Pick-up Converter Design - Part I

Specifications

Parameter	Value	Unit
Nominal Vout(avg)	16.00	V
Isc(rms)	1.13	A
Voc(rms)	14.00	V
Number of turns (min)	30.00	
Winding L2	60.00	µH
Track f0	38.40	kHz

Evaluating Steady-State Operating Conditions

Parameter	Value	Unit (eq)	Value	Unit (eq)	Value	Unit (eq)
Load	10.00	Ω	15.00	Ω	25.00	Ω
Io	1.24	A (1)	1.07	A (2)	0.64	A (2)
Vout	12.43	V (3)	16.00	V (3)	16.00	V (3)
Po	15.45	W (4)	17.07	W (4)	10.24	W (4)
D	0.00	% (5)	14.19	% (5)	48.51	% (5)
Qmax	0.98	(6)	1.26	(6)	1.26	(6)
Qavg	0.98	(7)	1.08	(7)	0.65	(7)

Evaluating Compensation Capacitor

Parameter	Value	Unit (eq)
C2	0.29	µF (8)
Max V2	17.60	V (9)
Max IC2	1.22	A (10)

Pick-up Converter Design - Part II

Specifications

Parameter	Value	Unit
Max fs	1000.00	Hz
Nominal Vout	16.00	V
Max Iout	1.24	A
Design ΔVo	1.00	V

Minimum Capacitance to Meet ΔVo

Parameter	Value	Unit (eq)
C(min)	310.75	µF (11)

Selecting a Capacitor

Parameter	Value	Unit
Manufacturer	Panasonic	
Series	TP	
Voltage rating	25	V
Capacitance	820	µF
ESR	52	mΩ
IC,rms rating	1.5	A

Evaluating Steady-State Capacitor Losses

Parameter	Value	Unit (eq)	Value	Unit (eq)	Value	Unit (eq)
Load	10.0	Ω	15.0	Ω	25.0	Ω
fs	0.0	Hz (12)	0.0	Hz (12)	378.6	Hz (12)
IC,rms	0.0	A (13)	0.4	A (13)	0.6	A (13)
PC	0.0	mW (14)	9.8	mW (14)	20.1	mW (14)

Evaluating Feedback Resistor Netowrk

Parameter	Value	Unit
Vref	4.00	V
Vo,opamp	15.00	V
Rf/Rth	60.88	
A	4.06	
Selected Rb	10.00	kΩ
Ra	30.58	kΩ (15)
Rth	7.54	kΩ (16)
Rf	458.75	kΩ (17)

Pick-up Converter Design - Part III

Specifications

Parameter	Value	Unit
Max IL	1.24	A
Ripple fs	38.40	kHz
Design Bmax	0.25	T
Design Jmax	5.00	A/mm^2

Core, Former & Magnet Wire Details

Parameter	Value	Unit
Core type	Drum15	
Al	0.052	μH
Ae	28.30	mm^2
AN	36.00	mm^2
le	31.50	mm
Wire ρ	1.8E-08	Ωm
Wire μ0	1.3E-06	H/m
Achievable Kf	0.70	

Design Choices

Parameter	Value	Unit (eq)
Selected L	200.00	μH
Selected dcu	0.69	mm

Evaluating Inductor Parameters

Parameter	Value	Unit (eq)
N	30	Turns (18)
Bc(max)	0.29	T (19)
Acu (1 strand)	3.73E-01	mm^2 (20)
Used Winding Area	15.99	mm^2 (21)
Jmax	3.33	A/mm^2 (22)
Bundle Rw(dc)	45.6	mΩ (23)

Evaluating Steady-State Inductor Losses

Parameter	Value	Unit (eq)	Value	Unit (eq)	Value	Unit (eq)
Load	10.0	Ω	15.0	Ω	25.0	Ω
IL,rms	1.2	A	1.2	A	1.2	A
Pcu	70.46	mW (24)	70.46	mW (24)	70.46	mW (24)

Pick-up Converter Design - Part IV

Specifications

Parameter	Value	Unit
Max Vsw	16.00	V
Max Is,rms	1.24	A
Ta	30.00	Degrees C

Selecting a N-Channel MOSFET

Parameter	Value	Unit
Manufacturer	IR	
Model no	IRF3710	
Vdss	100	V
ID(max)	42	A
tr	77	ns
tf	56	ns
Crss @ Max Vsw/2	200	pF
Vgs(Io)	5	V
Rds,on	14	mΩ
RthJA - no heatsink	62	C/W

Gate Drive Details

Parameter	Value	Unit (eq)
Design Vgg	15.00	V
Design Igg	0.10	A
Rg	150.00	Ω (25)

Evaluating Steady-State Switch Losses

Parameter	Value	Unit (eq)	Value	Unit (eq)	Value	Unit (eq)
Load	10.00	Ω	15.0	Ω	25.0	Ω
fs	0.00	Hz	0.0	Hz	378.6	Hz
Is,rms	0.00	A	4.6		0.87	A
Is @ on	0.00	A (26)	0.00	A (26)	1.24	A (26)
Is @ off	0.00	A (26)	0.00	A (26)	1.24	A (26)
tvf	48.00	ns (27)	48.00	ns (27)	47.95	ns (27)
trv	96.00	ns (28)	96.00	ns (28)	95.90	ns (28)
ts,on	125.00	ns (29)	125.00	ns (29)	124.95	ns (29)
ts,off	152.00	ns (30)	152.00	ns (30)	151.90	ns (30)
Pswitching	0.00	mW (31)	0.00	mW (31)	1.04	mW (31)
Pconduction	0.00	mW (32)	306.86	mW (32)	10.49	mW (32)
Ptotal	0.00	mw (33)	306.86	mw (33)	11.54	mw (33)

Evaluating Junction Temprature

Parameter	Value	Unit (eq)
Tj,max	30.72	C (34)

Pick-up Converter Design - Part V

Specifications

Parameter	Value	Unit (eq)
Max Vd	16.00	V
Max Id,avg	1.24	A
Ta	30.00	Degrees C

Selecting a Diode

Parameter	Value	Unit
Manufacturer	Vishay	
Model no	40CTQ045	
Vr(max)	45	V
IF(max) - dual	40	A
VF	0.3	V
RthJA - D2Pak	45	C/W

Evaluating Steady-State Switch Losses

Parameter	Value	Unit (eq)	Value	Unit (eq)	Value	Unit (eq)
Load	10.00	Ω	15.0	Ω	25.0	Ω
D	0.00	%	14.19	%	48.51	%
ID,avg	1.24	A (35)	1.07	A (35)	0.64	A (35)
Pconduction	0.37	W (36)	0.32	W (36)	0.19	W (36)
Prr	0.00	W (37)	0.00	W (37)	0.00	W (37)
Ptotal	0.37	W (38)	0.32	W (38)	0.19	W (38)

Evaluating Junction Temprature

Parameter	Value	Unit (eq)
Tj,max	46.78	C (39)