverter efficiency rating

e.g.:

6 modules x 200 watts STC x .95 inverter efficiency = 1140 watts

At 240 VAC, a single 15 amp branch circuit could contain up to 16 micro-inverters. With 200 watt STC modules, the minimum quantity per tenant would be 6.

Note: If there is available rooftop space to install more than the minimum requirement per tenant, it is possible to reallocate the modules based on a tenant's energy requirements.



2. Communications and Monitoring Considerations

The Enphase Envoy gateway is the data logger / internet gateway for the micro-inverters in the Enphase micro-inverter system. The micro-inverters communicate performance and production data over the AC power-line to the Envoy. The Envoy simply plugs into any 120 Vac receptacle inside the building and then connects to a broadband router to forward data to the Enlighten server.

We recommend that the Envoy be connected as close to the meter stack as possible, preferably to the house load center. The power-line communication from each tenant passes through the meter stack, so placing the Envoy as close as possible to the meter stack improves signal strength.

There is a limit of 180 Micro-Inverters that can be managed by each Envoy gateway, this corresponds to a 44 kW system for the 175 watt micro-inverter model and, 50 kW for the 200 watt micro-inverter model.



3. Best Practices

a. Consider combining branch circuits in conduit runs

Instead of installing individual conduit runs for each branch circuit or tenant as shown below, consider combining the conductors from multiple circuits into one larger conduit. Installing a single large conduit with multiple branch conductors will incur less labor and material costs. The single conduit run may be less visible, more aesthetically pleasing.



b. Install a dedicated broadband connection prior to system installation

The Enlighten website enables a new level of performance monitoring for your solar energy installation. Individual module performance information is displayed on an aerial view of the solar array. It is desirable to have the broadband connection established prior to the installation of the micro-inverters and modules. With an active internet connection, the installer will be able to verify that every module and inverter is correctly connected and producing power prior to leaving the site.

The screenshot displays the Enlighten website interface for a commercial solar installation. The top navigation bar includes 'enlighten', 'systems', 'account', 'support', and 'sign out'. The main header identifies the system as 'Apartments Commercial' with links for 'overview', 'devices', and 'events'.

The 'Overview' section provides key performance indicators: Status (NO ISSUES), Power Production (5.7 kW, Today's Peak: 0.7 kW), Today's Energy (27.5 kWh), This Month's Energy (427.4 kWh), Lifetime Energy (1.5 MWh), and Local Weather (46°F).

The 'Apartments Commercial PV Arrays' section features a heatmap of individual module performance. The heatmap shows power production in Watts for each module, with values ranging from 90 to 98. A legend at the bottom indicates 'Power Produced (W)' with a scale from 0 to 180.

The 'Graphs for Morey Apartments Commercial' section displays a line graph of 'Power Produced (W)' over time. The y-axis ranges from 0 to 8000 W, and the x-axis shows dates from 12/11/09 to 12/17/09. The graph shows a significant increase in power production starting around 12/16/09.

The 'Environmental Benefits To Date' section highlights the following achievements:

- Energy Produced: 1476 kWh
- Carbon Offset: 2,532 lbs

Visualizations of these benefits include:

- 4,474 light bulbs
- 1,476 computers
- 45 homes
- Planting 30 trees
- Not Driving 77 cars for 1 day
- Not consuming 120 gallons of gas

The 'Current issues for Morey Apartments Commercial' section shows a status of 'none - operating normally'.

The 'Generate Reports for Morey Apartments Commercial' section offers options to view or print reports. A dropdown menu is set to 'Energy Production Report'. A brief description states: 'The Energy Production Report summarizes the daily energy production of your site and for the year to date. Since this report displays energy by day, you can only request dates up to yesterday.' Fields for 'Start Date' and 'End Date' are provided, along with a 'Generate' button.

The bottom navigation bar includes 'systems', 'account', 'support', and a footer with 'Privacy Terms © 2009 Enphase Energy Inc'.

c. Size Conductors for Voltage Drop

Installing the minimum allowable conductor size per NEC guidelines will be adequate for current flow requirements but is not always adequate to prevent excessive voltage drop in the branch and feeder circuits. The resistance in long circuit lengths can cause the circuit voltage to rise outside of IEEE allowable levels, causing the inverters to drop off line. The power consumed by this line loss is energy that is not delivered to the utility. The table below contains recommended maximum distances based on wire gauge and the number of inverters per branch. This table applies to 240 Vac single phase installations.

External Branch (Home Run) Wiring Maximum Distance in Feet									
	Micro-Inverters per Branch								
Wire	8	9	10	11	12	13	14	15	16
14 AWG	122	101	83	68	55	43	32	22	13
12 AWG	193	160	132	108	87	68	51	35	21
10 AWG	308	255	210	172	138	108	81	56	33
8 AWG	491	406	335	274	220	172	129	90	53
6 AWG	778	644	531	434	349	273	205	142	84

d. Install a single Grounding Electrode Conductor

The enclosures of the micro-inverters as well as the module frames and racking must be connected to the building grounding electrode conductor. Instead of including a grounding conductor with each branch circuit, install a single #8 AWG grounding conductor, connecting each micro-inverter to the building grounding electrode.