



Flow Computer:	40mA continuous, 12 volts
Temperature Trans.:	20mA max (4-20mA range)
Communications:	10mA continuous, 2 Amps while communicating, (20 seconds every hour)
Service Elevation	2500 Ft. above Sea Level

Application: Sample Worksheet - Case 1 Date: July 26, 2010

**STEP 1: Determine the Intermittent Power Requirements**

- A. Enter the Amps required for each piece of equipment that is on for intervals (radios, solenoid valves, etc), and the average time it is on in Hours per Day. Multiply Amps and Hours per Day to get Amp/Hours for each row. Add A + B + C + D to get the Total Intermittent Amp/Hour Requirements and enter this into box 1.

To Convert	Into	Multiply by
milliamps	Amps	0.001
Milliseconds/Day	Hours/Day	0.277 <sup>e</sup>
Seconds/Day	Hours/Day	0.000277
Minutes/Day	Hours/Day	0.0167

Amps		Hours per Day	=	Amp/Hours per Day
2	x	0.133	= A	0.266
	x		= B	
	x		= C	
	x		= D	
Total Daily Intermittent Amp/Hour Requirements				0.266

Box 1

- B. Transfer the answer from box 1 to box 2. Divide box 2 by 24 to get the Amps per Hour Average, box 3.

$$\text{Box 2 } \boxed{0.266} \div 24 \text{ Hours} = \boxed{0.011} \text{ Amps/Hour Average} \text{ Box 3}$$

- C. Transfer box 3 to box 4. Multiply box 4 by 12 for a 12-volt system, or 24 for a 24-volt system, to determine the Total Intermittent Power Requirements.

$$\text{Box 4 } \boxed{0.011} \times \text{Sys. Volts } 12 \text{ or } 24 = \boxed{0.132} \text{ Total Intermittent Watts} \text{ Box 5}$$

**STEP 2: Determine the Constant Power Requirements**

- A. Enter the constant load for each piece of equipment. Add the constant loads to get the Total Load, box 6.

$$\text{Load A (Amps)} \boxed{0.04} + \text{Load B (Amps)} \boxed{0.02} + \text{Load C (Amps)} \boxed{0.01} = \boxed{0.07} \text{ Total Load (Amps)} \text{ Box 6}$$

- B. Transfer box 6 to box 7. Multiply Box 7 by 12 for a 12-volt system, or 24 for a 24-volt system, to determine the total Constant Power Requirements.

$$\text{Box 7 } \boxed{0.07} \times \text{Sys. Volts } 12 \text{ or } 24 = \boxed{0.84} \text{ Total Constant Watts} \text{ Box 8}$$

**STEP 3: Combine Intermittent and Constant Power**

- A. Add the total intermittent power requirements to the total constant power requirements to get the Total Watts, box 9.

$$\text{Total Intermittent Watts From Box 5 } \boxed{0.132} + \text{Total Constant Watts From Box 8 } \boxed{0.84} = \boxed{.972} \text{ Total Watts @ 20°C ambient temp} \text{ Box 9}$$

**STEP 4: Apply Safety Factor to Power Requirements**

- B. Allow for a 30% safety factor. Transfer box 9 to box 10. Multiply Box 10 by 1.30 for the total Power Requirements.

$$\text{Box 10 } \boxed{.972} \times 30\% \text{ S.F. } 1.30 = \boxed{1.264} \text{ Power Requirements - Total Watts} \text{ Box 11}$$

## STEP 5: Apply Elevation Power Reduction Factor to Charger Output Rating

A. Allow 4% reduction in Power output from charger for every 1000 Ft. of elevation the TEC will be operating above sea level.

A Elevation Above Sea Level (per 1,000 ft) (i.e. 1 = 1,000 ft.; 3.5 = 3,500 ft.)	B Power Reduction Factor (%)	C Total Power Reduction % (Box A x Box B)
2,500 ft. = 2.5	4%	$2.5 \times 4 = 10\%$

B. Calculate % reduced TEC output due to elevation ( Transfer Box C to Box E)

D TEC Output at Sea Level	E Total Power Reduction % from Box C	F Power Output Reduction at Elevation (Box D x Box E)
TEC 2 (min output rating at sea level) 1.7 W	10%	.17 Watts
TEC 8 (min output rating at sea level) 6.3 W	10%	.63 Watts

C. Calculate Corrected Minimum TEC Output Due to Elevation ( Transfer Box F to Box H)

G TEC Output at Sea Level	H Power Output Reduction at Elevation from Box F	I Corrected TEC Output Due to Elevation (Box G - Box H)
TEC 2 (min output rating at sea level) 1.7 W	.17 Watts	1.53 Watts
TEC 8 (min output rating at sea level) 6.3 W	.63 Watts	5.67 Watts

D. Select TEC Model – Corrected TEC Output (Box I) must exceed Power Requirements – Total Watts (Box 11). Multiple units can be wired in parallel to achieve required power output. See attached information on multiple installations.

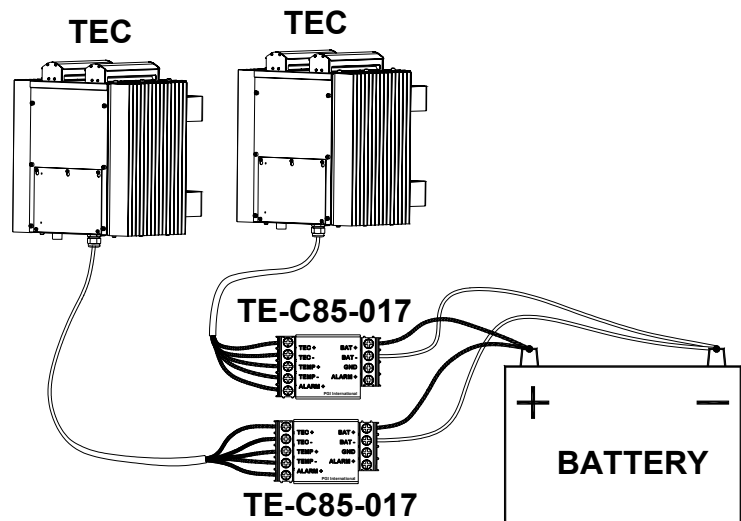
## Using Multiple TECs to Charge the Same Battery

If your battery load is too much for the TEC to keep fully charged, it is possible to connect two or more TEC units to the same battery to increase the charging capacity. For example two TEC-8 units could provide 12.5 watts of continuous charging capacity.

Installation for each unit is the same as described in the TEC IO&M manual for single units.

Please note the following calibration check that should be made when charging the same battery with multiple TECs.

The TEC controller uses the battery temperature to accurately determine the battery full charge or setpoint voltage. **When connecting multiple TECs to the same battery, each TEC must have its own battery temperature sensor.** This is accomplished by connecting a TE-C85-017 Remote Battery Interface Module for each TEC. **The TE-C85-017 includes the battery temperature sensor so it is important that it be installed on the battery or as close to the battery as possible.**



Since the TECs will be charging the same battery, each TEC should be calibrated so that they display the same battery temperature, and thus will charge to the same full charge or setpoint voltage.



## STEP 5: Apply Elevation Power Reduction Factor to Charger Output Rating

A. Allow 4% reduction in Power output from charger for every 1000 Ft. of elevation the TEC will be operating above sea level.

Box A Elevation Above Sea Level (per 1,000 ft) (i.e. 1 = 1,000 ft.; 3.5 = 3,500 ft.)	Box B Power Reduction Factor (%)	Box C Total Power Reduction % (Box A x Box B)
[ ]	4%	= [ ]

B. Calculate % reduced TEC output due to elevation ( Transfer Box C to Box E)

Box D TEC Output at Sea Level	Box E Total Power Reduction % from Box C	Box F Power Output Reduction at Elevation (Box D x Box E)
<i>TEC 2 (min output rating at sea level) 1.7 W</i>	x [ ]	= [ ]
<i>TEC 8 (min output rating at sea level) 6.3 W</i>	x [ ]	= [ ]

C. Calculate Corrected Minimum TEC Output Due to Elevation ( Transfer Box F to Box H)

Box G TEC Output at Sea Level	Box H Power Output Reduction at Elevation from Box F	Box I Corrected TEC Output Due to Elevation (Box G - Box H)
<i>TEC 2 (min output rating at sea level) 1.7 W</i>	- [ ]	= [ ]
<i>TEC 8 (min output rating at sea level) 6.3 W</i>	- [ ]	= [ ]

D. Select TEC Model – Corrected TEC Output (Box I) must exceed Power Requirements – Total Watts (Box 11). Multiple units can be wired in parallel to achieve required power output. See attached information on multiple installations.

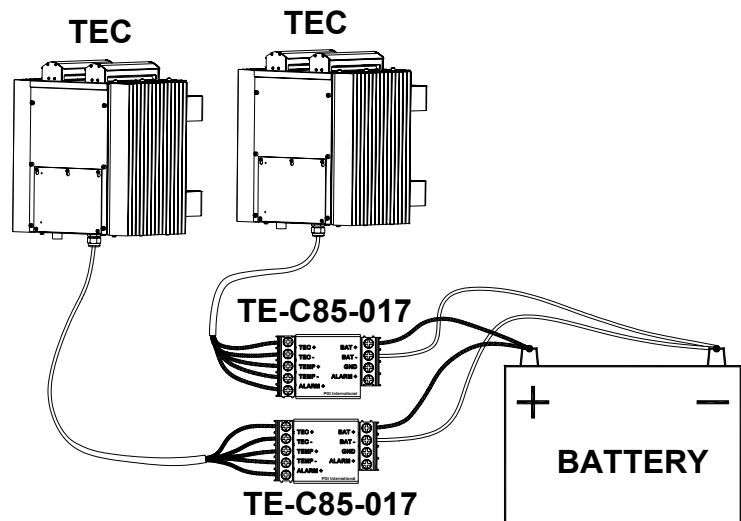
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