Subject S03: Solar Design

Hand-out – Matching panels to inverter

Calculate V_{MAX}	**Calculate V_{MIN}**
Formula: • $V_{MAX\_OC} = V_{OC\_STC} + [\ \gamma_v \text{ x } (T_{MIN} - T_{STC})]$ • T_{MIN} = Minimum temperature for the region at dawn • $T_{STC} = 25^o$ • γ_v (temperature coefficient of V_{OC}) can be obtained from manufacturers specifications • If V/ºC is not available, convert %/ºC to V/ºC • = $\frac{\%^oC}{100}$ x V_{OC} • A 5% safety margin may be concidered Example: • γ_v = -0.32%/ºC = $\frac{-0.32}{100}$ x 45.5V = -0.1456V/ºC • $V_{MAX\_OC} = V_{OC\_STC} + [\ \gamma_v \text{ x } (T_{MIN} - T_{STC})]$ = 45.5V + [-0.1456 x (-10 - 25)] = 45.5V + [-0.1456 x -35] = 45.5V + 5.096V = 50.596V = 50.596V x 11 panels = 556.556 V • Inv Max = 600V • Panel Max = 556.556 V • Requirement satisfied Note: Failure to calculate maximum voltage including temperature coefficients may result in defects and/or damage to the cable and inverter.	Formula: • $V_{MPP\_CELL.EFF} = V_{MP\_STC} + [\ \gamma_v \text{ x } (T_{CELL\_EFF} - T_{STC})]$ • $T_{CELL\_EFF} = T_{MAX} + 25^oC$ (25º above ambient maximum temperature) • T_{MAX} = Maximum temperature for the region • $T_{STC} = 25^o$ • γ_v (temperature coefficient of V_{OC}) can be obtained from manufacturers specifications • If V/ºC is not available, convert %/ºC to V/ºC • = $\frac{\%^oC}{100}$ x V_{OC} • Voltage drop may be added Example: • γ_v = -0.32%/ºC = $\frac{-0.32}{100}$ x 45.5V = -0.1456V/ºC • $T_{CELL\_EFF} = T_{MAX} + 25^oC$ = 45ºC + 25ºC = 70ºC • $V_{MPP\_CELL.EFF} = V_{MP\_STC} + [\ \gamma_v \text{ x } (T_{CELL\_EFF} - T_{STC})]$ = 37V + [-0.1456 x (70 – 25)] = 37V + [-0.1456 x 45] = 37V – 6.552V = 30.448V = 30.48V x 11 panels = 334.928V • Inv Min 300V • Panel Min = 334.928V • Requirement satisfied Alternate formula: • $V_{MPP\_CELL.EFF} = V_{MP\_STC} + (\gamma_v \text{ x } T_{MAX})$ • (Don't need to add 25 degrees and then straight away take off 25 degrees) Note: Failure to calculate minimum voltage including temperature coefficients may result in the inverter not working on hot days.

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Calculate I_{MAX}

Calculate I_{MAX}

Formula:

- $I_{SC\_CELL.EFF} = I_{SC\_STC} + [\ \gamma_I \times (T_{CELL\_EFF} - T_{STC}\ )]$
- $T_{CELL\_EFF} = T_{MAX} + 25ºC$ (25º above ambient maximum temperature)
- T_{MAX} = Maximum temperature for the region
- $T_{STC} = 25º$
- γ_I (temperature coefficient of I_{SC}) can be obtained from manufacturers specifications
- If I/ºC is not available, convert %/ºC to I/ºC
- $= \frac{\%ºC}{100} \times I_{SC}$
- Can consider 5% safety margin

Example:

- $\gamma_v = 0.05\%/ºC$

  $= \frac{0.05}{100} \times 8.85A$

  $= 0.004mA/ºC$

- $T_{CELL\_EFF} = T_{MAX} + 25ºC$

  $= 45ºC + 25ºC$

  $= 70ºC$

- $I_{SC\_CELL.EFF} = I_{SC\_STC} + [\ \gamma_I \times (T_{CELL\_EFF} - T_{STC}\ )]$

  $= 8.85A + [0.004425 \times (70 – 25)]$

  $= 8.85A + (0.004425 \times 45)$

  $= 8.85A + 0.199$

  $= 9.05A$
- Inv Max 10A
- Panel Max = 9.05A
- Requirement satisfied

Alternate formula:

- $I_{SC\_CELL.EFF} = I_{SC\_STC} + (\gamma_v \times T_{MAX})$
- (Don’t need to add 25 degrees and then straight away take off 25 degrees)