Guidelines for solar powered operation

CWT Compact 2.38-0

CALE

CONTENT

LIST OF MAJOR CHANGES

Version	*Change*
2.32	• Updated power measurements with Cwt application version 2.32 and the Cwt 3G modem. • Additions to *CWT parameter settings* ○ modemType, keepGprsConnection

2.34.1	• Added two configurations (purchase distribution)
	  ○ Coin and Bill reader (75 % coin, 25 % bill)
	  ○ Coin, Bill reader and Magstripe Creditcard (50 % coin, 25 % bill, 25 % Card)

2.36-4	• Added EMV NG Xenoa and Xenteo
2.38-0	• No updates

INTRODUCTION

This document contains important guidelines that must be taken into consideration when planning a solar powered operation for CWT Compact. The results presented in this document are only valid for a Cwt Compact equipped with a 3G modem, a CPU board rev. E, an Atos Xenteo or Xenoa and CWT application version 2.36-4 or 2.38-0.

Solar power

The solar panel continuously charges a high capacity battery serving as an uninterruptible power supply (UPS). This, combined with the CWT Compact´s extremely low power consumption, means that the terminal will be operational even during longer periods of darkness or low light.

Please note that the overall operational capacity is dependent on location, configuration, maintenance and usage frequency further explained in this document.

GEOGRAPHY

Latitude

Solar insolation at the earth's surface varies greatly dependent on the geographical location. It has the best average level at the equator and gets narrower as the latitude becomes higher. For higher latitudes, the winter months mean very little or no solar insolation at all. Due to this a good planning for solar operation gets more critical with higher latitudes.

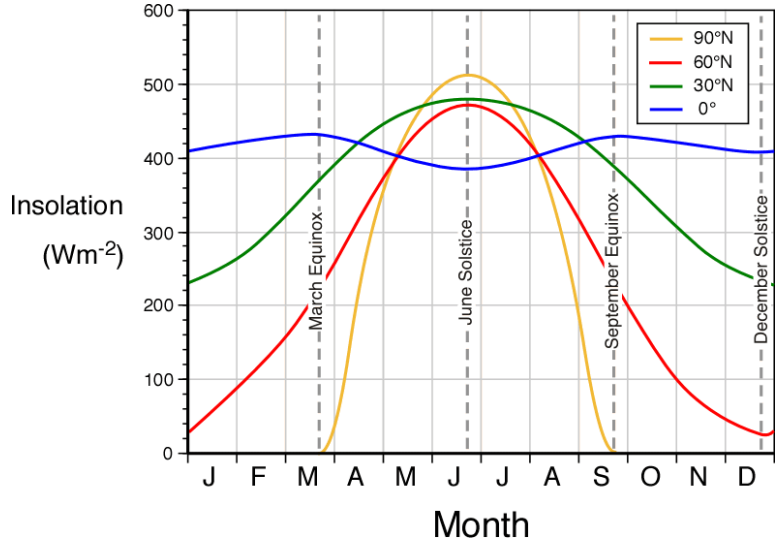


Figure 1 *Length of day (sunrise to sunset) in northern latitudes as a function of day of the year*

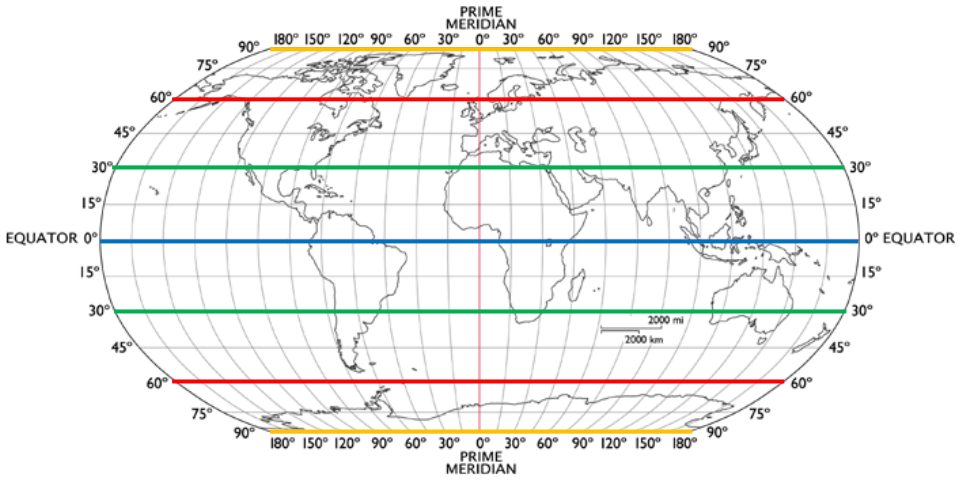


Figure 2 *World map with latitudes*

Cities at different latitudes

The figure below indicates which latitude some cities around the world have. It also describes which zone each city has been given.

60°1'N	24°E	Helsinki		Finland	Zone 6
59°9'N	30°E	Saint Petersburg		Russia	
59°6'N	10°E	Oslo		Norway	
59°3'N	18°E	Stockholm		Sweden	
55°6'N	03°E	Edinburgh		United Kingdom	Zone 5
55°4'N	37°E	Moscow		Russia	
55°4'N	12°E	Copenhagen		Denmark	
54°4'N	25°E	Vilnius		Lithuania	
52°3'N	13°E	Berlin		Germany	Zone 4
52°2'N	04°E	Amsterdam		Netherlands	
52°1'N	21°E	Warsaw		Poland	
51°3'N	00°W	London		United Kingdom	
51°0'N	114°W	Calgary		Canada	
50°5'N	04°E	Brussels		Belgium	
50°0'N	14°E	Prague		Czech Republic	Zone 3
48°6'N	13°E	Wien		Austria	
48°5'N	02°E	Paris		France	
46°5'N	71°W	Quebec City		Canada	
45°5'N	05°E	Lyon		France	
43°4'N	79°W	Toronto		Canada	
41°5'N	87°W	Chicago		United States	Zone 2
40°4'N	74°W	New York		United States	
40°2'N	03°W	Madrid		Spain	
38°4'N	09°W	Lisbon		Portugal	
32°1'N	34°E	Tel Aviv		Israel	Zone 1
24°3'N	54°E	Abu Dhabi		United Arab Emirates	
03°1'N	101°E	Kuala Lumpur		Malaysia	
35°2'S	149°E	Canberra		Australia	

Table 1 *Cities divided into zones*

OPTIMAL PERFOMANCE

General

The voltage and currency generated by the solar panel depends on the amount of light (insulation) that the panel is exposed to and the temperature within the solar cells. The optimal environment for a solar panel is low temperature in combination with full sunlight. Below items affect the operation performance and must be carefully followed.

Solar panel

- The solar panel is entirely dependent on receiving direct light, preferable a clear view straight up into the sky. Objects directly above the panel like balconies, cantilevered roofs, trees, branches, awnings, viaducts must be avoided.
- It is necessary to keep the solar panel clean from anything that can prevent the sun from reaching the solar cells. Otherwise, the generated power from the solar panel is reduced.
- Any object that prevents the solar panel from receiving direct light must be removed. Examples are dust, leaves, debris, paper, leaves, branches, frost, snow etc.
- Solar charging current must be controlled on a regular bases (can be done through CWO) to ensure a stable operation.
- A larger solar panel is recommended in areas with few hours of sunshine and with lots of clouds, rain, frost and snow.

Battery

- The battery voltage may under no circumstances fall too low. This is especially important at temperatures below 0°C. If the battery is subjected to high temperatures, it will age more quickly, and the capacity will decrease more rapidly, especially if this continues for a long time. In order to ensure a good battery capacity, the battery should under normal temperatures be replaced after 3 years, otherwise the battery capacity will decrease. Please refer to the manual for the used battery.
- The battery voltage must be controlled on a regular bases (can be done through CWO) to ensure a stable operation.
- When the battery voltage gets below a programmed level the terminal automatically creates a warning. If no improvement is made to the charging or battery situation the voltage will drop below the level where the terminal is set "out of order".
- The battery must be charged immediately when the voltage is too low. If the battery voltage has been decreased to a critically low level it may result in a permanent reduced capacity.
- At a constant high temperature batteries need to be replaced more often. Special high temperature batteries might be needed.
- Contact your local Cale distributor or sales representative for information about the most suitable battery for your specific needs.

RECOMMENDED SOLAR SETTINGS

CWT parameter settings

The recommended CWT configuration parameter settings for CWT Compact terminals are described below. The parameters are valid for Cwt application version 2.36-4.

Configuration parameters

Settings for Core

minPowerUpTimer = 30 and powerSaveTimer = 5 are specific to EMV terminals. For non-EMV terminals, set minPowerUpTimer = 5 and powerSaveTimer = 5. If a large number of purchases in darkness is expected (> 50 darkness purchases/24 h), it could be worth experimenting with lower brightnessMax values.

```
<CORE ...
                powerSaveMode="Solar" minPowerUpTime="30" powerSaveTimer="5"
                turnOnPrinterMode="DuringAccept" turnOffPrinterAfterPurchase="true"/>

<STNBacklight mode="TurnedOnDuringPurchaseInDarkness" brightnessMin="0"
                brightnessMax="40"/>

<supervisor  timer="5" wakeupTimer="60" clearPresenter="false"/>

</CORE>
```

Settings for Communication

Please note that there are other settings for Communication not displayed below. For an EMV configuration set keepGprsConnection to true. Furthermore, the Cwt 3G modem has been used in all configurations presented in this guide. The type of modem used is set with the parameter modemType.

```
<COMMUNICATION ..... cwoHeartbeatInterval="60" .... modemPowerSaveTimer="1"
    keepGprsConnection="false" modemType="CinterionPhs8"

</COMMUNICATION>
```

Settings for Printer

Below parameters must be tuned with the specific paper that is to be used. A lower value gives a lower current consumption but also a decreased print blackness.

```
<PRINTER>
    <ttp2030>
        <parameters>

        <parameter id="7" value="5" use="true" description="Burn time" min="1" max="15"/>

        </parameters>
```

</ttp2030>
</PRINTER>

INSTALLATION

Cale strongly recommend the following conditions and settings to be taken into account when planning and installing solar operated CWT Compact terminals. Deviations from the guidelines will result in lower efficiency from the solar panel which may lead to operational issues depending on location, configuration, maintenance and usage frequency.

Obstacles and shading

Even the smallest shading of the solar panel will result in substantial loss of output power. If for example, 2% of the surface of the solar panel were to be shaded, the output efficiency would be 30% lower (due to serial connection between the solar cells).

Shading can be caused by many different things, such as trees, buildings (and balconies), dirt/debris and snow. For more information see section *Solar panel*. The risk of shading from buildings and other objects in the vicinity will increase during the winter due to the lower altitude of the sun.

Positioning

The ideal installation of the terminal may vary due to the surroundings. A thumb rule is to have the solar panel facing south with the panel surface perpendicular towards the sun.

The drawing below illustrates how a Cale terminal is installed on an undefined street with obstacles (buildings) on both sides. The illustration also shows the angle where the solar panel will get the most sun during the day. Please note that the angle is also 360 degrees around the terminal. Mentioned parameters must be considered when planning an installation.

Also note that different latitudes will give variances in optimal solar angles, which also affects the ideal positioning of the terminal.

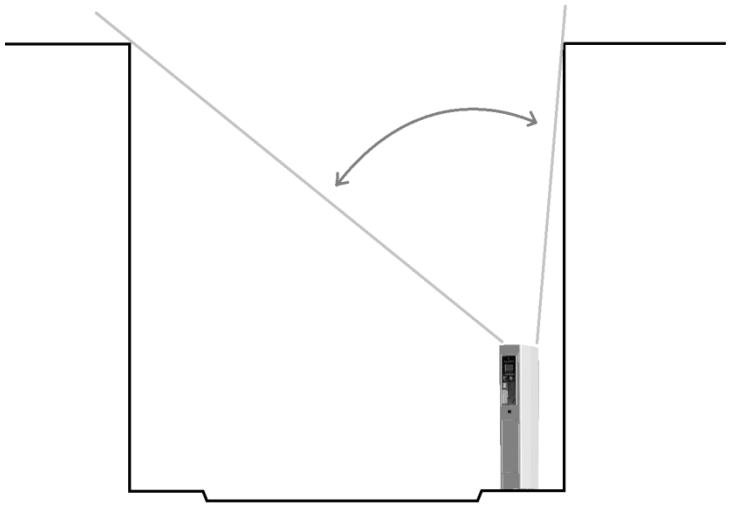


Figure 2 *Terminal positioning - Undefined street with obstacles (buildings) on both sides*

Solar panel types

The standard solar panel used for the Cale payment terminals is roof mounted. For optimal power generation, these terminals should be turned with their back facing straight south.

The fixed panel inclination is a compromise that, in most places, generates sufficient charging current.

	CWT C	CWT C Top Hat
Panel output power	10.5 W	10.5 W
Max charging power	9.6 W	9.6 W
Panel position	On terminal's top, fixed inclination, sloping down rearward at an angle of 7 degrees	On terminal's top, fixed inclination, sloping down rearward at an angle of 7 degrees
Battery capacity used in estimates	80 Ah	80 Ah
		

Table 2 *CWT C Solar panel solutions*

OPERATIONAL CAPACITY

Current consumption and battery recharges

Configurations

Different terminal configurations result in different levels of current consumption. To maximise battery life, it is favourable to strive to find the purchase flow which gives the shortest transaction time from wake up and until the terminal returns to sleep. Generally, external pay units such as card readers tend to have higher current consumption and longer transaction time than using a system with coin acceptance only. The most current consuming transactions are credit card transactions made with EMV systems. As these purchases often need to be checked and accepted by card acquirers on-line, these purchases also tend to be time consuming.

During a purchase, the printing of a ticket is a high current consuming event. Thus, configurations without compulsory tickets will be beneficial to achieve a longer battery life.

Please note that the PIN-pad consumes more current in active status when the temperature is low.

Solar panels

The CWT Compact has two different solar panels available; a roof mounted 10.5W panel and top hat configuration with the same 10.5W panel. The data for the 10.5W panel are presented in Table 3.

For terminals configured with the top hat, one additional battery per year is needed for zone 6 in columns B to E. This is because the external light and the speakers on the top hat add to the total power consumption of the terminal.

Table description

In *Table 3*, the battery performance is presented for different CWT Compact configurations, and for different geographical zones. The zones are defined as latitudinal intervals. Zone 1 is the zone closest to the equator and zone 6 is the zone that is farthest away from the equator, see *Table 1*.

For each configuration five different load levels, as in number of purchases per day, is presented. For configurations with more than one pay unit, the number of purchases per day is divided in a 75/25 ratio between coin purchases and purchases with the other pay unit. For configurations with more than two pay units, the number of purchases per day is divided in a 50/25/25 ratio between coin purchases and purchases with the two other pay units. A *prepay easy* flow is used in all the purchases except for CCC, where *prepay easy step* is used. Detailed information about the different load levels are described at the bottom of *Table 3*.

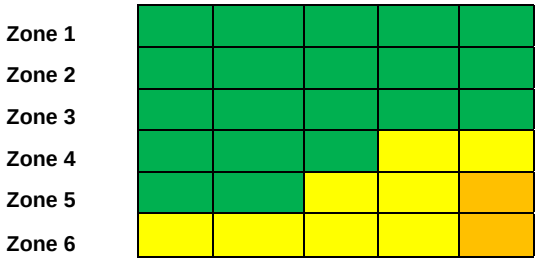
Given the geographical zone, the load level, the configuration, and the solar panel type, the table displays how many battery recharges that can be expected per year if the terminal is installed and maintained according to the recommendations in section *optimal performance*. A green color indicates that the terminal is fully autonomous meaning no battery recharges are necessary. Yellow corresponds to 1-2 annual recharges, orange corresponds to 3-5 recharges, and red corresponds to more than 6 recharges of the battery.

During the winter, when it is cold and dark, the charging capacity of the solar panel decreases, and it is during this time of the year that the majority of the predicted battery recharges will take place.

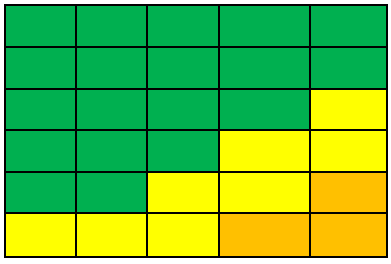
No battery recharges
1 - 2 battery recharges/year
3 - 5 battery recharges/year
≥ 6 battery recharges /year

A 20 purchases/day (15 coin + 5 external pay unit)
B 50 purchases/day (38 coin + 12 external pay unit)
C 100 purchases/day (75 coin + 25 external pay unit)
D 200 purchases/day (150 coin + 50 external pay unit)
E 400 purchases/day (300 coin + 100 external pay unit)

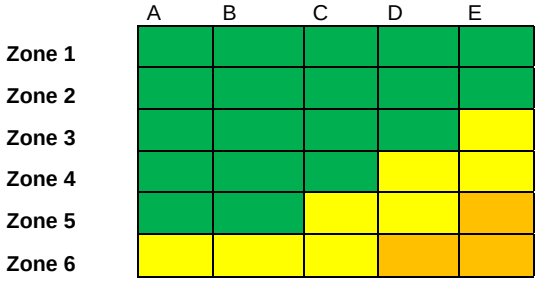
Coin



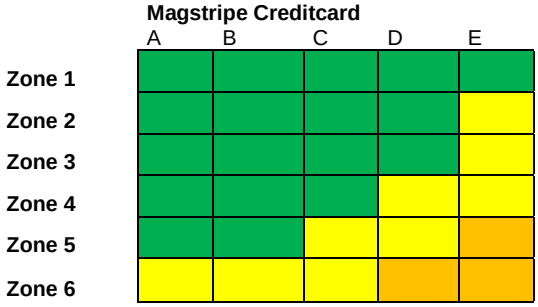
Coin + Magstripe Creditcard



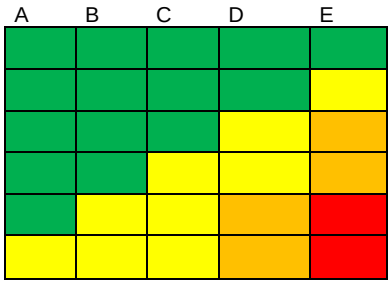
Coin + Cale Contactless Card



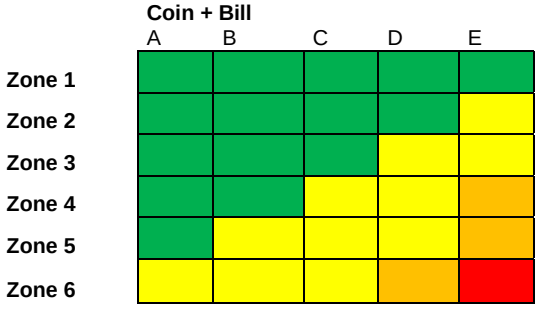
Magstripe Creditcard



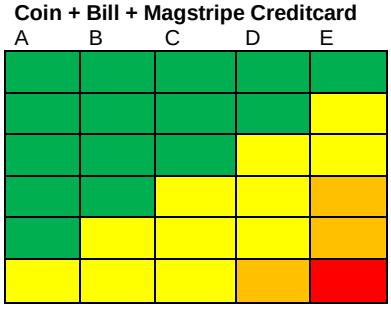
Cale Contactless Card



Coin + Bill



Coin + Bill + Magstripe Creditcard



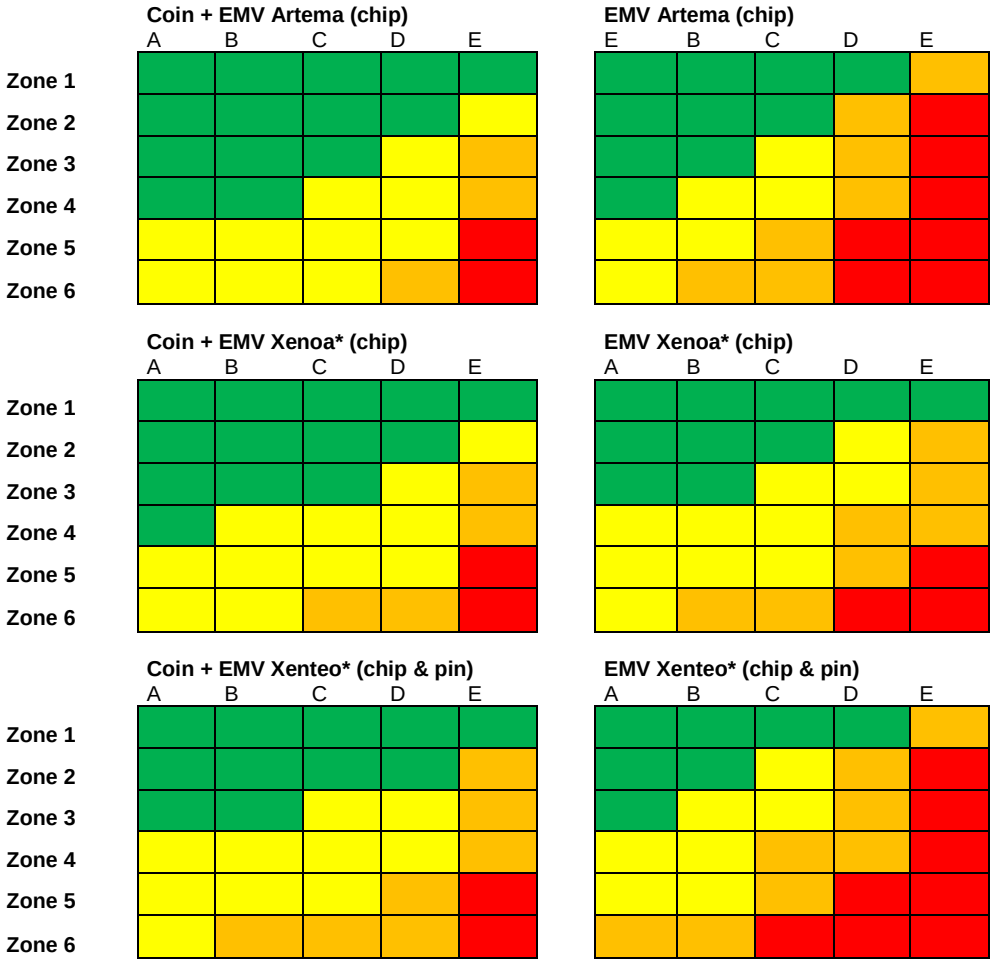


Table 3 *Battery replacement/recharging chart with 10,5W solar panel – For terminals configured with the top hat, one additional battery per year is needed for zone 6 in columns B to E.*

***** *The Xenoa/Xenteo purchases were made with the receipt printed on the ticket and the EMV Artema with receipt printed separately.*