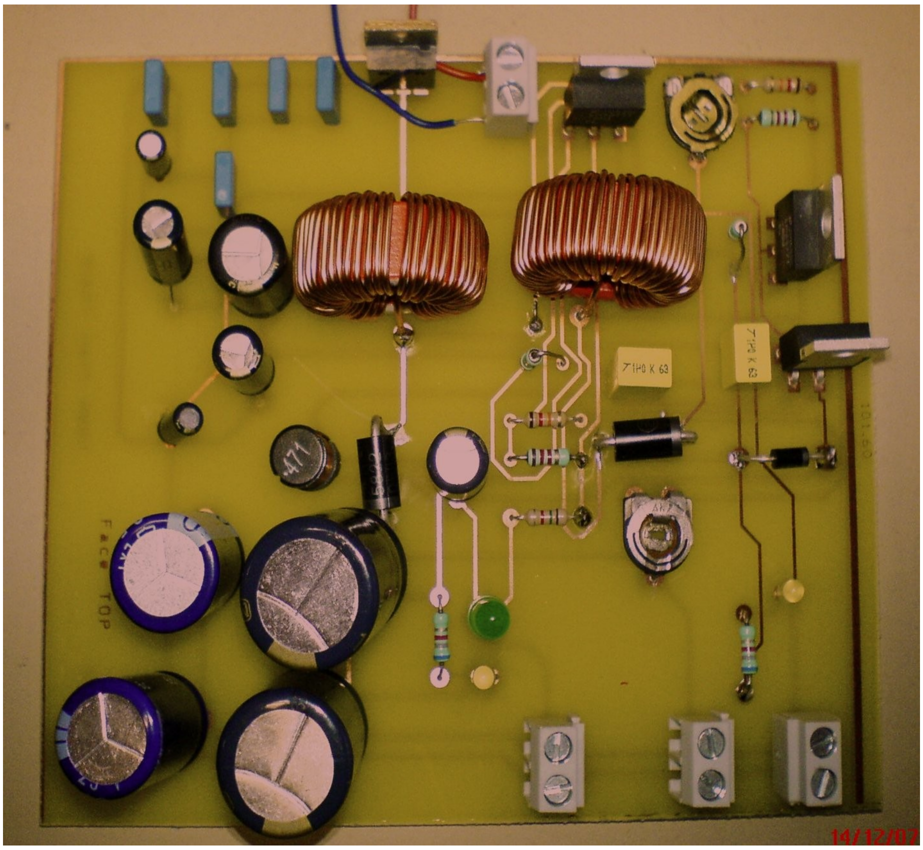
Université François Rabelais de Tours
Institut Universitaire de Technologie de Tours
Département Génie Électrique et Informatique Industrielle

Rapport de projet tutoré



Alimentation

12 V vers +5 V et 2 x +15 V

TRAN Tien Thanh
2ère Année – Q2
Promotion 2006 / 2008

Enseignant:
M. Thierry LEQUEU

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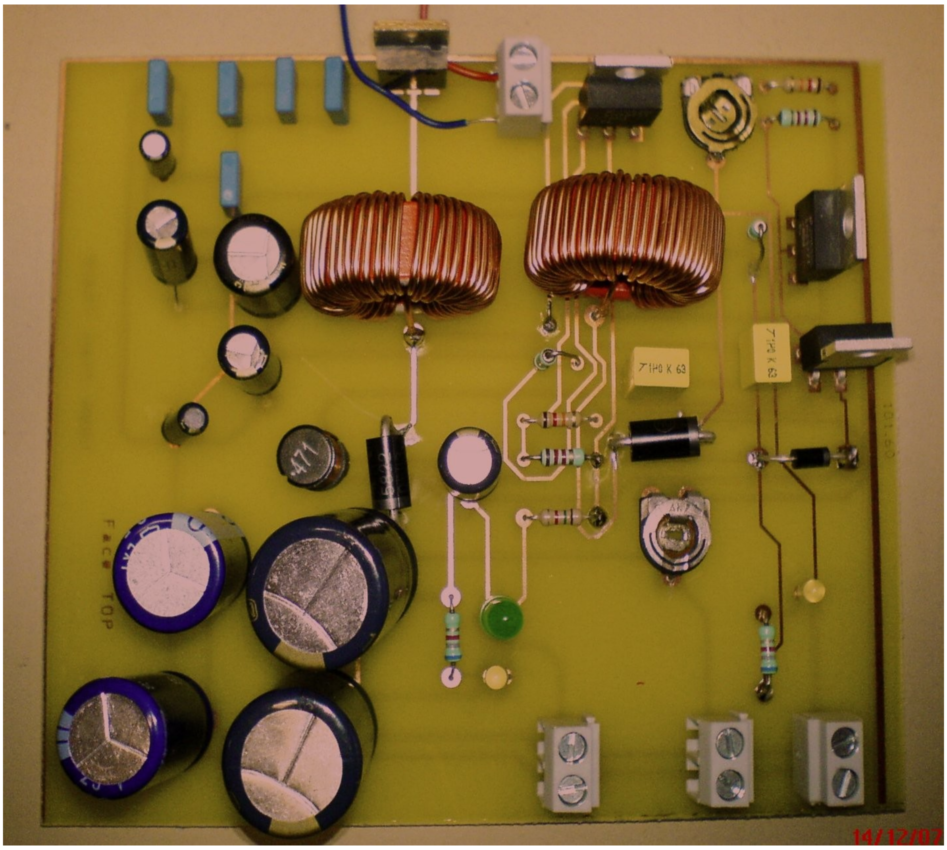

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Sommaire

Introduction

Ce projet répond au besoin du club e-Kart d u département GEII. Celui-ci a besoin d'une alimentation 2x +15V et +5V pour alimenter les afficheurs et les différentes cartes électroniques de commande. La source d'entrée de cette alimentation est une batterie de voiture de 12V. Il existe plusieurs méthodes pour réaliser cette fonction. Ici, j'utiliserai des régulateurs de tension de type LM xxxx qui fournissent une tension de référence fixe, donc on peut obtenir des tensions comme on le souhaite auxquels il faudra ajouter quelques composants extérieurs.

Cahier des charges

- A partir d'une batterie 12V qui alimente le circuit. La tension d'entrọe est typiquement de 12 V mais elle peut varier entre 10 V et 14 V sans qu'il y ait de variation de la tension de sortie. On doit fournir 3 tensions de sorties : une tension + 5V pour alimenter les micro-contrụleur et deux tensions + U rọglable de 15 à 17V pour alimenter les afficheurs 7 segments.

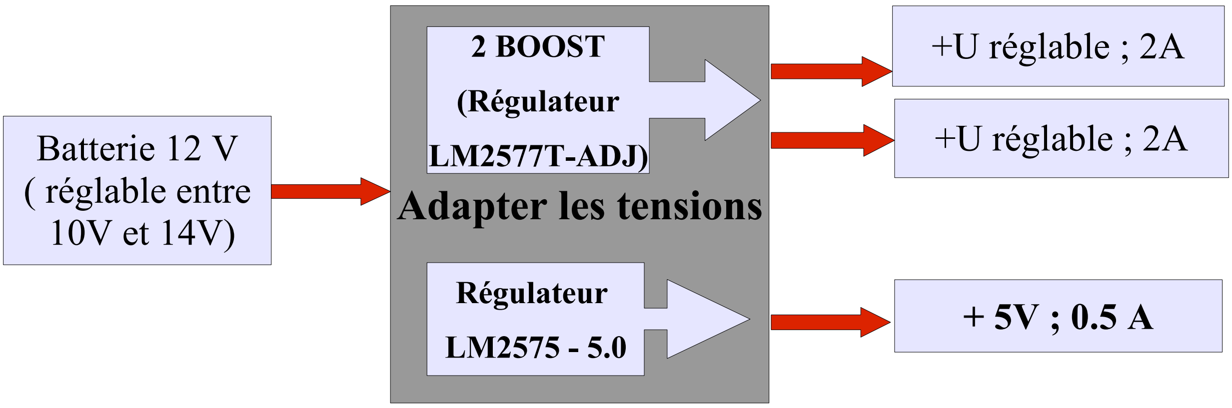


Figure 1 : Schéma fonctionnel

Planning prévisionnel

Tâches	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	01	02
Lecture du sujet proposé																		
Le planning prévisionnel & le cahier des charge																		
la formation Orcad Capture et Layout																		
Trouver toutes les fonctions des composants nécessaires au projet																		
Calculer les valeurs des composants								--										
Faire le typon																		
Fabrication de la carte																		
Tester et réparer la carte																		
Préparation du dossier																		
Oral																--	--	

Planning prévisionnel — Planning réel

Figure 2 : Planning prévisionnel et réel

A. Schéma de la carte d'alimentation

- On aura 2 schémas : le schéma général et le schéma du Boost.

Schéma général :

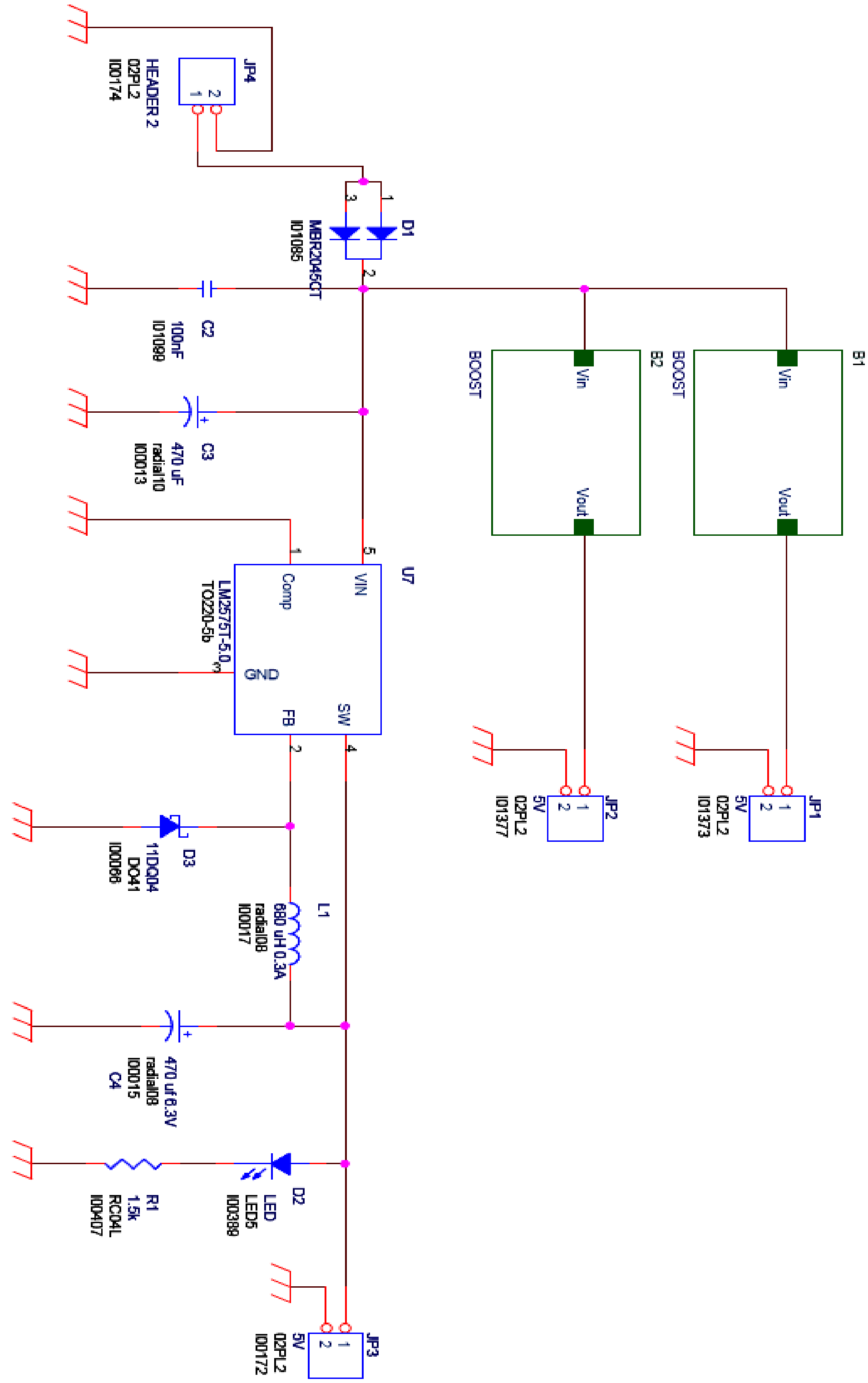


Figure 3 Schéma général

Schéma du BOOST :

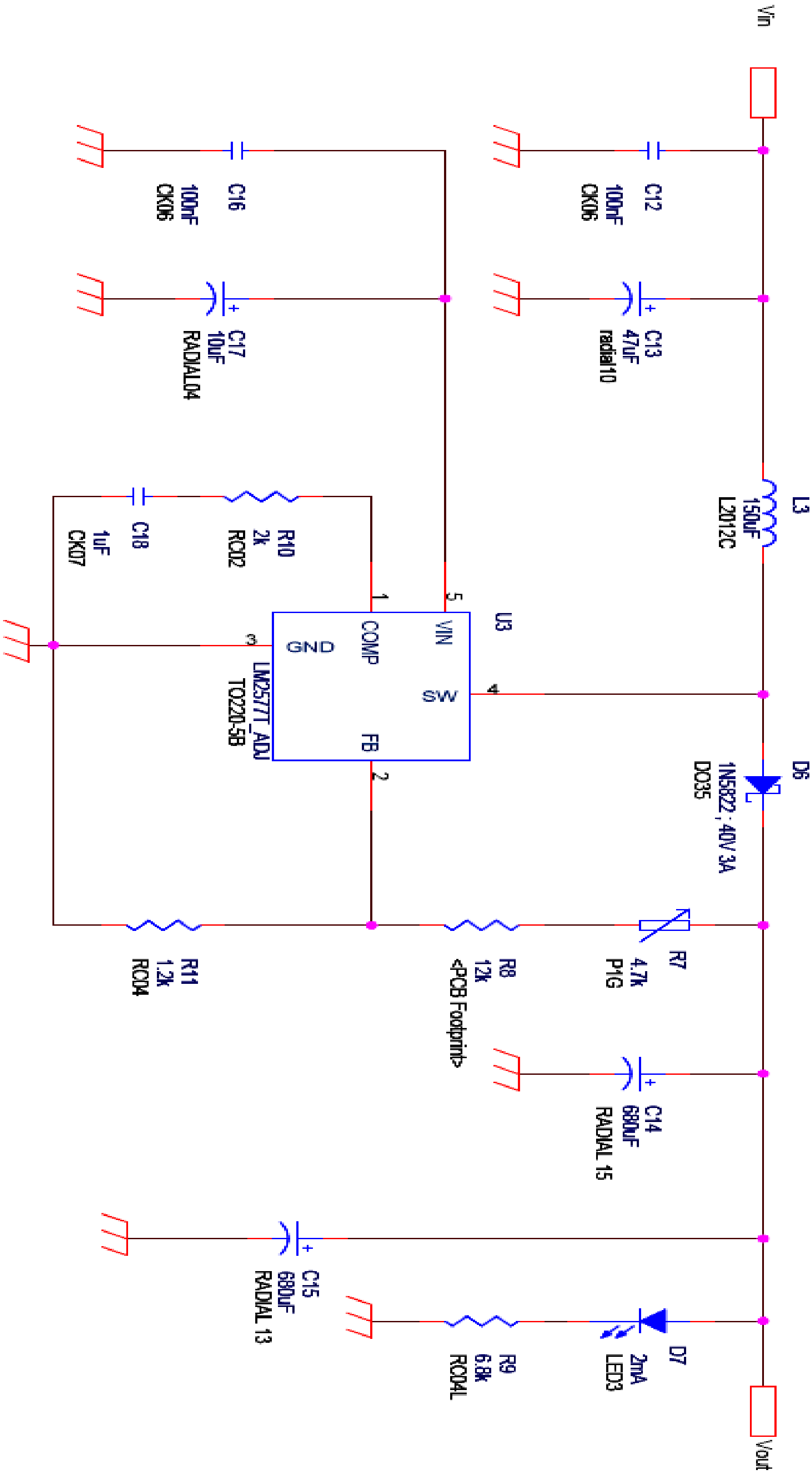


Figure 4 Schéma BOOST

B. Calcul théorique des valeurs des composants

1. Objectif:

Les différentes études proposées ont pour but une parfaite compréhension du fonctionnement des différents composants présents sur le schéma. Cela revient à étudier les différentes points:
+ régulation de tension (2577T_ADJ ; 2575T_5.0)
+ calcul du condensateur + choix de l'inductance

2. Régulateur de tension:

2.1. Présentation:

- Un régulateur de tension est un élément qui permet de stabiliser une tension à une valeur fixe. Un régulateur de tension peut être composé d'un ensemble de composants classiques (résistance, diodes zener et transistor par exemple), mail il peut aussi être de type " intégré " et contenir tout ce qu'il faut dans un seul et même boîtier, pour faciliter son usage.
- Tout régulateur est capable de supporter une tension d'entrée jusqu'à une certaine valeur. De même, tout régulateur est capable de délivrer un courant maximal (I_{LOAD} max).

2.2. LM 2575T-05 :

On va étudier le schéma général.

- LM 2575T-05 est un régulateur de tension fixe qui fournit une tension de sortie 5 V.
- Type d'application :

Typical Application (Fixed Output Voltage Versions)

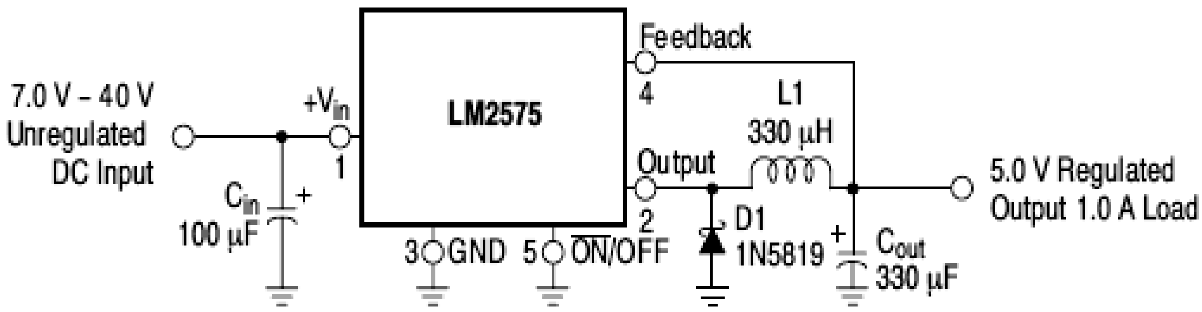


Figure 5: Schéma d'application du régulateurLM2575T-05

- D'après la documentation technique:

a) Calcul de l'inductance L1 :

$$E \times T = \left(V_{in} - V_{out}\right) \frac{V_{out}}{V_{on}} \times \frac{10^6}{F[Hz]} \; [V \times \mu s]$$

Sur notre schéma, on a $\mathbf{V_{IN}}$= 12 V , V_{OUT} = 5V , F = 52 kHz.

Application numérique : on a E.T = 56 V µs

En pratique, on prend **L**= 680µH et $\mathbf{I_L}$ = 0.32 A

b) Calcul de la capacité de sortie :

$$C_{out} \geq 7.785 \frac{V_{in(max)}}{V_{out} \times L\,[\mu H]}$$ **(en mF)**

=> C_{OUT} (min) = (7.785 x 14) / (5 x 680) = 0.032 mF

= 32 µF

Et $V_{COUT} \simeq 1.5 * V_{OUT} = 1.5 * 5 = 7.5$ V

En pratique, on prend **C4 =** C_{OUT} = 470 uF 6,3 V

c) Choix de la Diode D :

. $I_D > 1.2 * I_{LOAD}(max) = 1.2 * 0.32 = 0.384$ A

. $V_D > 1.25 * V_{IN}(max) = 1.25 * 14 = 17.5$ V

=> On choisit D3 : **1N5819 (40V, 1A). ou 11DQ04**.

d) Choix du condensateur d'entrée C_{IN} :

C_{IN} = C2 // C3

En pratique, pour le découplage HF on prend **C2 = 100 nF , 63 V**

et pour le découplage BF. **C3 = 470 uF , 25 V**

2.3. *LM2577T_ADJ* :

On va étudier le schéma du BOOST.

LM2577T_ADJ est un régulateur ajustable.

- Les régulateurs ajustables ont été conçus afin de pouvoir fournir une tension de sortie pouvant prendre une valeur quelconque dans une plage bien déterminée, et dont la valeur peut être réglée facilement. La plupart du temps, la tension de sortie d'un régulateur de tension ajustable est déterminée par la valeur de deux résistances additionnelles.

- **Type d'application** :

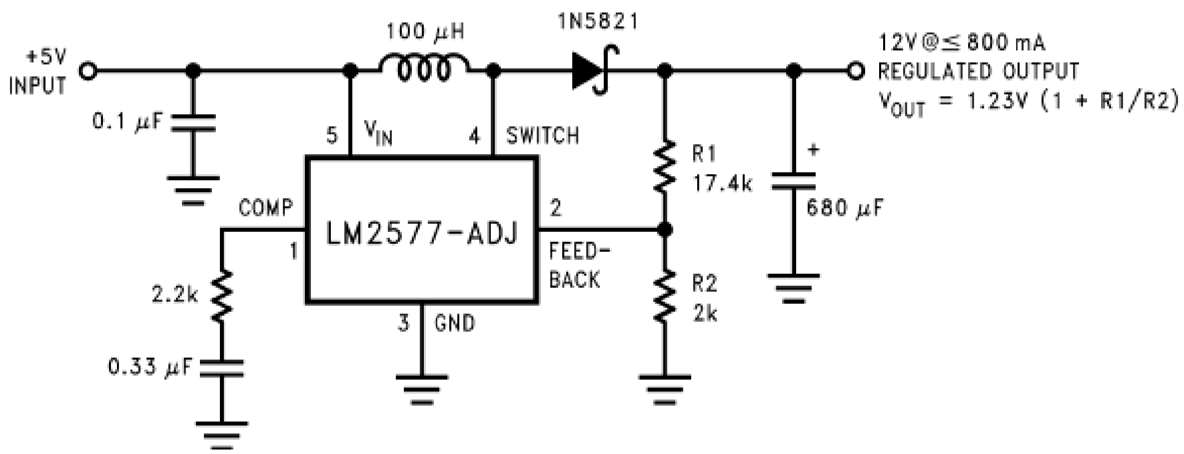


Figure 6 : Schéma d'application du régulateur LM2577T-ADJ

- D'après la documentation technique:

a) Calcul de la résistance de sortie :

Pour un LM 2577T_ADJ, la tension de sortie est donnée par :

$$V_{out} = 1,23\ (1 + R1 / R2)$$

Soit R1 = R2 (Vout / 1,23 - 1)

1,23 est la valeur de la tension de référence (Feed Back) en volts.

On a besoin de V_{OUT} variable entre 15V et 17V et **R2 = R11 = 1,2 kOhm**

D'après le tableau de calcul, on a **R1**min = 13434 Ohm pour $\mathbf{V_{OUT}}$ = 15 V

R1max = 15385 Ohm pour $\mathbf{V_{OUT}}$ = 17 V

En pratique, pour faire varier la tension de sortie, on remplace la résistance R1 par 2 résistances, dont l'une est variable, en série car V_{OUT} est fonction de R1. Donc R1 = **Rf** + **Raj**

* **Rf** (fixe) = 12 kOhm * **Raj** = 4,7 kOhm (résistance ajustable)

Soit dans le schéma, **R8 = Rf = 12K.Ohm** **R7 = Raj = 4,7 K.Ohm**

- Comme V_{OUT} dépend de la valeur **R**aj, $\mathbf{V_{OUT}}$ aura 2 nouvelles valeurs limites :

  * **Raj** = 0 => **R1** = **Rf** = 12 kOhm ==> $\mathbf{V_{OUT}}$ min = 13,53 V

  * **Raj**= 4,7 kOhm => **R1** = **Rf** + **Raj** = 16,7 kOhm =>$\mathbf{V_{OUT}}$ max = 18.35 V

==> On peut dire que c'est R1 et R2 du schéma précédent qui permettent de "programmer" la tension de sortie. Ici, c'est R8 ajustable qui fait varier la tension de sortie Vout.

b) **Calcul de l'inductance:**

- La batterie : $\mathbf{V_{IN\,min}}$ = 10 V

$$I_{LOAD(max)} \leq \frac{2.1A \times V_{IN(min)}}{V_{OUT}}$$

$$D_{(max)} = \frac{V_{OUT} + V_F - V_{IN(min)}}{V_{OUT} + V_F - 0.6V}$$

- D'après le tableau de calcul, on a : D1(max) = 0.3 et D2(max) = 0.49 , ces 2 valeurs sont inférieures à 0.85. Donc, on ne peut pas calculer la valeur de l'inductance par la formule suivante :

$$L_{MIN} = \frac{6.4\,(V_{IN(min)} - 0.6V)\,(2D_{(max)} - 1)}{1 - D_{(max)}} \quad (\mu H)$$

Il nous faut :

- Calculer le produit de Volt * Time (E.T) qui change la valeur de l'inductance.

$$E \bullet T = \frac{D_{(max)} (V_{IN(min)} - 0.6V) 10^6}{52{,}000\ Hz} \qquad (V \bullet \mu s)$$

D'après le tableau de calcul, on a : E.T1 = 54,24 E.T2 = 88

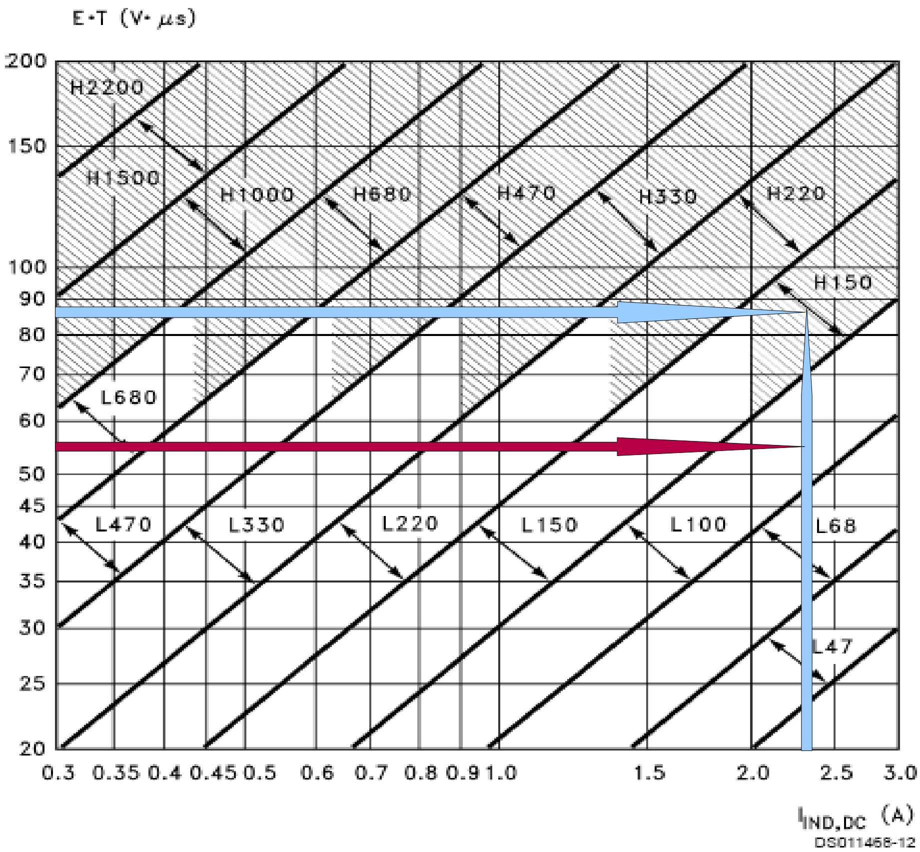
- Et calculer le courant d'inductance moyen sous la pleine charge

$$I_{IND,DC} = \frac{1.05 \times I_{LOAD(max)}}{1 - D_{(max)}}$$

$I_{IND,DC1}$ = 2.33 A

$I_{IND,DC2}$ = 2.33 A

En déduire sa valeur en utilisant le tableau suivant:



- On aura 2 valeurs de Lmin: Lmin1 = 100 µH et Lmin2 = 150 µH.

- Si on avait 2 valeurs de Lmin, on choisirait la plus grande possible.

  ==> La valeur d'inductance : **L = 150 (µH)**

c) La valeur maximale de Rc (R10) :

$$R_C \leq \frac{750 \times I_{LOAD(max)} \times V_{OUT}^2}{V_{IN(min)}^2}$$

D'après le tableau de calcul, on a : Rc1 = 2131Ohm et Rc2 = 2890 Ohm

En pratique, on prend **R10 = Rc = 2 K.Ohm**

d) Calcul de la valeur minimale C_{OUT}: en utilisant les deux formules suivantes:

$$C_{OUT} \geq \frac{V_{IN(min)} \times R_C \times (V_{IN(min)} + (3.74 \times 10^5 \times L))}{487{,}800 \times V_{OUT}^3}$$

$$C_{OUT} \geq \frac{0.19 \times L \times R_C \times I_{LOAD(max)}}{V_{IN(min)} \times V_{OUT}}$$

La plus grande de ces deux valeurs est la valeur minimale qui garantit la stabilité.

D'après le tableau de calcul, on a : **Cout** = 1.09 mF

Sur le schéma, **Cout** = C14 // C15 = C14 + C151

Donc, en pratique, on prend **C14** = **C15** = 1000 µF , 25V

=> **Cout = 2 mF**

e) Calcul de la valeur minimale Cc :

$$C_C \geq \frac{58.5 \times V_{OUT}^2 \times C_{OUT}}{R_C^2 \times V_{IN(min)}}$$

D'après le tableau de calcul, on va choisir **Cc** ayant la plus grande valeur,

Cc = 670 nF

En pratique, on utilise **C18** = **Cc** = 1 uF , 63V.

2. Choix de la Diode :

En pratique, on a $\mathbf{V_{OUT}}$ = 18.35V et $\mathbf{I_{LOAD}}$ max = 1.552 > 1 A

$\mathbf{V_{RRM}} \geq \mathbf{V_{OUT}} * 1.5 = 18.35 * 1.5 = 27.5$ V

$\mathbf{I_{F(AV)}} = \mathbf{I_{LOAD}}$ (max) * 1.5 = 1.552 * 1.5 = 2.33 A

==> On va prendre : **D : 1N5822**

ses caractéristiques : **V**= 40 V et **I** = 3 A

C. Fabrication de la carte:

Il nous faut faire le typon en double face avec les logiciels :

- Orcard pour simuler le schéma de la carte.
- Layout pour créer le typon de la carte.
- La liste des composants que j'ai utilisé pour ce circuit est présentée à l'annexe II.

Processus de fabrication de la carte:

J'ai rencontré quelques problèmes lorsque j'ai soudé les composants.

- il y a quelques pattes de composants trop gros (Diode 1N5822 par exemple).
- Ce circuit est soudé en double faces donc, j'ai eu du mal à souder la deuxième face car les pattes des composants étaient trop petites.

Tests sur la carte.

- Appareils de mesure nécessaires : un oscilloscope, un générateur
- Alimenter le circuit : une tension d'entrée 12 V continue.

Point de tests :

- Les tensions de référence des régulateurs de tension LM2577 et LM2575.
- La tension de sortie + 5 V.
- La tension de sortie + 15 V variable.

Résultat des tests

- J'ai obtenu 2 tensions de sortie + 11, 8 V (avec les différentes valeurs de R ajustable) correspondant aux 2 sorties + 15V variable.
- je n'ai rien obtenu à la sortie + 5V : le voltmètre affichait 0V

Conclusion

Pour créer une tension continue dont la valeur est de quelques dizaines de volts, à partir d'une source de tension continue (une batterie par exemple) environ quelques dizaines de volts, on peut utiliser les régulateurs de tension qui fournissent une tension de référence fixe. La tension de sortie est fixée en fonction de la valeur des résistances de sortie.

On peux également dire que ce circuit est un convertisseur de tension continu - continu (DC – DC). Je n'ai pas eu assez de temps pour rechercher la panne de ma carte. Après avoir vérifié le schéma et le typon sur orcard, je me suis aperçu que j'ai oublié une piste et j'ai inversé les broches 1 et 5 du régulateur LM2575T-05.

Bien que ce projet était plutôt simple, je n'ai pas eu le temps pour le terminer car j'étais tout seul à travailler dessus et le logiciel Orcad m'a fait perdre beaucoup de temps. D'autre part j'ai des difficultés de compréhension de la langue française et cela m'a gêné dans l'organisation de mon projet.

Index des illustrations

ANNEXE

Annexe1 : Tableau de calcul

Vs =	١٥	١٧	V
Vref =	١.٢٣	١.٢٣	V
R٢ =	١٢٠٠	١٢٠٠	Ohms
R١ =	١٣٤٣٤.١٥	١٥٣٨٥.٣٧	Ohms
Choix de R١ :			
R١ =	١٢٠٠٠	١٦٧٠٠	Ohms
Vout =	١٣.٥٣	١٨.٣٥	V
Vin(min) =	١٠	١٠	V
I load(max) =	١.٥٥	١.١٤	A
VF =	٠.٥	٠.٥	V
D(max) =	٠.٣	٠.٤٩	
E.T =	٥٤.٢٤	٨٨	V.us
I ind,dc	٢.٣٣	٢.٣٣	A
Choix de l'inductance :			
Lmin	١٥٠	١٥٠	UH
Calcul de Rc =	٢١٣٠.٩٨	٢٨٨٩.٧٣	Ohms
Choix de Rc:	٢٠٠٠	٢٠٠٠	Ohms
calcul du Cout			
Cout١ =	٠.٦٥	٠.٣٦	mF
Cout٢ =	١.٠٩	٠.٤٤	mF
Choix de Cout min:	١.٣٦	١.٣٦	mF
Calcul de Cc min =	٣٦٤	٦٧٠	nF
Choix de Cc min:	٦٨٠	٦٨٠	nF
Choix de Cin:			
Cin = C١٢//C١٣			
C١٢ =	١٠٠	١٠٠	nF
C١٣ =	٤٧	٤٧	uF

Figure 7 : Tableau de calcul

Annexe 2 : Nomenclature

Liste de composants .

Remarque : Les valeurs des composants en pratique peut être différentes aux valeurs prévues

N°	Quantité	Référence	Désignation	Prix en Euros	Total en Euros
1	5	C2,C5,C9,C12,C16	100 nF	0,1755	0,8775
2	2	C14, C15	680µF , 25V	0,564	1,128
3	2	C7, C8	680µF , 25V	0,564	1,128
4	2	C18, C11	1 µF , 63 V	0,462	0,924
5	2	C6, C13	47 µF, 25 V	0,158	0,316
6	2	C10, C17	10 µF, 50 V	0,136	0,272
7	2	L2, L3	150 µH,	2,30	4,6
8	1	L1	680 µH, 0,3A	1,94	1.94
9	1	C4	470 µF ; 6,3V	0,27	0,27
10	2	R7 , R2	4.7 kOhm		
11	2	R8, R3	12 kOhm	0,0252	0,0504
12	2	R11, R6	1.2 kOhm	0,01411	0,02822
13	2	R9, R4	6.8 kOhm	0,01411	0,02822
14	1	R1	1.5 kOhm	0,042	0,042
15	2	R5, R10	2 kOhm	0,074	0,148
16	1	D2	2 mA	0,158	0,158
17	2	D5, D7	Led	0,158	0,316
18	2	D6, D4	1N5822	0,57	1,14
19	1	D3	1N5819	1,11	1,11
20	1	U1	LM2575T-5.0	1,91	1,91
21	2	U2, U3	LM2577T-ADJ	8,85	17,7
22	2	JP1,JP2	+15 V		
23	1	JP 3	+5 V		
24	1	JP4	12 V		
25	1	D1	MBR2045CT		
26	1	C3	470 µF, 25V	0,452	0,452
				TOTAL	

Annexe 3 : Régulateur LM2577

National Semiconductor

June 1999

LM1577/LM2577 Series SIMPLE SWITCHER® Step-Up Voltage Regulator

General Description

The LM1577/LM2577 are monolithic integrated circuits that provide all of the power and control functions for step-up (boost), flyback, and forward converter switching regulators. The device is available in three different output voltage versions: 12V, 15V, and adjustable.

Requiring a minimum number of external components, these regulators are cost effective, and simple to use. Listed in this data sheet are a family of standard inductors and flyback transformers designed to work with these switching regulators.

Included on the chip is a 3.0A NPN switch and its associated protection circuitry, consisting of current and thermal limiting, and undervoltage lockout. Other features include a 52 kHz fixed-frequency oscillator that requires no external components, a soft start mode to reduce in-rush current during start-up, and current mode control for improved rejection of input voltage and output load transients.

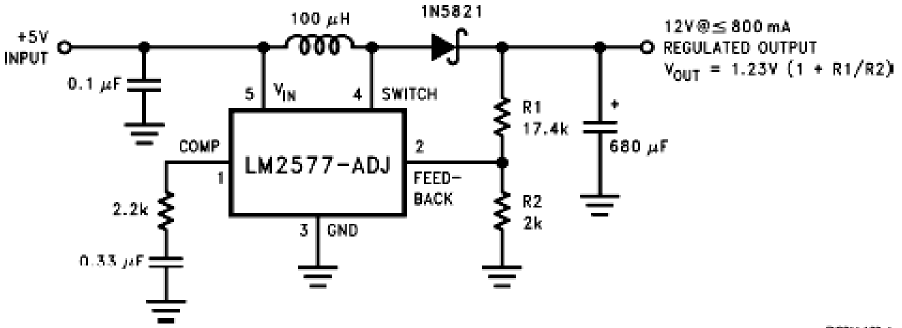
Features

- Requires few external components
- NPN output switches 3.0A, can stand off 65V
- Wide input voltage range: 3.5V to 40V
- Current-mode operation for improved transient response, line regulation, and current limit
- 52 kHz internal oscillator
- Soft-start function reduces in-rush current during start-up
- Output switch protected by current limit, under-voltage lockout, and thermal shutdown

Typical Applications

- Simple boost regulator
- Flyback and forward regulators
- Multiple-output regulator

Typical Application



Note: Pin numbers shown are for TO-220 (T) package.

Ordering Information

Temperature Range	Package Type	Output Voltage 12V	15V	ADJ	NSC Package Drawing	Package
−40˚C ≤ T_A ≤ +125˚C	24-Pin Surface Mount	LM2577M-12	LM2577M-15	LM2577M-ADJ	M24B	SO
	16-Pin Molded DIP	LM2577N-12	LM2577N-15	LM2577N-ADJ	N16A	N
	5-Lead Surface Mount	LM2577S-12	LM2577S-15	LM2577S-ADJ	TS5B	TO-263
	5-Straight Leads	LM2577T-12	LM2577T-15	LM2577T-ADJ	T05A	TO-220
	5-Bent Staggered Leads	LM2577T-12 Flow LB03	LM2577T-15 Flow LB03	LM2577T-ADJ Flow LB03	T05D	TO-220
−55˚C ≤ T_A ≤ +150˚C	4-Pin TO-3	LM1577K-12/883	LM1577K-15/883	LM1577K-ADJ/883	K04A	TO-3

SIMPLE SWITCHER® is a registered trademark of National Semiconductor Corporation.

Application Hints (Continued)

STEP-UP (BOOST) REGULATOR

Figure 4 shows the LM1577-ADJ/LM2577-ADJ used as a Step-Up Regulator. This is a switching regulator used for producing an output voltage greater than the input supply voltage. The LM1577-12/LM2577-12 and LM1577-15/LM2577-15 can also be used for step-up regulators with 12V or 15V outputs (respectively), by tying the feedback pin directly to the regulator output.

A basic explanation of how it works is as follows. The LM1577/LM2577 turns its output switch on and off at a frequency of 52 kHz, and this creates energy in the inductor (L). When the NPN switch turns on, the inductor current charges up at a rate of V_{IN}/L, storing current in the inductor. When the switch turns off, the lower end of the inductor flies above V_{IN}, discharging its current through diode (D) into the output capacitor (C_{OUT}) at a rate of $(V_{OUT} - V_{IN})/L$. Thus, energy stored in the inductor during the switch on time is transferred to the output during the switch off time. The output voltage is controlled by the amount of energy transferred which, in turn, is controlled by modulating the peak inductor current. This is done by feeding back a portion of the output voltage to the error amp, which amplifies the difference between the feedback voltage and a 1.230V reference. The error amp output voltage is compared to a voltage proportional to the switch current (i.e., inductor current during the switch on time).

The comparator terminates the switch on time when the two voltages are equal, thereby controlling the peak switch current to maintain a constant output voltage.

Voltage and current waveforms for this circuit are shown in *Figure 5*, and formulas for calculating them are given in *Figure 6*.

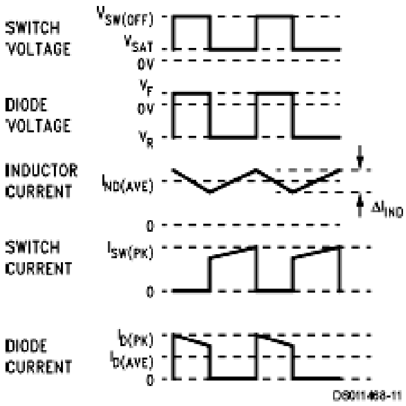
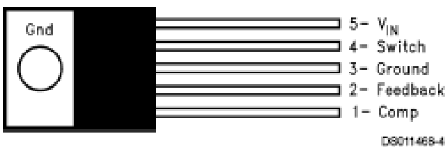


FIGURE 5. Step-Up Regulator Waveforms

Straight Leads
5-Lead TO-220 (T)



Top View
Order Number LM2577T-12, LM2577T-15, or LM2577T-ADJ
See NS Package Number T05A

Duty Cycle	D	$\frac{V_{OUT} + V_F - V_{IN}}{V_{OUT} + V_F - V_{SAT}} \approx \frac{V_{OUT} - V_{IN}}{V_{OUT}}$
Average Inductor Current	$I_{IND(AVE)}$	$\frac{I_{LOAD}}{1 - D}$
Inductor Current Ripple	ΔI_{IND}	$\frac{V_{IN} - V_{SAT}}{L} \frac{D}{52{,}000}$
Peak Inductor Current	$I_{IND(PK)}$	$\frac{I_{LOAD(max)}}{1 - D_{(max)}} + \frac{\Delta I_{IND}}{2}$
Peak Switch Current	$I_{SW(PK)}$	$\frac{I_{LOAD(max)}}{1 - D_{(max)}} + \frac{\Delta I_{IND}}{2}$
Switch Voltage When Off	$V_{SW(OFF)}$	$V_{OUT} + V_F$
Diode Reverse Voltage	V_R	$V_{OUT} - V_{SAT}$
Average Diode Current	$I_{D(AVE)}$	I_{LOAD}
Peak Diode Current	$I_{D(PK)}$	$\frac{I_{LOAD}}{1 - D_{(max)}} + \frac{\Delta I_{IND}}{2}$
Power Dissipation of LM1577/2577	P_D	$0.25\Omega \left(\frac{I_{LOAD}}{1 - D}\right)^2 D + \frac{I_{LOAD}\, D\, V_{IN}}{50\,(1 - D)}$

V_F = Forward Biased Diode Voltage
I_{LOAD} = Output Load Current

FIGURE 6. Step-Up Regulator Formulas

STEP-UP REGULATOR DESIGN PROCEDURE

The following design procedure can be used to select the appropriate external components for the circuit in *Figure 4*, based on these system requirements.

Given:

$V_{IN\,(min)}$ = Minimum input supply voltage

V_{OUT} = Regulated output voltage

$I_{LOAD(max)}$ = Maximum output load current

Before proceeding any further, determine if the LM1577/LM2577 can provide these values of V_{OUT} and $I_{LOAD(max)}$ when operating with the minimum value of V_{IN}. The upper limits for V_{OUT} and $I_{LOAD(max)}$ are given by the following equations.

$V_{OUT} \le 60V$

and $V_{OUT} \le 10 \times V_{IN(min)}$

$$I_{LOAD(max)} \le \frac{2.1A \times V_{IN(min)}}{V_{OUT}}$$

These limits must be greater than or equal to the values specified in this application.

1. **Inductor Selection (L)**

A. *Voltage Options:*

1. **For 12V or 15V output**

Application Hints (Continued)

From *Figure 7* **(for 12V output) or** *Figure 8* **(for 15V output), identify inductor code** for region indicated by $V_{IN\ (min)}$ and $I_{LOAD\ (max)}$. The shaded region indicates conditions for which the LM1577/LM2577 output switch would be operating beyond its switch current rating. The minimum operating voltage for the LM1577/LM2577 is 3.5V.

From here, ***proceed to step C***.

2. **For Adjustable version**

Preliminary calculations:

The inductor selection is based on the calculation of the following three parameters:

$D_{(max)}$, the maximum switch duty cycle ($0 \leq D \leq 0.9$):

$$D_{(max)} = \frac{V_{OUT} + V_F - V_{IN(min)}}{V_{OUT} + V_F - 0.6V}$$

where V_F = 0.5V for Schottky diodes and 0.8V for fast recovery diodes (typically);

E •T, the product of volts x time that charges the inductor:

$$E \bullet T = \frac{D_{(max)} (V_{IN(min)} - 0.6V) 10^6}{52{,}000\ Hz} \quad (V \bullet \mu s)$$

$I_{IND,DC}$, the average inductor current under full load;

$$I_{IND,DC} = \frac{1.05 \times I_{LOAD(max)}}{1 - D_{(max)}}$$

B. *Identify Inductor Value:*

1. From *Figure 9*, identify the inductor code for the region indicated by the intersection of E•T and $I_{IND,DC}$. This code gives the inductor value in microhenries. The L or H prefix signifies whether the inductor is rated for a maximum E•T of 90 V•µs (L) or 250 V•µs (H).

2. If D < 0.85, go on to step C. If $D \geq 0.85$, then calculate the minimum inductance needed to ensure the switching regulator's stability:

$$L_{MIN} = \frac{6.4 (V_{IN(min)} - 0.6V) (2D_{(max)} - 1)}{1 - D_{(max)}} \quad (\mu H)$$

If L_{MIN} is smaller than the inductor value found in step B1, go on to step C. Otherwise, the inductor value found in step B1 is too low; an appropriate inductor code should be obtained from the graph as follows:

1. Find the lowest value inductor that is greater than L_{MIN}.

2. Find where E•T intersects this inductor value to determine if it has an L or H prefix. If E•T intersects both the L and H regions, select the inductor with an H prefix.

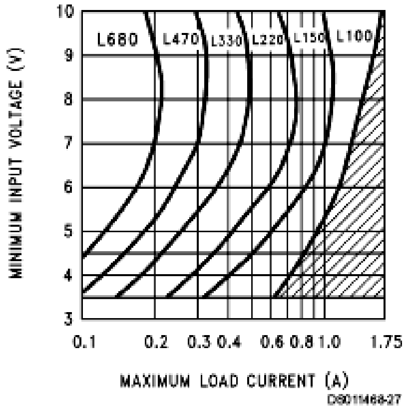


FIGURE 7. LM2577-12 Inductor Selection Guide

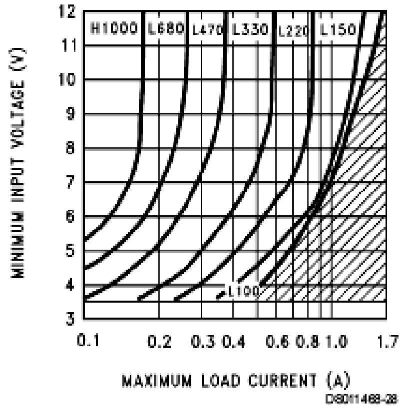
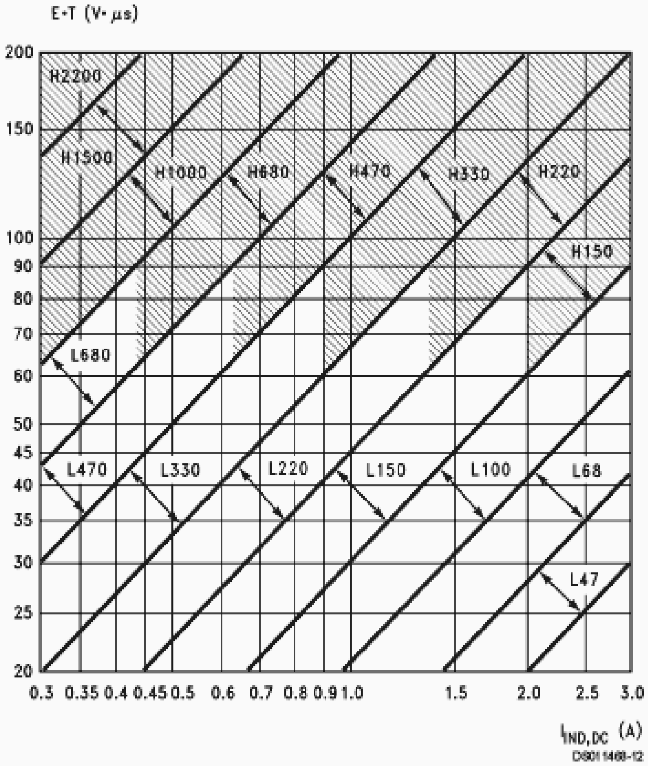


FIGURE 8. LM2577-15 Inductor Selection Guide

Application Hints (Continued)



Note: These charts assume that the inductor ripple current inductor is approximately 20% to 30% of the average inductor current (when the regulator is under full load). Greater ripple current causes higher peak switch currents and greater output ripple voltage; lower ripple current is achieved with larger-value inductors. The factor of 20 to 30% is chosen as a convenient balance between the two extremes.

FIGURE 9. LM1577-ADJ/LM2577-ADJ Inductor Selection Graph

C. *Select an inductor* from the table of *Figure 10* which cross-references the inductor codes to the part numbers of three different manufacturers. Complete specifications for these inductors are available from the respective manufacturers. The inductors listed in this table have the following characteristics:

AIE: ferrite, pot-core inductors; Benefits of this type are low electro-magnetic interference (EMI), small physical size, and very low power dissipation (core loss). Be careful not to operate these inductors too far beyond their maximum ratings for E•T and peak current, as this will saturate the core.

Pulse: powdered iron, toroid core inductors; Benefits are low EMI and ability to withstand E•T and peak current above rated value better than ferrite cores.

Renco: ferrite, bobbin-core inductors; Benefits are low cost and best ability to withstand E•T and peak current above rated value. Be aware that these inductors generate more EMI than the other types, and this may interfere with signals sensitive to noise.

Inductor Code	Manufacturer's Part Number		
	Schott	Pulse	Renco
L47	67126980	PE - 53112	RL2442
L68	67126990	PE - 92114	RL2443
L100	67127000	PE - 92108	RL2444
L150	67127010	PE - 53113	RL1954
L220	67127020	PE - 52626	RL1953
L330	67127030	PE - 52627	RL1952
L470	67127040	PE - 53114	RL1951
L680	67127050	PE - 52629	RL1950
H150	67127060	PE - 53115	RL2445
H220	67127070	PE - 53116	RL2446
H330	67127080	PE - 53117	RL2447
H470	67127090	PE - 53118	RL1961
H680	67127100	PE - 53119	RL1960
H1000	67127110	PE - 53120	RL1959
H1500	67127120	PE - 53121	RL1958
H2200	67127130	PE - 53122	RL2448

Schott Corp., (612) 475-1173
1000 Parkers Lake Rd., Wayzata, MN 55391
Pulse Engineering, (619) 268-2400
P.O. Box 12235, San Diego, CA 92112
Renco Electronics Inc., (516) 586-5566
60 Jeffryn Blvd. East, Deer Park, NY 11729

FIGURE 10. Table of Standardized Inductors and Manufacturer's Part Numbers

2. Compensation Network (R_C, C_C) and Output Capacitor (C_{OUT}) Selection

R_C and C_C form a pole-zero compensation network that stabilizes the regulator. The values of R_C and C_C are mainly dependant on the regulator voltage gain, $I_{LOAD(max)}$, L and C_{OUT}. The following procedure calculates values for R_C, C_C, and C_{OUT} that ensure regulator stability. Be aware that this procedure doesn't necessarily result in R_C and C_C that provide optimum compensation. In order to guarantee optimum compensation, one of the standard procedures for testing loop stability must be used, such as measuring V_{OUT} transient response when pulsing I_{LOAD} (see *Figure 15*).

A. *First, calculate the maximum value for R_C.*

$$R_C \le \frac{750 \times I_{LOAD(max)} \times V_{OUT}^2}{V_{IN(min)}^2}$$

Select a resistor less than or equal to this value, and it should also be no greater than 3 kΩ.

B. *Calculate the minimum value for* C_{OUT} using the following two equations.

$$C_{OUT} \ge \frac{0.19 \times L \times R_C \times I_{LOAD(max)}}{V_{IN(min)} \times V_{OUT}}$$

and

$$C_{OUT} \ge \frac{V_{IN(min)} \times R_C \times (V_{IN(min)} + (3.74 \times 10^5 \times L))}{487{,}800 \times V_{OUT}^3}$$

The larger of these two values is the minimum value that ensures stability.

C. *Calculate the minimum value of C_C.*

$$C_C > \frac{58.5 \times V_{OUT}^2 \times C_{OUT}}{R_C^2 \times V_{IN(min)}}$$

The compensation capacitor is also part of the soft start circuitry. When power to the regulator is turned on, the switch duty cycle is allowed to rise at a rate controlled by this capacitor (with no control on the duty cycle, it would immediately rise to 90%, drawing huge currents from the input power supply). In order to operate properly, the soft start circuit requires $C_C \ge 0.22$ µF.

The value of the output filter capacitor is normally large enough to require the use of aluminum electrolytic capacitors. *Figure 11* lists several different types that are recommended for switching regulators, and the following parameters are used to select the proper capacitor.

Working Voltage (WVDC): Choose a capacitor with a working voltage at least 20% higher than the regulator output voltage.

Ripple Current: This is the maximum RMS value of current that charges the capacitor during each switching cycle. For step-up and flyback regulators, the formula for ripple current is

$$I_{RIPPLE(RMS)} = \frac{I_{LOAD(max)} \times D_{(max)}}{1 - D_{(max)}}$$

Choose a capacitor that is rated at least 50% higher than this value at 52 kHz.

Equivalent Series Resistance (ESR) : This is the primary cause of output ripple voltage, and it also affects the values of R_C and C_C needed to stabilize the regulator. As a result, the preceding calculations for C_C and R_C are only valid if ESR doesn't exceed the maximum value specified by the following equations.

$$ESR \le \frac{0.01 \times V_{OUT}}{I_{RIPPLE(P-P)}} \text{ and } \le \frac{8.7 \times (10)^{-3} \times V_{IN}}{I_{LOAD(max)}}$$

where

$$I_{RIPPLE(P-P)} = \frac{1.15 \times I_{LOAD(max)}}{1 - D_{(max)}}$$

Select a capacitor with ESR, at 52 kHz, that is less than or equal to the lower value calculated. Most electrolytic capacitors specify ESR at 120 Hz which is 15% to 30% higher than at 52 kHz. Also, be aware that ESR increases by a factor of 2 when operating at −20˚C.

In general, low values of ESR are achieved by using large value capacitors (C ≥ 470 µF), and capacitors with high WVDC, or by paralleling smaller-value capacitors.

Application Hints (Continued)

3. Output Voltage Selection (R1 and R2)

This section is for applications using the LM1577-ADJ/LM2577-ADJ. Skip this section if the LM1577-12/LM2577-12 or LM1577-15/LM2577-15 is being used.

With the LM1577-ADJ/LM2577-ADJ, the output voltage is given by

$$V_{OUT} = 1.23V\ (1 + R1/R2)$$

Resistors R1 and R2 divide the output down so it can be compared with the LM1577-ADJ/LM2577-ADJ internal 1.23V reference. For a given desired output voltage V_{OUT}, select R1 and R2 so that

$$\frac{R1}{R2} = \frac{V_{OUT}}{1.23V} - 1$$

4. Input Capacitor Selection (C_{IN})

The switching action in the step-up regulator causes a triangular ripple current to be drawn from the supply source. This in turn causes noise to appear on the supply voltage. For proper operation of the LM1577, the input voltage should be decoupled. Bypassing the Input Voltage pin directly to ground with a good quality, low ESR, 0.1 µF capacitor (leads as short as possible) is normally sufficient.

Cornell Dublier —Types 239, 250, 251, UFT, 300, or 350
P.O. Box 128, Pickens, SC 29671
(803) 878-6311

Nichicon —Types PF, PX, or PZ
927 East Parkway,
Schaumburg, IL 60173
(708) 843-7500

Sprague —Types 672D, 673D, or 674D
Box 1, Sprague Road,
Lansing, NC 28643
(919) 384-2551

United Chemi-Con —Types LX, SXF, or SXJ
9801 West Higgins Road,
Rosemont, IL 60018
(708) 696-2000

FIGURE 11. Aluminum Electrolytic Capacitors Recommended for Switching Regulators

If the LM1577 is located far from the supply source filter capacitors, an additional large electrolytic capacitor (e.g. 47 µF) is often required.

5. Diode Selection (D)

The switching diode used in the boost regulator must withstand a reverse voltage equal to the circuit output voltage, and must conduct the peak output current of the LM2577. A suitable diode must have a minimum reverse breakdown voltage greater than the circuit output voltage, and should be rated for average and peak current greater than $I_{LOAD(max)}$ and $I_{D(PK)}$. Schottky barrier diodes are often favored for use in switching regulators. Their low forward voltage drop allows higher regulator efficiency than if a (less expensive) fast recovery diode was used. See *Figure 12* for recommended part numbers and voltage ratings of 1A and 3A diodes.

V_{OUT}	Schottky		Fast Recovery	
(max)	1A	3A	1A	3A
20V	1N5817 MBR120P	1N5820 MBR320P		
30V	1N5818 MBR130P 11DQ03	1N5821 MBR330P 31DQ03		
40V	1N5819 MBR140P 11DQ04	1N5822 MBR340P 31DQ04		
50V	MBR150 11DQ05	MBR350 31DQ05	1N4933 MUR105	
100V			1N4934 HER102 MUR110 10DL1	MR851 30DL1 MR831 HER302

FIGURE 12. Diode Selection Chart

BOOST REGULATOR CIRCUIT EXAMPLE

By adding a few external components (as shown in *Figure 13*), the LM2577 can be used to produce a regulated output voltage that is greater than the applied input voltage. Typical performance of this regulator is shown in *Figure 14* and *Figure 15*. The switching waveforms observed during the operation of this circuit are shown in *Figure 16*.

LM2575

1.0 A, Adjustable Output Voltage, Step-Down Switching Regulator

The LM2575 series of regulators are monolithic integrated circuits ideally suited for easy and convenient design of a step−down switching regulator (buck converter). All circuits of this series are capable of driving a 1.0 A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3 V, 5.0 V, 12 V, 15 V, and an adjustable output version.

These regulators were designed to minimize the number of external components to simplify the power supply design. Standard series of inductors optimized for use with the LM2575 are offered by several different inductor manufacturers.

Since the LM2575 converter is a switch−mode power supply, its efficiency is significantly higher in comparison with popular three−terminal linear regulators, especially with higher input voltages. In many cases, the power dissipated by the LM2575 regulator is so low, that no heatsink is required or its size could be reduced dramatically.

The LM2575 features include a guaranteed ±4% tolerance on output voltage within specified input voltages and output load conditions, and ±10% on the oscillator frequency (±2% over 0°C to 125°C). External shutdown is included, featuring 80 μA typical standby current. The output switch includes cycle−by−cycle current limiting, as well as thermal shutdown for full protection under fault conditions.

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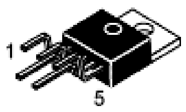
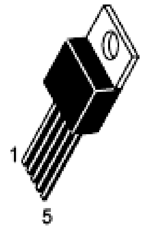


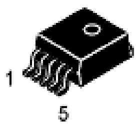
TO−220
TV SUFFIX
CASE 314B

Heatsink surface connected to Pin 3



TO−220
T SUFFIX
CASE 314D

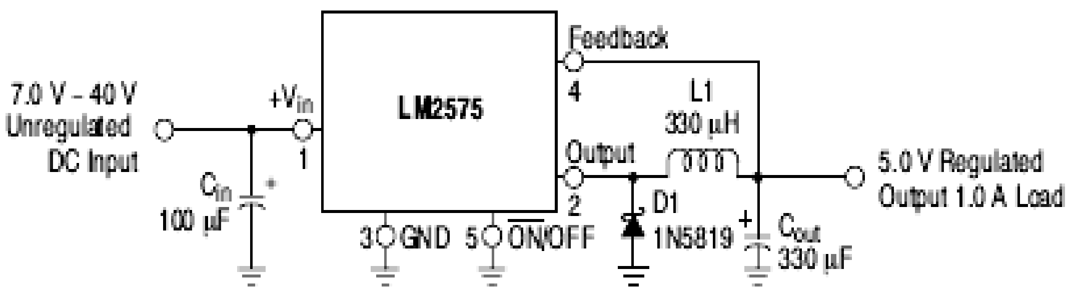
Pin 1. V_{in}
2. Output
3. Ground
4. Feedback
5. $\overline{ON}$/OFF



D^{2}PAK
D2T SUFFIX
CASE 936A

Heatsink surface (shown as terminal 6 in case outline drawing) is connected to Pin 3

Typical Application (Fixed Output Voltage Versions)



May, 2004 − Rev. 6

Publication Order Number:
LM2575/D

PIN FUNCTION DESCRIPTION

Pin	Symbol	Description (Refer to Figure 1)
1	V_{in}	This pin is the positive input supply for the LM2575 step−down switching regulator. In order to minimize voltage transients and to supply the switching currents needed by the regulator, a suitable input bypass capacitor must be present (C_{in} in Figure 1).
2	Output	This is the emitter of the internal switch. The saturation voltage V_{sat} of this output switch is typically 1.0 V. It should be kept in mind that the PCB area connected to this pin should be kept to a minimum in order to minimize coupling to sensitive circuitry.
3	GND	Circuit ground pin. See the information about the printed circuit board layout.
4	Feedback	This pin senses regulated output voltage to complete the feedback loop. The signal is divided by the internal resistor divider network R2, R1 and applied to the non−inverting input of the internal error amplifier. In the Adjustable version of the LM2575 switching regulator this pin is the direct input of the error amplifier and the resistor network R2, R1 is connected externally to allow programming of the output voltage.
5	$\overline{ON}$/OFF	It allows the switching regulator circuit to be shut down using logic level signals, thus dropping the total input supply current to approximately 80 µA. The input threshold voltage is typically 1.4 V. Applying a voltage above this value (up to $+V_{in}$) shuts the regulator off. If the voltage applied to this pin is lower than 1.4 V or if this pin is connected to ground, the regulator will be in the "on" condition.

DESIGN PROCEDURE

Buck Converter Basics

The LM2575 is a "Buck" or Step−Down Converter which is the most elementary forward−mode converter. Its basic schematic can be seen in Figure 15.

The operation of this regulator topology has two distinct time periods. The first one occurs when the series switch is on, the input voltage is connected to the input of the inductor.

The output of the inductor is the output voltage, and the rectifier (or catch diode) is reverse biased. During this period, since there is a constant voltage source connected across the inductor, the inductor current begins to linearly ramp upwards, as described by the following equation:

$$I_{L(on)} = \frac{(V_{in} - V_{out})\, t_{on}}{L}$$

During this "on" period, energy is stored within the core material in the form of magnetic flux. If the inductor is properly designed, there is sufficient energy stored to carry the requirements of the load during the "off" period.

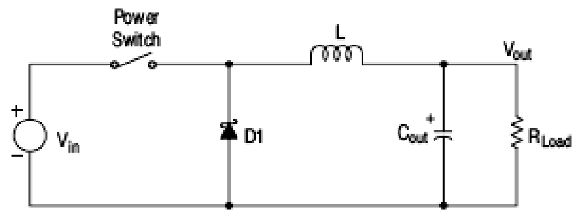


Figure 15. Basic Buck Converter

The next period is the "off" period of the power switch. When the power switch turns off, the voltage across the inductor reverses its polarity and is clamped at one diode voltage drop below ground by catch dioded. Current now flows through the catch diode thus maintaining the load current loop. This removes the stored energy from the inductor.

The inductor current during this time is:

$$I_{L(off)} = \frac{(V_{out} - V_D)\, t_{off}}{L}$$

This period ends when the power switch is once again turned on. Regulation of the converter is accomplished by varying the duty cycle of the power switch. It is possible to describe the duty cycle as follows:

$$d = \frac{t_{on}}{T}, \text{ where T is the period of switching.}$$

For the buck converter with ideal components, the duty cycle can also be described as:

$$d = \frac{V_{out}}{V_{in}}$$

Figure 16 shows the buck converter idealized waveforms of the catch diode voltage and the inductor current.

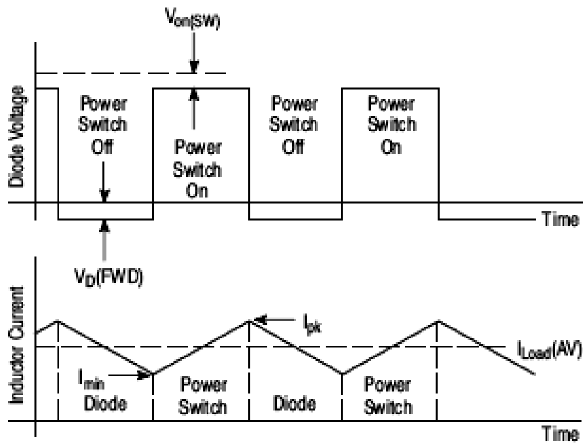


Figure 16. Buck Converter Idealized Waveforms

Procedure (Fixed Output Voltage Version) In order to simplify the switching regulator design, a step−by−step design procedure and example is provided.

Procedure	Example
Given Parameters: V_{out} = Regulated Output Voltage (3.3 V, 5.0 V, 12 V or 15 V) $V_{in(max)}$ = Maximum DC Input Voltage $I_{Load(max)}$ = Maximum Load Current	**Given Parameters:** V_{out} = 5.0 V $V_{in(max)}$ = 20 V $I_{Load(max)}$ = 0.8 A
1. Controller IC Selection According to the required input voltage, output voltage and current, select the appropriate type of the controller IC output voltage version.	**1. Controller IC Selection** According to the required input voltage, output voltage, current polarity and current value, use the LM2575−5 controller IC
2. Input Capacitor Selection (C_{in}) To prevent large voltage transients from appearing at the input and for stable operation of the converter, an aluminium or tantalum electrolytic bypass capacitor is needed between the input pin $+V_{in}$ and ground pin GND. This capacitor should be located close to the IC using short leads. This capacitor should have a low ESR (Equivalent Series Resistance) value.	**2. Input Capacitor Selection (C_{in})** A 47 μF, 25 V aluminium electrolytic capacitor located near to the input and ground pins provides sufficient bypassing.
3. Catch Diode Selection (D1) A. Since the diode maximum peak current exceeds the regulator maximum load current the catch diode current rating must be at least 1.2 times greater than the maximum load current. For a robust design the diode should have a current rating equal to the maximum current limit of the LM2575 to be able to withstand a continuous output short B. The reverse voltage rating of the diode should be at least 1.25 times the maximum input voltage.	**3. Catch Diode Selection (D1)** A. For this example the current rating of the diode is 1.0 A. B. Use a 30 V 1N5818 Schottky diode, or any of the suggested fast recovery diodes shown in the Table 4.
4. Inductor Selection (L1) A. According to the required working conditions, select the correct inductor value using the selection guide from Figures 17 to 21. B. From the appropriate inductor selection guide, identify the inductance region intersected by the Maximum Input Voltage line and the Maximum Load Current line. Each region is identified by an inductance value and an inductor code. C. Select an appropriate inductor from the several different manufacturers part numbers listed in Table 1 or Table 2. When using Table 2 for selecting the right inductor the designer must realize that the inductor current rating must be higher than the maximum peak current flowing through the inductor. This maximum peak current can be calculated as follows: $I_{p(max)} = I_{Load(max)} + \frac{(V_{in}-V_{out})\,t_{on}}{2L}$ where t_{on} is the "on" time of the power switch and $t_{on} = \frac{V_{out}}{V_{in}} \times \frac{1}{f_{osc}}$ For additional information about the inductor, see the inductor section in the "External Components" section of this data sheet.	**4. Inductor Selection (L1)** A. Use the inductor selection guide shown in Figures 17 to 21. B. From the selection guide, the inductance area intersected by the 20 V line and 0.8 A line is L330. C. Inductor value required is 330 μH. From the Table 1 or Table 2, choose an inductor from any of the listed manufacturers.

Procedure (Fixed Output Voltage Version) (continued) In order to simplify the switching regulator design, a step−by−step design procedure and example is provided.

Procedure	Example
5. Output Capacitor Selection (C_{out}) **A.** Since the LM2575 is a forward−mode switching regulator with voltage mode control, its open loop 2−pole−2−zero frequency characteristic has the dominant pole−pair determined by the output capacitor and inductor values. For stable operation and an acceptable ripple voltage, (approximately 1% of the output voltage) a value between 100 μF and 470 μF is recommended. **B.** Due to the fact that the higher voltage electrolytic capacitors generally have lower ESR (Equivalent Series Resistance) numbers, the output capacitor's voltage rating should be at least 1.5 times greater than the output voltage. For a 5.0 V regulator, a rating at least 8V is appropriate, and a 10 V or 16 V rating is recommended.	**5. Output Capacitor Selection (C_{out})** **A.** C_{out} = 100 μF to 470 μF standard aluminium electrolytic. **B.** Capacitor voltage rating = 16 V.

Procedure (Adjustable Output Version: LM2575−Adj)

Procedure	Example
Given Parameters: V_{out} = Regulated Output Voltage $V_{in(max)}$ = Maximum DC Input Voltage $I_{Load(max)}$ = Maximum Load Current	**Given Parameters:** V_{out} = 8.0 V $V_{in(max)}$ = 12 V $I_{Load(max)}$ = 1.0 A
1. Programming Output Voltage To select the right programming resistor R1 and R2 value (see Figure 14) use the following formula: $V_{out} = V_{ref}\left(1 + \frac{R2}{R1}\right)$ where V_{ref} = 1.23 V Resistor R1 can be between 1.0 k and 5.0 kΩ. (For best temperature coefficient and stability with time, use 1% metal film resistors). $R2 = R1\left(\frac{V_{out}}{V_{ref}} - 1\right)$	**1. Programming Output Voltage** (selecting R1 and R2) Select R1 and R2: $V_{out} = 1.23\left(1 + \frac{R2}{R1}\right)$ Select R1 = 1.8 kΩ $R2 = R1\left(\frac{V_{out}}{V_{ref}} - 1\right) = 1.8\,k\left(\frac{8.0\,V}{1.23\,V} - 1\right)$ R2 = 9.91 kΩ, choose a 9.88 k metal film resistor.
2. Input Capacitor Selection (C_{in}) To prevent large voltage transients from appearing at the input and for stable operation of the converter, an aluminium or tantalum electrolytic bypass capacitor is needed between the input pin $+V_{in}$ and ground pin GND This capacitor should be located close to the IC using short leads. This capacitor should have a low ESR (Equivalent Series Resistance) value. For additional information see input capacitor section in the "External Components" section of this data sheet.	**2. Input Capacitor Selection (C_{in})** A 100 μF aluminium electrolytic capacitor located near the input and ground pin provides sufficient bypassing.
3. Catch Diode Selection (D1) **A.** Since the diode maximum peak current exceeds the regulator maximum load current the catch diode current rating must be at least 1.2 times greater than the maximum load current. For a robust design, the diode should have a current rating equal to the maximum current limit of the LM2575 to be able to withstand a continuous output short. **B.** The reverse voltage rating of the diode should be at least 1.25 times the maximum input voltage.	**3. Catch Diode Selection (D1)** **A.** For this example, a 3.0 A current rating is adequate. **B.** Use a 20 V 1N5820 or MBR320 Schottky diode or any suggested fast recovery diode in the Table 4.

Procedure (Adjustable Output Version: LM2575−Adj) (continued)

Procedure	Example
4. Inductor Selection (L1) A. Use the following formula to calculate the inductor Volt x microsecond [V x µs] constant: $E \times T = \left(V_{in} - V_{out}\right) \frac{V_{out}}{V_{on}} \times \frac{10^6}{F[Hz]} [V \times \mu s]$ B. Match the calculated E x T value with the corresponding number on the vertical axis of the Inductor Value Selection Guide shown in Figure 21. This E x T constant is a measure of the energy handling capability of an inductor and is dependent upon the type of core, the core area, the number of turns, and the duty cycle. C. Next step is to identify the inductance region intersected by the E x T value and the maximum load current value on the horizontal axis shown in Figure 21. D. From the inductor code, identify the inductor value. Then select an appropriate inductor from the Table 1 or Table 2. The inductor chosen must be rated for a switching frequency of 52 kHz and for a current rating of 1.15 x I_{load}. The inductor current rating can also be determined by calculating the inductor peak current: $I_{p(max)} = I_{Load(max)} + \frac{\left(V_{in} - V_{out}\right) t_{on}}{2L}$ where t_{on} is the "on" time of the power switch and $t_{on} = \frac{V_{out}}{V_{in}} \times \frac{1}{f_{osc}}$ For additional information about the inductor, see the inductor section in the "External Components" section of this data sheet.	**4. Inductor Selection (L1)** A. Calculate E x T [V x µs] constant: $E \times T = (12 - 8.0) \times \frac{8.0}{12} \times \frac{1000}{52} = 51 [V \times \mu s]$ B. E x T = 51 [V x µs] C. $I_{Load(max)}$ = 1.0 A Inductance Region = L220 D. Proper inductor value = 220 µH Choose the inductor from the Table 1 or Table 2.
5. Output Capacitor Selection (C_{out}) A. Since the LM2575 is a forward−mode switching regulator with voltage mode control, its open loop 2−pole−2−zero frequency characteristic has the dominant pole−pair determined by the output capacitor and inductor values. For stable operation, the capacitor must satisfy the following requirement: $C_{out} \geq 7.785 \frac{V_{in(max)}}{V_{out} \times L [\mu H]} [\mu F]$ B. Capacitor values between 10 µF and 2000 µF will satisfy the loop requirements for stable operation. To achieve an acceptable output ripple voltage and transient response, the output capacitor may need to be several times larger than the above formula yields. C. Due to the fact that the higher voltage electrolytic capacitors generally have lower ESR (Equivalent Series Resistance) numbers, the output capacitor's voltage rating should be at least 1.5 times greater than the output voltage. For a 5.0 V regulator, a rating of at least 8V is appropriate, and a 10 V or 16 V rating is recommended.	**5. Output Capacitor Selection (C_{out})** A. $C_{out} \geq 7.785 \frac{12}{8.220} = 53 \mu F$ To achieve an acceptable ripple voltage, select C_{out} = 100 µF electrolytic capacitor.

INDUCTOR VALUE SELECTION GUIDE

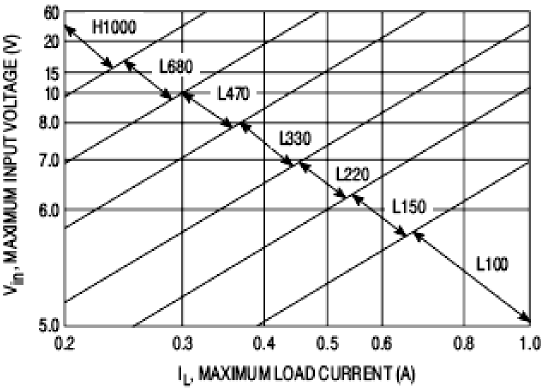


Figure 17. LM2575−3.3

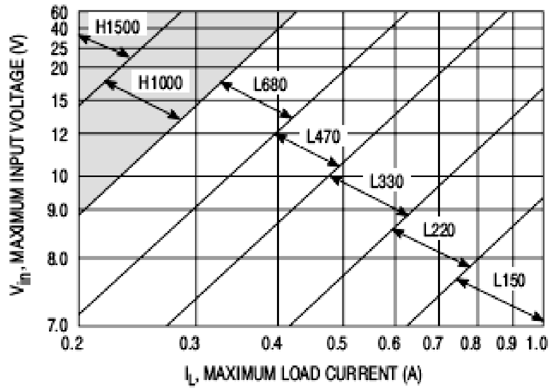


Figure 18. LM2575−5.0

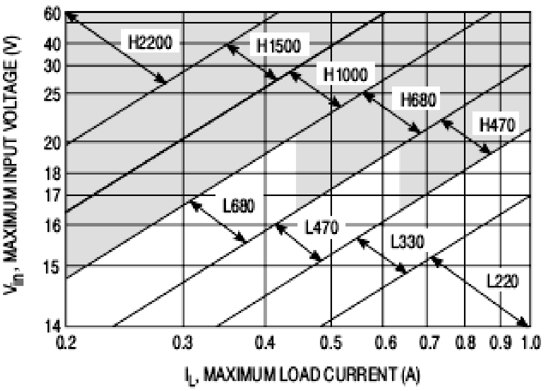


Figure 19. LM2575−12

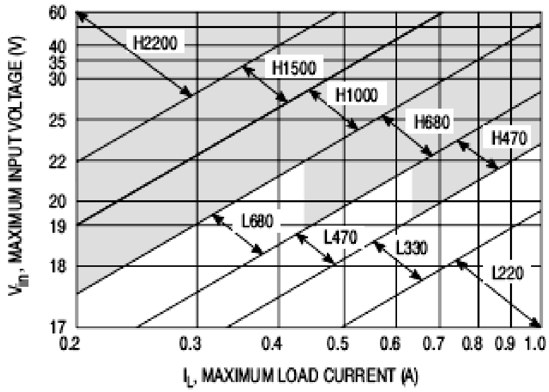


Figure 20. LM2575−15

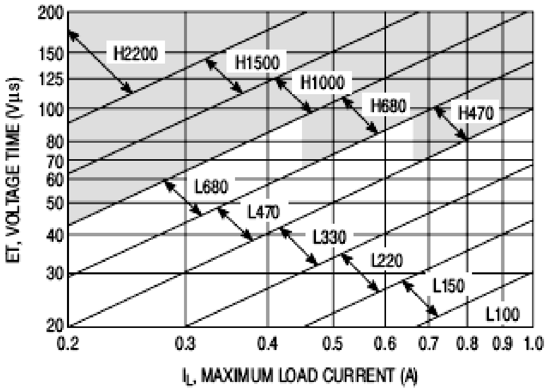


Figure 21. LM2575−Adj

NOTE: This Inductor Value Selection Guide is applicable for continuous mode only.

Table 1. Inductor Selection Guide

Inductor Code	Inductor Value	Pulse Eng	Renco	AIE	Tech 39
L100	100 μH	PE−92108	RL2444	415−0930	77 308 BV
L150	150 μH	PE−53113	RL1954	415−0953	77 358 BV
L220	220 μH	PE−52626	RL1953	415−0922	77 408 BV
L330	330 μH	PE−52627	RL1952	415−0926	77 458 BV
L470	470 μH	PE−53114	RL1951	415−0927	−
L680	680 μH	PE−52629	RL1950	415−0928	77 508 BV
H150	150 μH	PE−53115	RL2445	415−0936	77 368 BV
H220	220 μH	PE−53116	RL2446	430−0636	77 410 BV
H330	330 μH	PE−53117	RL2447	430−0635	77 460 BV
H470	470 μH	PE−53118	RL1961	430−0634	−
H680	680 μH	PE−53119	RL1960	415−0935	77 510 BV
H1000	1000 μH	PE−53120	RL1959	415−0934	77 558 BV
H1500	1500 μH	PE−53121	RL1958	415−0933	−
H2200	2200 μH	PE−53122	RL2448	415−0945	77 610 BV

Table 2. Inductor Selection Guide

Inductance	Current	Schott		Renco		Pulse Engineering		Coilcraft
(μH)	(A)	THT	SMT	THT	SMT	THT	SMT	SMT
68	0.32	67143940	67144310	RL−1284−68−43	RL1500−68	PE−53804	PE−53804−S	DO1608−68
	0.58	67143990	67144360	RL−5470−6	RL1500−68	PE−53812	PE−53812−S	DO3308−683
	0.99	67144070	67144450	RL−5471−5	RL1500−68	PE−53821	PE−53821−S	DO3316−683
	1.78	67144140	67144520	RL−5471−5	−	PE−53830	PE−53830−S	DO5022P−683
100	0.48	67143980	67144350	RL−5470−5	RL1500−100	PE−53811	PE−53811−S	DO3308−104
	0.82	67144060	67144440	RL−5471−4	RL1500−100	PE−53820	PE−53820−S	DO3316−104
	1.47	67144130	67144510	RL−5471−4	−	PE−53829	PE−53829−S	DO5022P−104
150	0.39	−	67144340	RL−5470−4	RL1500−150	PE−53810	PE−53810−S	DO3308−154
	0.66	67144050	67144430	RL−5471−3	RL1500−150	PE−53819	PE−53819−S	DO3316−154
	1.20	67144120	67144500	RL−5471−3	−	PE−53828	PE−53828−S	DO5022P−154
220	0.32	67143960	67144330	RL−5470−3	RL1500−220	PE−53809	PE−53809−S	DO3308−224
	0.55	67144040	67144420	RL−5471−2	RL1500−220	PE−53818	PE−53818−S	DO3316−224
	1.00	67144110	67144490	RL−5471−2	−	PE−53827	PE−53827−S	DO5022P−224
330	0.42	67144030	67144410	RL−5471−1	RL1500−330	PE−53817	PE−53817−S	DO3316−334
	0.80	67144100	67144480	RL−5471−1	−	PE−53826	PE−53826−S	DO5022P−334

NOTE: Table 1 and Table 2 of this Indicator Selection Guide shows some examples of different manufacturer products suitable for design with the LM2575.

Annexe 5 : Diode 1N5822

JGD

1N5820 THRU 1N5822

3.0 AMPS. SCHOTTKY BARRIER RECTIFIERS

VOLTAGE RANGE
20 to 40 volts
CURRENT
3.0 Amperes

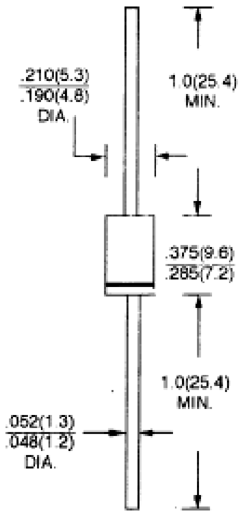
FEATURES

- * Low forward voltage drop
- * High current capability
- * High reliability
- * High surge current capability

MECHANICAL DATA

- * Case: DO-201 AD Molded plastic
- * Epoxy: UL 94V – 0 rate flame retardant
- * Lead: Axial leads, solderable per MIL – STD – 202, method 208 guaranteed
- * Polarity: Color band denotes cathode end
- * Weight: 1.10grams

DO-201AD



Dimensions in inches and (milimeters)

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Rating at 25℃ ambient temperature unless otherwise specified.
Single phase, half wave, 60 H_Z, resistive or inductive load.
For capacitive load, derate current by 20%

TYPE NUMBER	SYMBOLS	1N5820	1N5821	1N5822	UNITS
Maximum Recurrent Peak Reverse Voltage	V_{RRM}	20	30	40	V
Maximum RMS Voltage	V_{RMS}	14	21	28	V
Maximum DC Blocking Voltage	V_{DC}	20	30	40	V
Maximum Average Forward Rectified Current @ T_L = 90℃	$I_{F(AV)}$		3.0		A
Peak Forward Surge Current. (8.3 ms half sine)	I_{FSM}		80		A
Maximum Instantaneous Forward Voltage @ 3.0A (Note 1)	V_F	0.475	0.500	0.525	V
Maximum Instantaneous Forward Voltage @ 9.0A	V_{FM}	0.850	0.900	0.950	V
Maximum D.C Reverse Current @ T_A = 25℃ at Rated D.C Blocking Voltage @ T_A = 100℃	I_R		2.0 20		mA
Typical Thermal Resistance (Note 2)	$R_{\theta JA}$		40		℃/W
Typical Junction Capacitance (Note 3)	C_J		300		pF
Operating and Storage Temperature Range	T_J		– 65 to + 125		℃

NOTE: (1) Pulse test: 300μs pulse width, 1% duty cycle
(2) Thermal Resistance Junction to Ambient Vertical PC Board Mounted, 0.500"(12.7mm) Lead Length wich 2.5 × 2.5"(63.5 × 63.5mm) copper pads.
(3) Measured at 1 MHz and applied reverse voltage of 4.0V D.C.

Annexe 6 : Diode MBR 2045CT

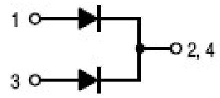
MBR2045CT

SWITCHMODE ™ Power Rectifier

ON Semiconductor®

http://onsemi.com

SCHOTTKY BARRIER RECTIFIER
20 AMPERES, 45 VOLTS



Features and Benefits

- Low Forward Voltage
- Low Power Loss / High Efficiency
- High Surge Capacity
- 175°C Operating Junction Temperature
- 20 A Total (10 A Per Diode Leg)
- Pb−Free Package is Available*

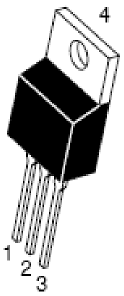
Applications

- Power Supply − Output Rectification
- Power Management
- Instrumentation

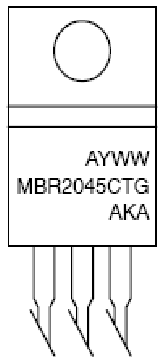
Mechanical Characteristics

- Case: Epoxy, Molded
- Epoxy Meets UL 94, V−0 @ 0.125 in
- Weight: 1.9 Grams (Approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- ESD Rating: Human Body Model = 3B
  Machine Model = C

MARKING DIAGRAM



TO−220AB
CASE 221A
STYLE 6

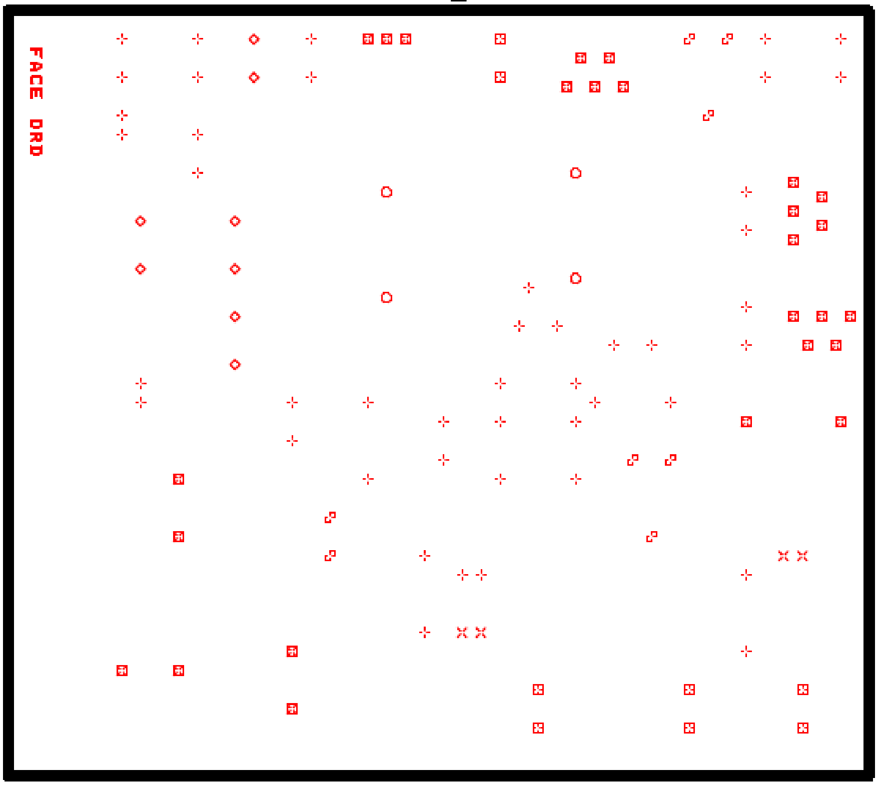


A = Assembly Location
Y = Year
WW = Work Week
MBR2045CT = Device Code
G = Pb−Free Package
AKA = Diode Polarity

ORDERING INFORMATION

Device	Package	Shipping
MBR2045CT	TO−220	50 Units / Rail
MBR2045CTG	TO−220 (Pb−Free)	50 Units / Rail

Annexe 6 : Implantation des composants



DRILL CHART

SYM	DIAM	TOL	QTY	NOTE
×	0.762 mm		4	
+	0.787 mm		45	
◇	0.889 mm		8	
⊠	0.991 mm		26	
⊞	1.000 mm		8	
small square	1.194 mm		8	
○	1.499 mm		4	
TOTAL			103	

Figure 8: Plan de perçage

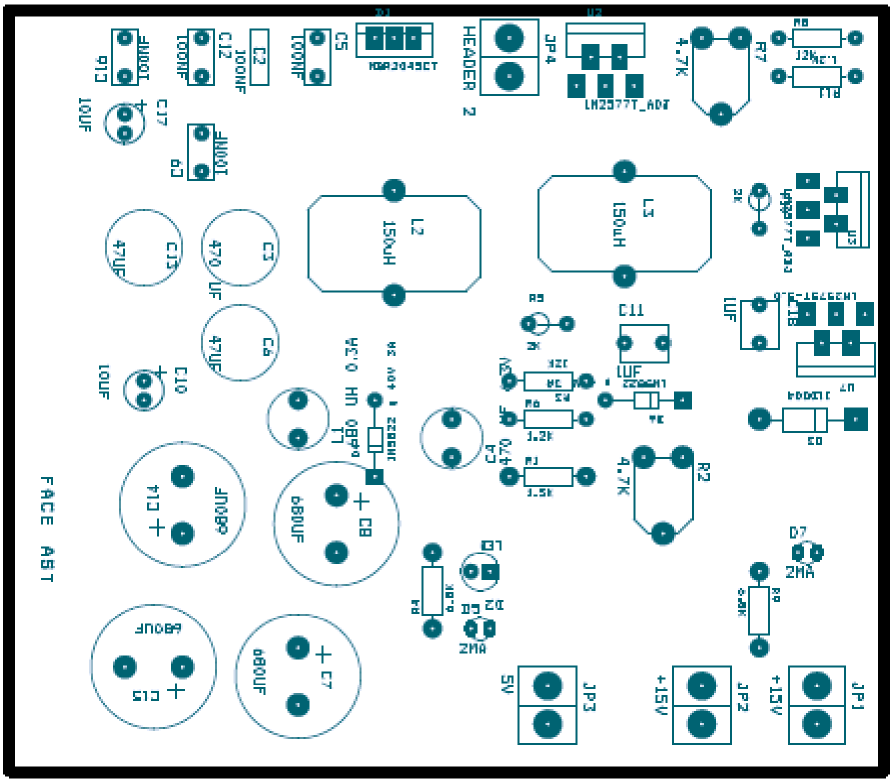


Figure 9: Emplacement des composants

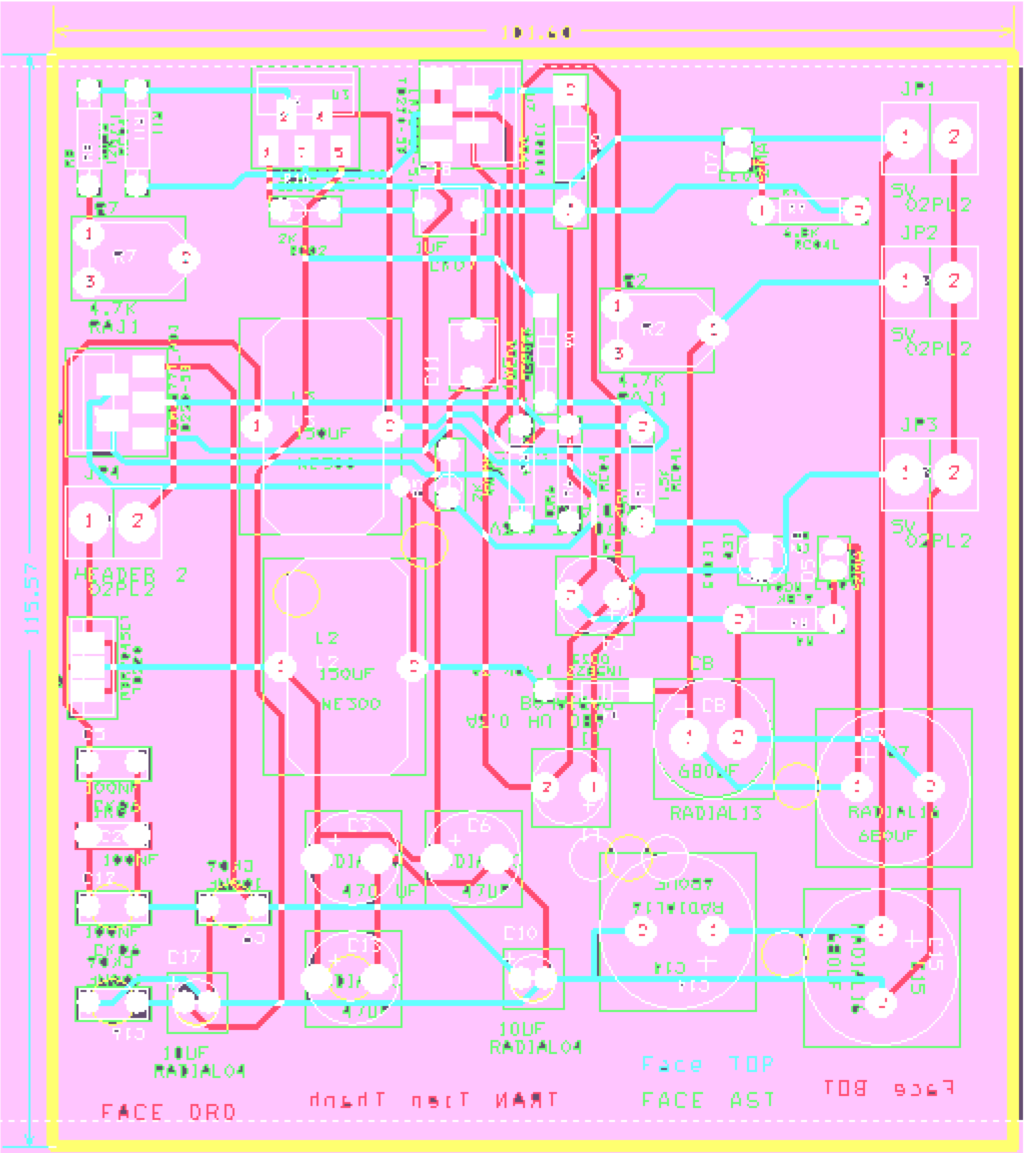


Figure 10: Typon complet

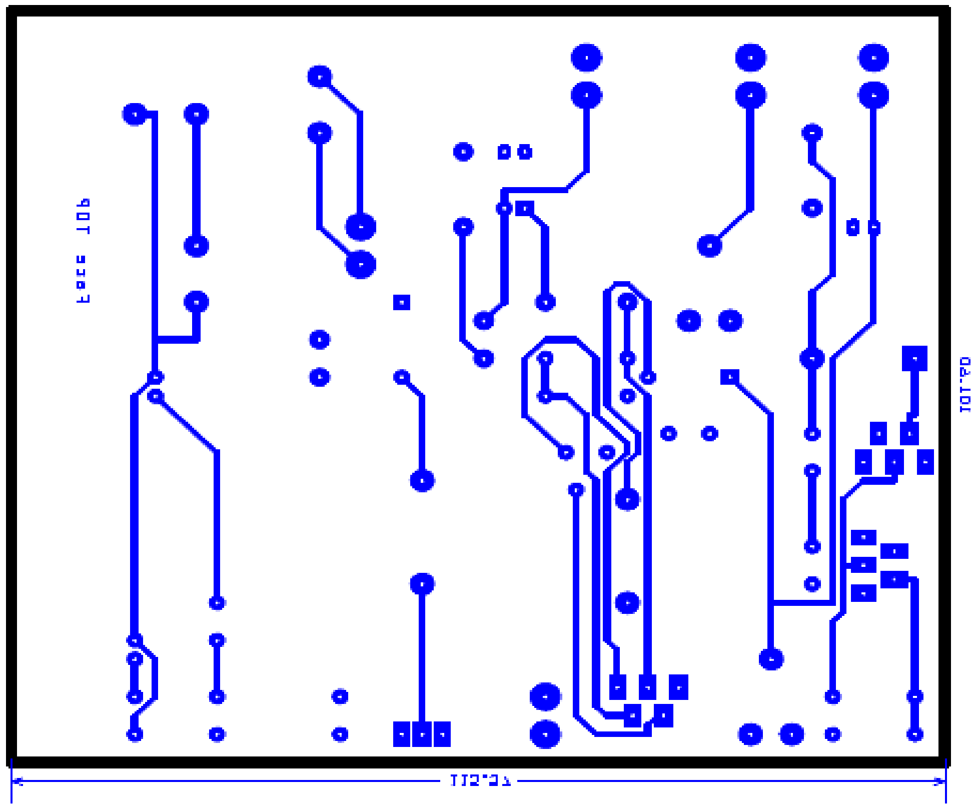


Figure 11 : Typon de la face de dessus(TOP)

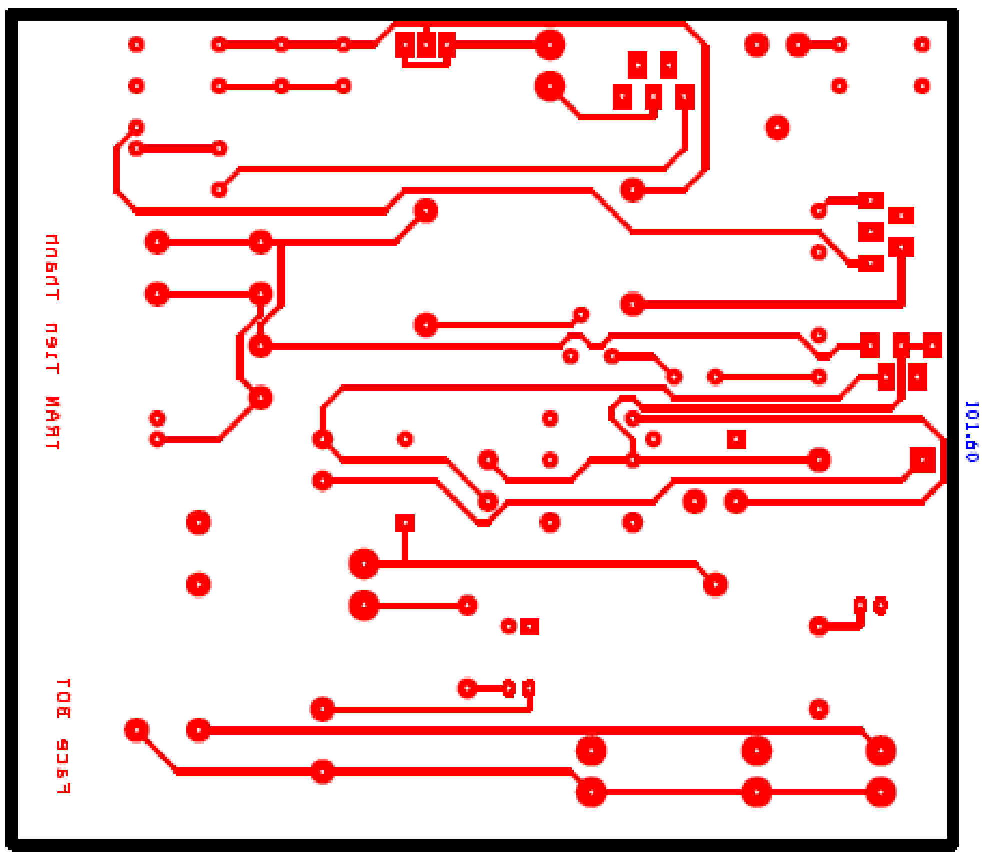


Figure 12 : Typon de la face de-dessous (BOTTOM)

Bibliographie

Sites internet utilisés :

http://www.thierry-lequeu.fr/data/DATA347.HTM

MBR2045CT :

http://www.onsemi.com/pub/Collateral/MBR2045CT-D.PDF

LM2575 :

http://www.onsemi.com/pub/Collateral/LM2575-D.PDF

LM2577T-ADJ :

http://www.futurlec.com/Linear/LM2577T-ADJ.shtml