

Botswana Latitude and Charge hours					PANEL OUTPUTS RELATED TO LOCATION			OUTPUT
City	Deg. Lat	Charge Hours	Winter Angels	Summer Angels	N-S	Deg.Lat	CHARGE HOURS	
Maun	20	5.90	47	-4.5				90
Selebi-Phikwe	21.5	5.83	48.35	-3.15				
Palapye	22	5.80	48.8	-2.7				
Serowe	22	5.80	48.8	-2.7				
Mahalapye	23	5.75	49.7	-1.8	MUSINA	22	5.80	522
Francistown	24	5.70	50.6	-0.9	THOYOYANDOU	23	5.75	518
Letlhakane	24	5.70	50.6	-0.9	POLOKWANE	24	5.70	513
Mochudi	24	5.70	50.6	-0.9	GABORONE	25	5.65	509
Molepolole	24	5.67	50.6	-0.9	PRETORIA/NELSPRUIT/MAPUTO/RUSTENBURG/MAFIKENG	26	5.60	504
Gaborone	24.5	5.67	51.05	-0.45	JOHANNESBURG/MBABANE/LICHTENBURG	26.5	5.50	495
Jwaneng	24.5	5.67	51.05	-0.45	KLERKSDORP/VRYPBURG/PIET RETIEF	27	5.25	473
Kanye	24.5	5.67	51.05	-0.45	KROONSTAD/NEWCASTLE	28	5.00	450
Moshupa	24.5	5.67	51.05	-0.45	WELKOM/UPINGTON/BETHLEHEM	28	4.80	432
Ramotswa	24.5	5.67	51.05	-0.45	KIMBERLY	29	4.70	423
Lobatse	25	5.65	51.5	0	BLOEMFONTEIN/ESRCOURT/PITERMARITSBURG	29.5	4.65	419
Zimbabwe Latitude And Charge Hours					DURBAN			OUTPUT
City	Deg. Lat	Charge Hours	Winter Angels	Summer Angels	DE AAR/ALI WAL NORTH	Deg.Lat	CHARGE HOURS	
Chinhoyi	17	6.10	44.3	-7.2	MIDDLEBURG (EC)	31	4.50	405
Harare	17.5	6.07	44.75	-6.75	GRAAF REINET/CRADDOCK/BEAUFORT WEST/MTHATHA	31.5	4.45	401
Morondera	18	6.00	45.2	-6.3	EAST LONDON/GRAHAMSTOWN	32	4.40	396
Masvingo	18	6.00	45.2	-6.3	OUDTSHORN/WELLINGTON	33.5	4.35	392
Mutare	18.5	5.97	45.65	-5.85	CAPE TOWN/P.E./STELLENBOSCH/KNYSNA/GEORGE	34	4.30	387
Bulawayo	20	5.90	47	-4.5	MOSSEL BAY/SIMONSTOWN	34	4.25	383
Gweru	19	5.95	46.1	-5.4	CAPE AGHULLAS	34	4.20	378
						35	4.15	374

INDICATION OF AVERAGE CONSUMPTION OF MOBILE FRIDGE SIZES					NOTES
BEST WATTS	WORST WATTS	AVE WATTS	IDEAL PANEL SIZE	(JHB)	
14L COOLER	150	500	325	60W	These figures are only a mean average and will vary greatly depending upon make, age, manufacturer, ambient, content and amount and duration of door openings Panel size requirement will be greater the further South the location (refer the OUTPUTS' section).
21L COOLER	150	350	250	45W	
32L	175	400	300	60W	
40L	300	600	450	80W	
60L	350	700	550	100W	
80L	375	750	600	110W	
100L	400	800	650	120W	
120L	425	850	700	130W	



Deltec solar sizing



Angola Latitude and Charge hours				
City	Deg. Lat	Charge Hours	Winter Angels	Summer Angels
Cabinda	5	6.70	33.5	-18
Luanda	8	6.55	36.2	-15.3
Gabela	11	6.40	38.9	-12.6
Camacupa	11.5	6.43	39.35	-12.15
Benguela	12	6.35	39.8	-11.7
Kuito	12	6.35	39.8	-11.7
Lobito	12	6.35	39.8	-11.7
Caála {Caala}	12.5	6.33	40.25	-11.25
Huambo (Nova Lisboa)	12.5	6.33	40.25	-11.25
			29	-22.5

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Maun	20	5.90	47	-4.5
Selebi-Phikwe	21.5	5.83	48.35	-3.15
Palapye	22	5.80	48.8	-2.7
Serowe	22	5.80	48.8	-2.7
Mahalapye	23	5.75	49.7	-1.8
Francistown	24	5.70	50.6	-0.9
Letlhakane	24	5.70	50.6	-0.9
Mochudi	24	5.70	50.6	-0.9
Molepolole	24	5.67	50.6	-0.9
Gaborone	24.5	5.67	51.05	-0.45
Jwaneng	24.5	5.67	51.05	-0.45
Kanye	24.5	5.67	51.05	-0.45
Moshupa	24.5	5.67	51.05	-0.45
Ramotswa	24.5	5.67	51.05	-0.45
Lobatse	25	5.65	51.5	0

Malawi Latitude and Charge hours				
City	Deg. Lat	Charge Hours	Winter Angels	Summer Angels
Mzuzu	11	6.40	38.9	-12.6
Nkhotakota	12.5	6.33	40.25	-11.25
Kasungu	13	6.30	40.7	-10.8
Salima	13.5	6.27	41.15	-10.35
Lilongwe	14	6.25	41.6	-9.9
Mangochi	14	6.25	41.6	-9.9
Blantyre	15.5	6.23	42.95	-8.55

Mozambique Latitude and Charge hours

City	Deg. Lat	Charge Hours	Winter Angels	Summer Angels
Nacala	14	6.25	41.6	-9.9
Nampula	15	6.20	42.5	-9
Tete	16	6.15	43.4	-8.1
Quelimane	17.5	6.07	44.75	-6.75
Chimoio	19	5.95	46.1	-5.4
Beira	19.5	5.93	46.55	-4.95
Maputo	25.5	5.63	51.95	0.45

Nigeria Latitude and Charge hours

City	Deg. Lat	Charge Hours	Winter Angels	Summer Angels
Port Harcourt	4	6.75	32.6	-18.9
Aban	5	6.70	33.5	-18
Lagos	6	6.65	34.4	-17.1
Benin City	6	6.65	34.4	-17.1
Ibadan	7	6.60	35.3	-16.2
Ilorin	8	6.55	36.2	-15.3
Abuja	9	6.50	37.1	-14.4
Jos	9.5	6.47	37.55	-13.95
Kaduna	10	6.45	38	-13.5
Kano	12	6.35	39.8	-11.7

Zambia Latitude and Charge hours

City	Deg. Lat	Charge Hours	Winter Angels	Summer Angels
Kasama	10	6.45	38	-13.5
Chililabombwe	12	6.35	39.8	-11.7
Chingola	12	6.35	39.8	-11.7
Mufulira	12	6.35	39.8	-11.7
Kalulushi (incl. Chabishi)	12.5	6.33	40.25	-11.25
Kitwe	12.5	6.33	40.25	-11.25
Chipata	13	6.30	40.7	-10.8
Luanshya	13	6.30	40.7	-10.8
Ndola	13	6.30	40.7	-10.8
Kabwe	14	6.25	41.6	-9.9
Lusaka	15	6.20	42.5	-9

Zimbabwe Latitude And Charge Hours

City	Deg. Lat	Charge Hours	Winter Angels	Summer Angels
Chinhoyi	17	6.10	44.3	-7.2
Harare	17.5	6.07	44.75	-6.75
Morondera	18	6.00	45.2	-6.3
Masvingo	18	6.00	45.2	-6.3
Mutare	18.5	5.97	45.65	-5.85
Bulawayo	20	5.90	47	-4.5
Gweru	19	5.95	46.1	-5.4



Deltec solar sizing

SYSTEM DC VOLTAGE		DC LOAD							
12		DC DEVICE	Qty	VOLTS (Watt ÷ Amps)	AMPS (Watt ÷ Volt)	HRS/DAY	DC A/HRS/DAY	DAYS PER WEEK	DC A/HRS/WEEK
		fridge	1	12	4	14	56	7	392
		LED Lights	4	12	0.18	2	1.44	7	10.08
		Fridge fan	2	12	0.21	14	5.88	7	41.16
				12			0		0
				12			0		0
				12			0		0
				12			0		0
				12			0		0
				12			0		0
				12			0		0
				12			0		0
				12			0		0
				12			0		0
				12			0		0
				12			0		0
				12			0		0
				12			0		0
				12			0		0
				12			0		0
				12			0		0
				12			0		0
				12			0		0
		REGULATOR SELF-CONSUMPTION		12	0.4	24	9.6	7	67.2

Total DC Ah/Day 72.92

Total DC Ah/Week 510.44

DC SYSTEM VOLTAGE	12
DC DEVICE A/HRS/DAY	72.92
INVERTER DC A/HRS/DAY	0.0
TOTAL DC A/HRS/DAY	72.9

DC DEVICE A/HRS/WEEK	510.4
INVERTER DC A/HRS/WEEK	0.0
TOTAL DC A/HRS/WEEK	510

Total Daily A/hrs usage	72.9
Divide by KW/hrs/m ² (Insolation)	6.0
Module Amps required (without losses)	12.2

% Added for losses (dust, voltage drop)	20
Module Amps required (including losses)	14.6
I _{pp} (Amps) from Module Selected	5.0

Select from Map

Select from chart

	12V Module	24V Module
Number of Modules required @ 12V	2.9	
Number of Modules required @ 24V	0.0	0.0
Number of Modules required @ 48V	0.0	0.0

12V Panels

Watts	Amps
5W	0.3
10W	0.6
20W	1.2
30W	1.8
35W	2.0
40W	2.3
45W	2.5
50W	2.9
55W	3.2
60W	3.4
65W	3.8
70W	4.2
75W	4.4
80W	4.6
85W	4.8
90W	5.0
100W	5.8
120W	6.8
125W	7.0
130W	7.3
135W	7.5
140W	7.7
155W	9.0

24V Panels

Watts	Amps
150	4.4
160	4.6
170	4.8
180	5.0

DC SYSTEM VOLTAGE	12
DC DEVICE A/HRS/DAY	72.92
INVERTER DC A/HRS/DAY	0.0
TOTAL DC A/HRS/DAY	72.9

DC DEVICE A/HRS/WEEK	510.4
INVERTER DC A/HRS/WEEK	0.0
TOTAL DC A/HRS/WEEK	510

Total Daily A/hrs usage	72.9
Days of Autonomy	1
Ah Battery bank required (80% useble)	73
Total Ah battery bank required + 20%	88

Ah of battery selected	105
Number of Batteries required - 12V system	0.8
Number of Modules required - 24V system	0.0
Number of Modules required - 48V system	0.0

LIST OF MAJOR TOWNS AND THEIR APPROXIMATE PANEL ANGLES

N-S	Deg.Lat	CHARGE HOURS	PMP AVE	EXPERTS SUMMER	EXPERTS WINTER	EXPERTS AVE.
MUSINA	22	5.80	31	-3.7	48.8	21
THOYANDOU	23	5.75	32	-2.8	49.7	22
POLOKWANE	24	5.70	33	-1.9	50.6	23
GABORONE	25	5.65	34	-1	51.5	25
PRETORIA/NELSPRUIT/MAPUTO/RUSTENBURG/MAFIKENG	26	5.60	35	-0.1	52.4	26
JOHANNESBURG/MBABANE/LICHTENBURG	26.5	5.50	35.5	0.35	52.85	27
KLERKSDORP/VRYBURG/PIET RETIEF	27	5.25	36	0.8	53.3	27
KROONSTAD/NEWCASTLE	28	5.00	37	1.7	54.2	29
WELKOM/UPINGTON/BETHLEHEM	28	4.80	37	1.7	54.2	29
KIMBERLY	29	4.70	38	2.6	55.1	30
BLOEMFONTEIN/ESRCOURT/PITERMARITSBURG	29.5	4.65	38.5	3.05	55.55	31
DURBAN	30	4.55	39	3.5	56	32
DE AAR/ALIWAL NORTH	31	4.50	40	4.4	56.9	33
MIDDLEBURG (EC)	31.5	4.45	40.5	4.85	57.35	34
GRAAF REINET/CRADDOCK/BEAUFORT WEST/MTHATHA	32	4.40	41	5.3	57.8	34
EAST LONDON/GRAHAMSTOWN	33.5	4.35	42.5	6.65	59.15	36
ODTSHORN/WELLINGTON	34	4.30	43	7.1	59.6	37
CAPE TOWN/P.E./STELLENBOSCH/KNYSNA/GEORGE	34	4.25	43	7.1	59.6	37
MOSEL BAY/SIMONSTOWN	34	4.20	43	7.1	59.6	37
CAPE AGHULLAS	35	4.15	44	8	60.5	38

NOTE: It is best to average with a bias towards winter angles due to the greater use of lights over the winter period.

Also note that in some instances with latitude lines of 26 or above, the panel should be facing SOUTH in the summer!!

Areas with Cloudy summers might bias the angle towards summer, rather than winter.

Outputs

PANEL OUTPUTS RELATED TO LOCATION			
N-S	Deg.Lat	CHARGE HOURS	OUTPUT
			80
MUSINA	22	5.80	464
THOYOYANDOU	23	5.75	460
POLOKWANE	24	5.70	456
GABORONE	25	5.65	452
PRETORIA/NELSPRUIT/MAPUTO/RUSTENBURG/MAFIKENG	26	5.60	448
JOHANNESBURG/MBABANE/LICHTENBURG	26.5	5.50	440
KLERKSDORP/VRYBURG/PIET RETIEF	27	5.25	420
KROONSTAD/NEWCASTLE	28	5.00	400
WELKOM/UPINGTON/BETHLEHEM	28	4.80	384
KIMBERLY	29	4.70	376
BLOEMFONTEIN/ESRCOURT/PITERMARITSBURG	29.5	4.65	372
DURBAN	30	4.55	364
DE AAR/ALIWAL NORTH	31	4.50	360
MIDDLEBURG (EC)	31.5	4.45	356
GRAAF REINET/CRADDOCK/BEAUFORT WEST/MTHATHA	32	4.40	352
EAST LONDON/GRAHAMSTOWN	33.5	4.35	348
OUDTSHORN/WELLINGTON	34	4.30	344
CAPE TOWN/P.E./STELLENBOSCH/KNYSNA/GEORGE	34	4.25	340
MOSSEL BAY/SIMONSTOWN	34	4.20	336
CAPE AGHULLAS	35	4.15	332

Outputs

OUTPUT	OUTPUT	OUTPUT	OUTPUT	OUTPUT	WATTS
90	100	120	140	200	
522	580	696	812	1160	
518	575	690	805	1150	
513	570	684	798	1140	
509	565	678	791	1130	
504	560	672	784	1120	
495	550	660	770	1100	
473	525	630	735	1050	
450	500	600	700	1000	
432	480	576	672	960	
423	470	564	658	940	
419	465	558	651	930	
410	455	546	637	910	
405	450	540	630	900	
401	445	534	623	890	
396	440	528	616	880	
392	435	522	609	870	
387	430	516	602	860	
383	425	510	595	850	
378	420	504	588	840	
374	415	498	581	830	

Fridge Times

INDICATION OF AVERAGE CONSUMPTION O				
	BEST	WORST	AVE	IDEAL
	WATTS	WATTS	WATTS	PANEL
				SIZE
				(JHB)
14L COOLER	150	500	325	60W
21L COOLER	150	350	250	45W
32L	175	400	300	60W
40L	300	600	450	80W
60L	350	700	550	100W
80L	375	750	600	110W
100L	400	800	650	120W
120L	425	850	700	130W

F MOBILE FRIDGE SIZES
NOTES
These figures are only a mean average
and will vary greatly depending upon make,
age, manufacturer, ambient, content and
amount and duration of door openings
Panel size requirement will be greater
the further South the location (refer the
OUTPUTS' section).