Projet 8 - BOOST / Convertisseur BOOST 6V vers 13V - 120 W

Projet : IUT2

Info : [DIV297]

Révision : 1 janvier 2002

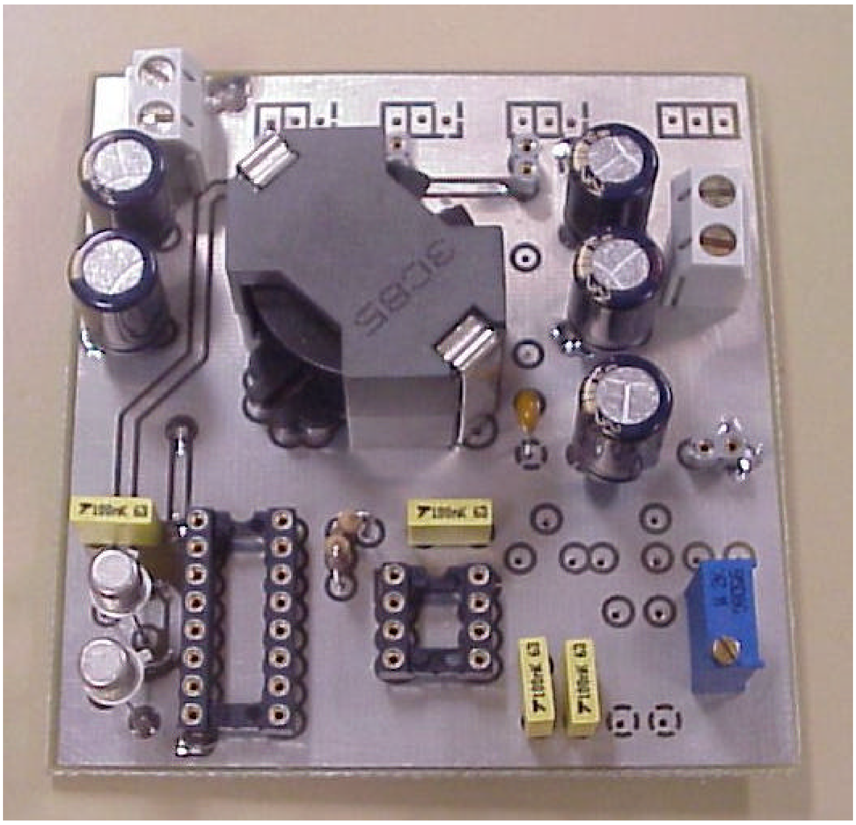


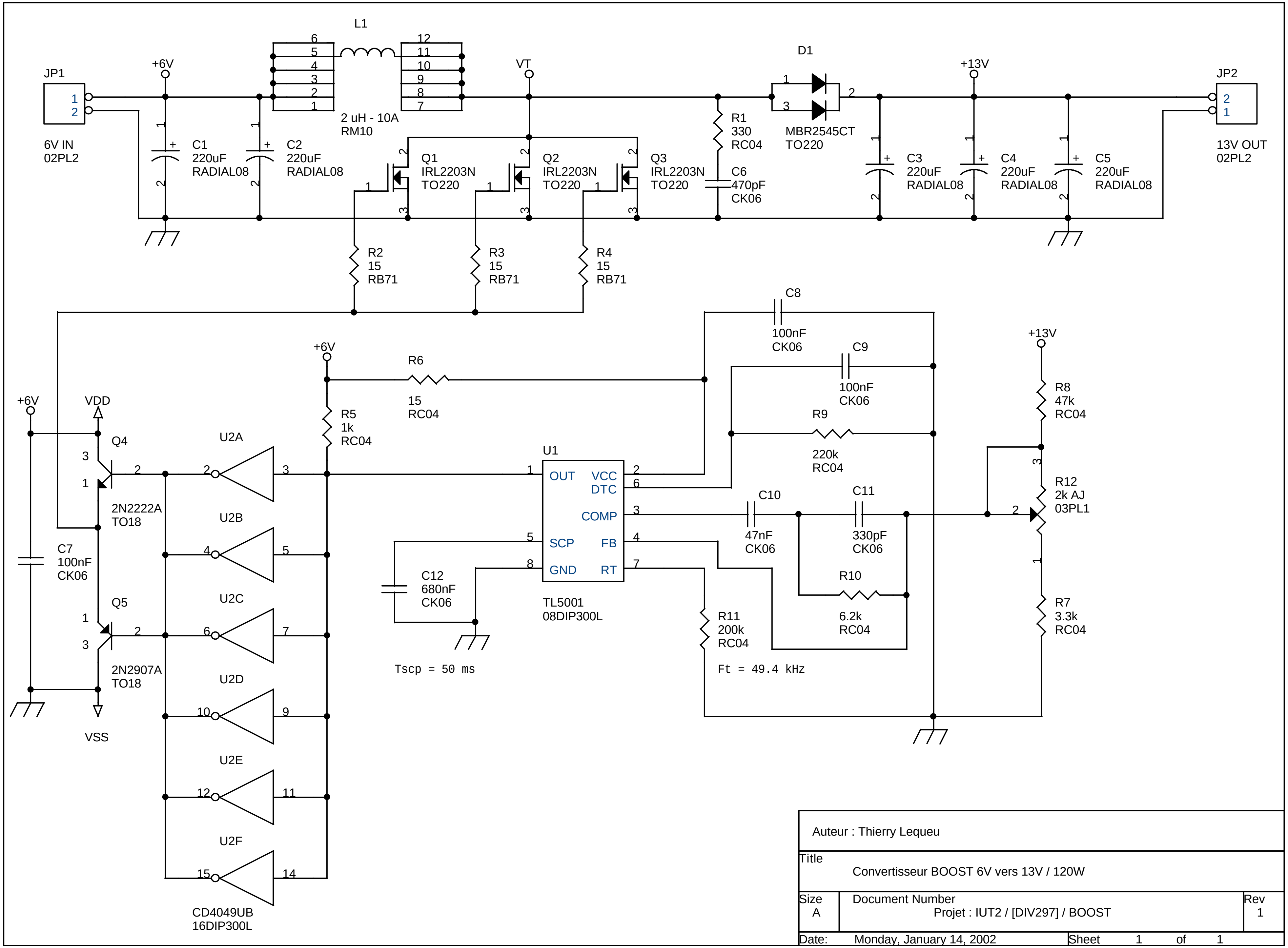
Figure 8.1. Maquette (images-maquettes\boost-1.jpg).

8.1 Liste des documents

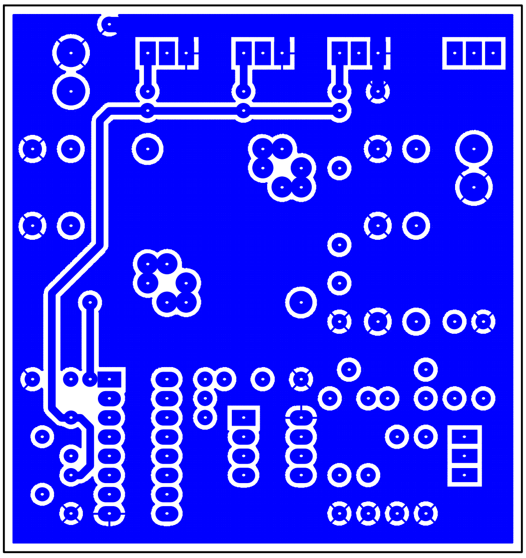
- renvoi
- Prix du montage.
- Schéma électronique.
- Circuit imprimé coté cuivre.
- Circuit imprimé coté composants.
- Implantation des composants.
- Documentations.

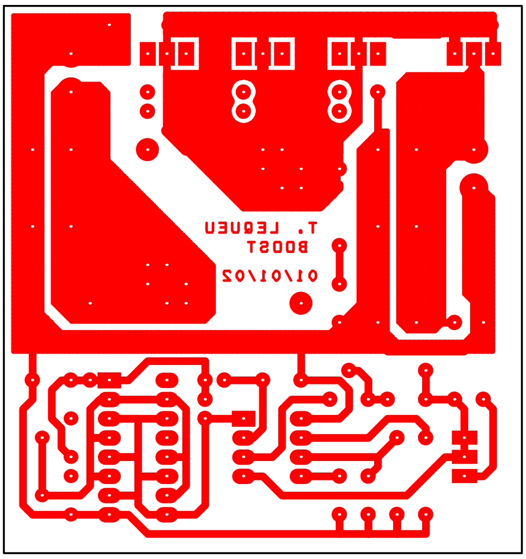
8.2 Désignation des composants

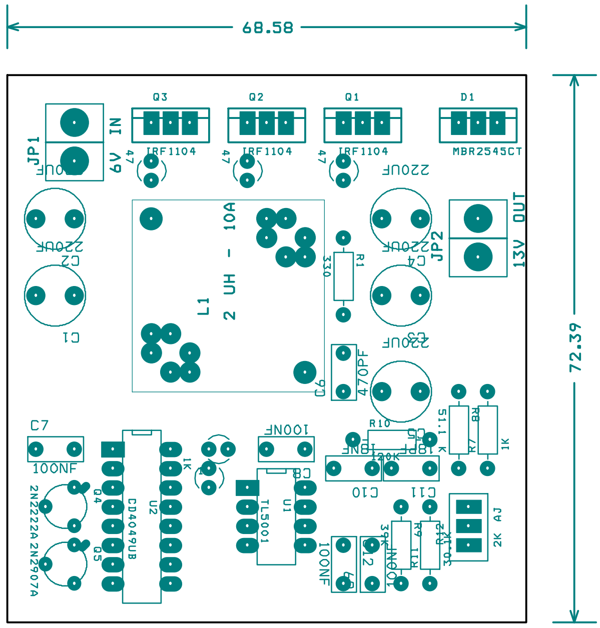
Tableau 8.1. Liste de composants (projets-iut2.xls / BOOST).

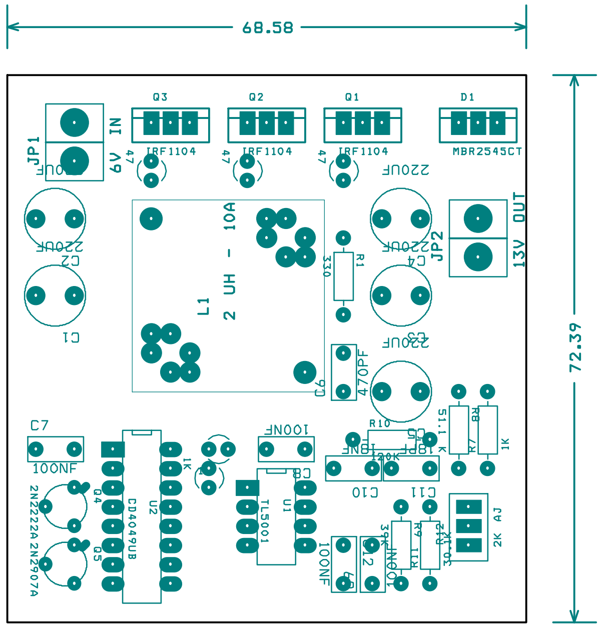


JP1
6V IN
02PL2
+6V
C1
220uF
RADIAL08
C2
220uF
RADIAL08
L1
2 uH - 10A
RM10
VT
Q1
IRL2203N
TO220
Q2
IRL2203N
TO220
Q3
IRL2203N
TO220
R1
330
RC04
C6
470pF
CK06
D1
MBR2545CT
TO220
+13V
C3
220uF
RADIAL08
C4
220uF
RADIAL08
C5
220uF
RADIAL08
JP2
13V OUT
02PL2
R2
15
RB71
R3
15
RB71
R4
15
RB71
C8
100nF
CK06
C9
100nF
CK06
R6
15
RC04
R5
1k
RC04
R9
220k
RC04
R8
47k
RC04
VDD
Q4
2N2222A
TO18
U2A
U2B
U2C
U2D
U2E
U2F
CD4049UB
16DIP300L
U1
OUT
VCC
DTC
COMP
SCP
FB
GND
RT
TL5001
08DIP300L
C10
47nF
CK06
C11
330pF
CK06
R12
2k AJ
03PL1
C7
100nF
CK06
Q5
2N2907A
TO18
VSS
C12
680nF
CK06
R10
6.2k
RC04
R11
200k
RC04
R7
3.3k
RC04
Tscp = 50 ms
Ft = 49.4 kHz
Auteur : Thierry Lequeu
Title
Convertisseur BOOST 6V vers 13V / 120W
Size
A
Document Number
Projet : IUT2 / [DIV297] / BOOST
Rev
1
Date: Monday, January 14, 2002
Sheet 1 of 1




T. LEQUEU
BOOST
01/01/02

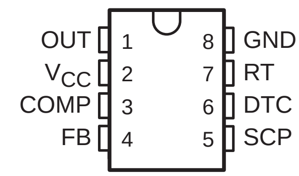

68.58
72.39
Q3
Q2
Q1
D1
IRF1104
IRF1104
IRF1104
MBR2545CT
JP1
9V IN
JP2
13V OUT
L1
2 UH - 10A
C1
C2
C7
100NF
2N2222A
2N2907A
CD4049UB
U2
TL5001
U1
470PF
220UF
330
R1
2K AJ



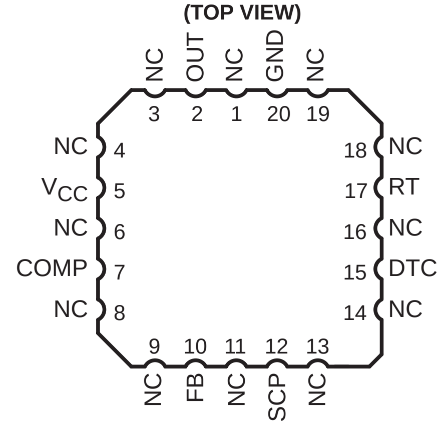
68.58
72.39
JP1
9V IN
Q3
Q2
Q1
D1
IRF1104
IRF1104
IRF1104
MBR2545CT
47
47
47
220UF
220UF
220UF
C1
C2
C3
C4
L1
2 UH - 10A
R1
330
JP2
13V OUT
470PF
C7
100NF
100NF
2N2222A
2N2907A
Q4
Q5
CD4049UB
U2
1K
TL5001
U1
C8
C10
C11
R10
120K
2K AJ
R7
R8
1K

- **Complete PWM Power Control**
- **3.6-V to 40-V Operation**
- **Internal Undervoltage-Lockout Circuit**
- **Internal Short-Circuit Protection**
- **Oscillator Frequency . . . 20 kHz to 500 kHz**
- **Variable Dead Time Provides Control Over Total Range**
- **±3% Tolerance on Reference Voltage (TL5001A)**
- **Available in Q-Temp Automotive**
  HighRel Automotive Applications
  Configuration Control / Print Support
  Qualification to Automotive Standards

D, JG OR P PACKAGE
(TOP VIEW)



FK PACKAGE
(TOP VIEW)



description

The TL5001 and TL5001A incorporate on a single monolithic chip all the functions required for a pulse-width-modulation (PWM) control circuit. Designed primarily for power-supply control, the TL5001/A contains an error amplifier, a regulator, an oscillator, a PWM comparator with a dead-time-control input, undervoltage lockout (UVLO), short-circuit protection (SCP), and an open-collector output transistor. The TL5001A has a typical reference voltage tolerance of ±3% compared to ±5% for the TL5001.

The error-amplifier common-mode voltage ranges from 0 V to 1.5 V. The noninverting input of the error amplifier is connected to a 1-V reference. Dead-time control (DTC) can be set to provide 0% to 100% dead time by connecting an external resistor between DTC and GND. The oscillator frequency is set by terminating RT with an external resistor to GND. During low V_{CC} conditions, the UVLO circuit turns the output off until V_{CC} recovers to its normal operating range.

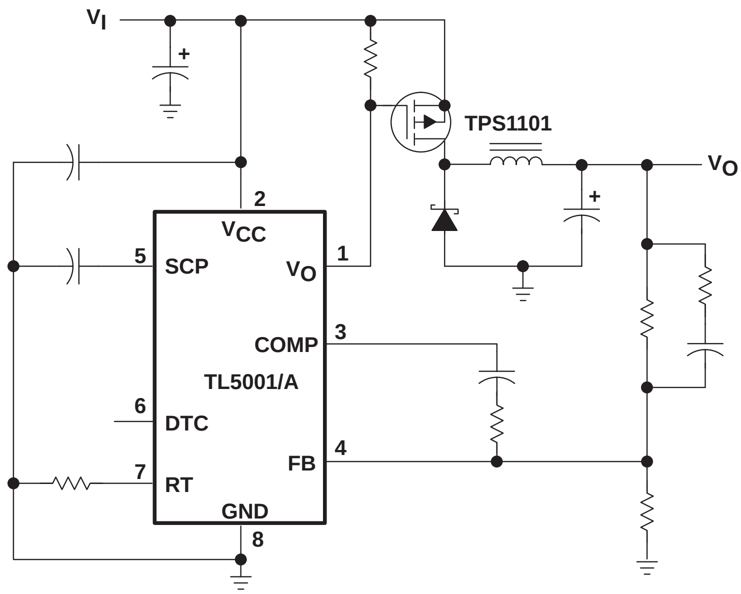
The TL5001C and TL5001AC are characterized for operation from –20°C to 85°C. The TL5001I and TL5001AI are characterized for operation from –40°C to 85°C. The TL5001Q and TL5001AQ are characterized for operation from –40°C to 125°C. The TL5001M and TL5001AM are characterized for operation from –55°C to 125°C.

AVAILABLE OPTIONS

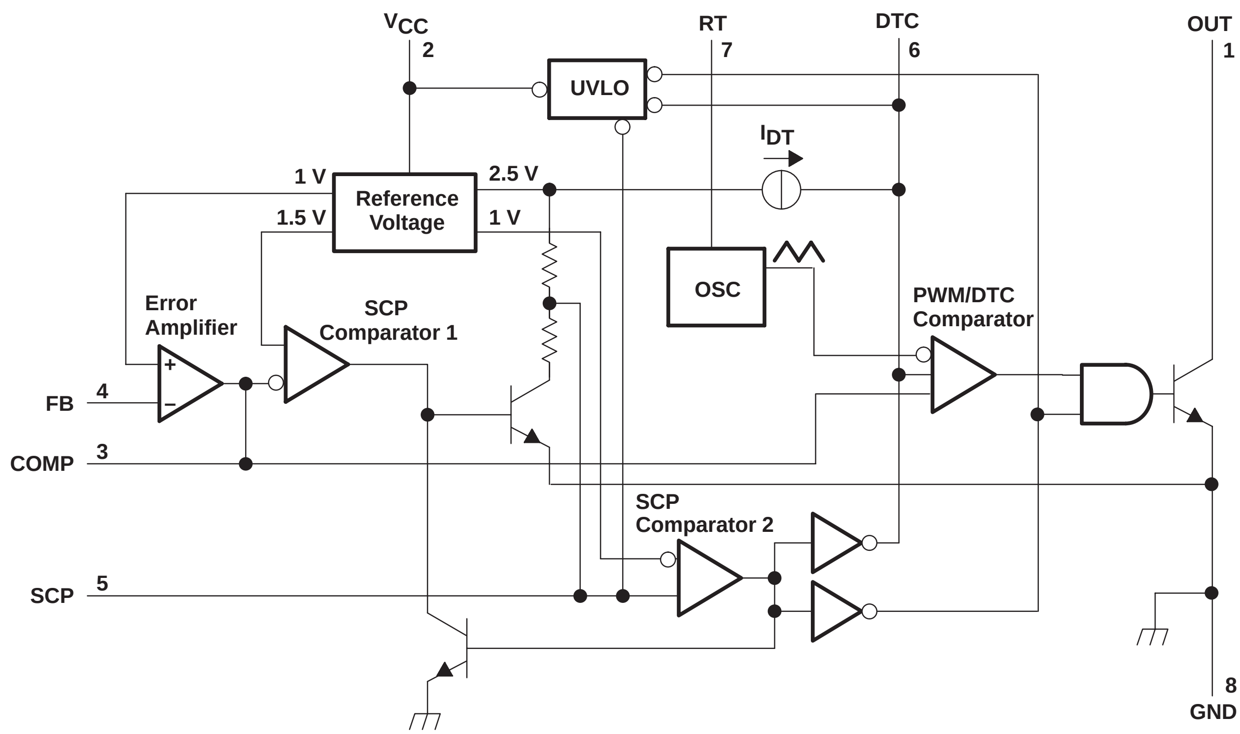
T_A	PACKAGED DEVICES			
	SMALL OUTLINE (D)	PLASTIC DIP (P)	CERAMIC DIP (JG)	CHIP CARRIER (FK)
–20°C to 85°C	TL5001CD	TL5001CP	—	—
	TL5001ACD	TL5001ACP	—	—
–40°C to 85°C	TL5001ID	TL5001IP	—	—
	TL5001AID	TL5001AIP	—	—
–40°C to 125°C	TL5001QD	—	—	—
	TL5001AQD	—	—	—
–55°C to 125°C	—	—	TL5001MJG	TL5001MFK
	—	—	TL5001AMJG	TL5001AMFK

The D package is available taped and reeled. Add the suffix R to the device type (e.g., TL5001CDR).

schematic for typical application



functional block diagram



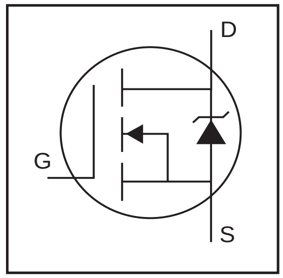
PD - 91366

International
IOR Rectifier

IRL2203N

HEXFET® Power MOSFET

- Advanced Process Technology
- Ultra Low On-Resistance
- Dynamic dv/dt Rating
- 175°C Operating Temperature
- Fast Switching
- Fully Avalanche Rated



V_{DSS} = 30V

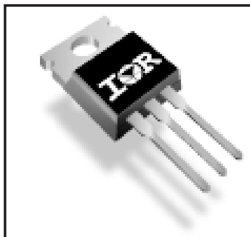
$R_{DS(on)}$ = 7.0mΩ

I_D = 116A⑦

Description

Advanced HEXFET® Power MOSFETs from International Rectifier utilize advanced processing techniques to achieve extremely low on-resistance per silicon area. This benefit, combined with the fast switching speed and ruggedized device design that HEXFET power MOSFETs are well known for, provides the designer with an extremely efficient and reliable device for use in a wide variety of applications.

The TO-220 package is universally preferred for all commercial-industrial applications at power dissipation levels to approximately 50 watts. The low thermal resistance and low package cost of the TO-220 contribute to its wide acceptance throughout the industry.



TO-220AB

Absolute Maximum Ratings

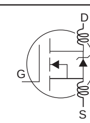
	Parameter	Max.	Units
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V	116⑦	A
I_D @ T_C = 100°C	Continuous Drain Current, V_{GS} @ 10V	82	
I_{DM}	Pulsed Drain Current ①	400	
P_D @T_C = 25°C	Power Dissipation	180	W
	Linear Derating Factor	1.2	W/°C
V_{GS}	Gate-to-Source Voltage	± 16	V
I_{AR}	Avalanche Current①	60	A
E_{AR}	Repetitive Avalanche Energy①	18	mJ
dv/dt	Peak Diode Recovery dv/dt ③	5.0	V/ns
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 175	°C
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	
	Mounting torque, 6-32 or M3 srew	10 lbf•in (1.1N•m)	

Thermal Resistance

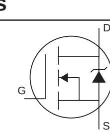
	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	——	0.85	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.50	——	
$R_{\theta JA}$	Junction-to-Ambient	——	62	

3/16/01

Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	30	—	—	V	V_{GS} = 0V, I_D = 250µA
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.029	—	V/°C	Reference to 25°C, I_D = 1mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	—	7.0	mΩ	V_{GS} = 10V, I_D = 60A ④
		—	—	10		V_{GS} = 4.5V, I_D = 48A ④
$V_{GS(th)}$	Gate Threshold Voltage	1.0	—	—	V	$V_{DS} = V_{GS}$, I_D = 250µA
g_{fs}	Forward Transconductance	73	—	—	S	V_{DS} = 25V, I_D = 60A④
I_{DSS}	Drain-to-Source Leakage Current	—	—	25	µA	V_{DS} = 30V, V_{GS} = 0V
		—	—	250		V_{DS} = 24V, V_{GS} = 0V, T_J = 125°C
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	V_{GS} = 16V
	Gate-to-Source Reverse Leakage	—	—	-100		V_{GS} = -16V
Q_g	Total Gate Charge	—	—	60	nC	I_D = 60A
Q_{gs}	Gate-to-Source Charge	—	—	14		V_{DS} = 24V
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	—	33		V_{GS} = 4.5V, See Fig. 6 and 13
$t_{d(on)}$	Turn-On Delay Time	—	11	—		V_{DD} = 15V
t_r	Rise Time	—	160	—		I_D = 60A
$t_{d(off)}$	Turn-Off Delay Time	—	23	—		R_G = 1.8Ω
t_f	Fall Time	—	66	—		V_{GS} = 4.5V, See Fig. 10 ④
L_D	Internal Drain Inductance	—	4.5	—	nH	Between lead, 6mm (0.25in.) from package and center of die contact 
L_S	Internal Source Inductance	—	7.5	—		
C_{iss}	Input Capacitance	—	3290	—	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	—	1270	—		V_{DS} = 25V
C_{rss}	Reverse Transfer Capacitance	—	170	—		ƒ = 1.0MHz, See Fig. 5
E_{AS}	Single Pulse Avalanche Energy②	—	1320⑤	290⑥	mJ	I_{AS} = 60A, L = 0.16mH

Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	116⑦	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode)①	—	—	400		
V_{SD}	Diode Forward Voltage	—	—	1.2	V	T_J = 25°C, I_S = 60A, V_{GS} = 0V ④
t_{rr}	Reverse Recovery Time	—	56	84	ns	T_J = 25°C, I_F = 60A
Q_{rr}	Reverse Recovery Charge	—	110	170	nC	di/dt = 100A/µs ④
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by L_S+L_D)				

Notes:

① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11)

② Starting T_J = 25°C, L = 0.16mH R_G = 25Ω, I_{AS} = 60A, V_{GS}=10V (See Figure 12)

③ $I_{SD} \leq$ 60A, di/dt ≤ 110A/µs, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq$ 175°C

④ Pulse width ≤ 400µs; duty cycle ≤ 2%.

⑤ This is a typical value at device destruction and represents operation outside rated limits.

⑥ This is a calculated value limited to T_J = 175°C .

⑦ Calculated continuous current based on maximum allowable junction temperature. Package limitation current is 75A.

SWITCHMODE™ Power Rectifier

MBR3045PT

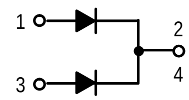
Motorola Preferred Device

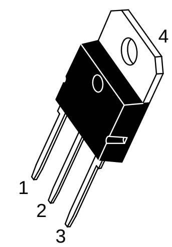
SCHOTTKY BARRIER RECTIFIER
30 AMPERES
45 VOLTS

. . . using the Schottky Barrier principle with a platinum barrier metal. These state–of–the–art devices have the following features:

- Dual Diode Construction — Terminals 1 and 3 may be Connected for Parallel Operation at Full Rating
- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Guaranteed Reverse Avalanche

Mechanical Characteristics:
- Case: Epoxy, Molded
- Weight: 4.3 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
- Shipped 30 units per plastic tube
- Marking: B3045





CASE 340D–02

MAXIMUM RATINGS

Rating		Symbol	Maximum	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage		V_{RRM} V_{RWM} V_R	45	Volts
Average Rectified Forward Current (Rated V_R) T_C = 105°C	Per Device Per Diode	$I_{F(AV)}$	30 15	Amps
Peak Repetitive Forward Current, Per Diode (Rated V_R, Square Wave, 20 kHz)		I_{FRM}	30	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	200	Amps
Peak Repetitive Reverse Current, Per Diode (2.0 μs, 1.0 kHz) See Figure 6		I_{RRM}	2.0	Amps
Operating Junction Temperature		T_J	– 65 to +150	°C
Storage Temperature		T_{stg}	– 65 to +175	°C
Peak Surge Junction Temperature (Forward Current Applied)		$T_{J(pk)}$	175	°C
Voltage Rate of Change (Rated V_R)		dv/dt	10000	V/μs

THERMAL CHARACTERISTICS PER DIODE

Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.4	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	40	°C/W

ELECTRICAL CHARACTERISTICS PER DIODE

Instantaneous Forward Voltage (1) (i_F = 20 Amps, T_C = 125°C) (i_F = 30 Amps, T_C = 125°C) (i_F = 30 Amps, T_C = 25°C)	v_F	 0.60 0.72 0.76	Volts
Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C) (Rated dc Voltage, T_C = 25°C)	i_R	 100 1.0	mA

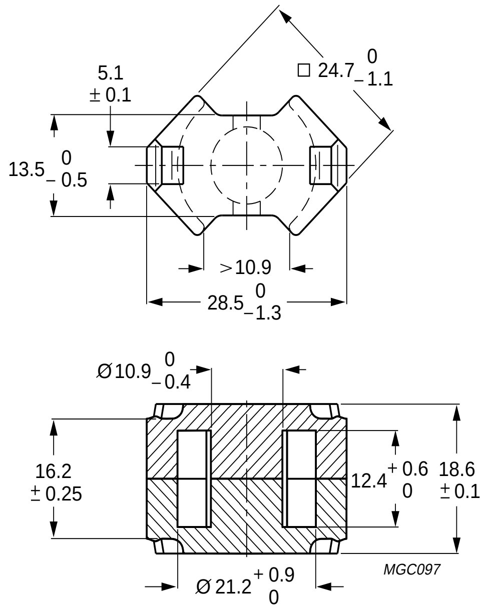
(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.

SWITCHMODE is a trademark of Motorola, Inc.
Preferred devices are Motorola recommended choices for future use and best overall value.

CORE SETS

Effective core parameters

SYMBOL	PARAMETER	VALUE	UNIT
Σ(I/A)	core factor (C1)	0.462	mm^{-1}
V_e	effective volume	4310	mm^3
l_e	effective length	44.6	mm
A_e	effective area	96.6	mm^2
A_{min}	minimum area	89.1	mm^2
m	mass of set	≈22	g



Dimensions in mm.

Fig.1 RM10/I core set.

Core sets for general purpose transformers and power applications

Clamping force for A_L measurements, 60 ±20 N.

GRADE	A_L (nH)	μ_e	AIR GAP (μm)	TYPE NUMBER
3C81	160 ±3%	≈59	≈900	RM10/I-3C81-E160
	250 ±3%	≈92	≈500	RM10/I-3C81-A250
	315 ±3%	≈116	≈400	RM10/I-3C81-A315
	400 ±3%	≈147	≈300	RM10/I-3C81-A400
	630 ±3%	≈232	≈150	RM10/I-3C81-A630
	5400 ±25%	≈2000	≈0	RM10/I-3C81
3C90	160 ±3%	≈59	≈900	RM10/I-3C90-A160
	250 ±3%	≈92	≈500	RM10/I-3C90-A250
	315 ±3%	≈116	≈400	RM10/I-3C90-A315
	400 ±3%	≈147	≈300	RM10/I-3C90-A400
	630 ±3%	≈232	≈150	RM10/I-3C90-A630
	4950 ±25%	≈1820	≈0	RM10/I-3C90
3C91 prot	5400 ±25%	≈2000	≈0	RM10/I-3C91
3C94 des	160 ±3%	≈59	≈900	RM10/I-3C94-A160
	250 ±3%	≈92	≈500	RM10/I-3C94-A250
	315 ±3%	≈116	≈400	RM10/I-3C94-A315
	400 ±3%	≈147	≈300	RM10/I-3C94-A400
	630 ±3%	≈232	≈150	RM10/I-3C94-A630
	4950 ±25%	≈1820	≈0	RM10/I-3C94

GRADE	A_L (nH)	μ_e	AIR GAP (μm)	TYPE NUMBER
3C96 prot	4400 ±25%	≈1820	≈0	RM10/I-3C96
3D3 des	315 ±3%	≈116	≈400	RM10/I-3D3-A315
	400 ±5%	≈147	≈300	RM10/I-3D3-A400
	630 ±8%	≈232	≈150	RM10/I-3D3-A630
	1900 ±25%	≈700	≈0	RM10/I-3D3
3F3 des	160 ±3%	≈59	≈900	RM10/I-3F3-A160
	250 ±3%	≈92	≈500	RM10/I-3F3-A250
	315 ±3%	≈116	≈400	RM10/I-3F3-A315
	400 ±3%	≈147	≈300	RM10/I-3F3-A400
	630 ±3%	≈232	≈150	RM10/I-3F3-A630
	4050 ±25%	≈1490	≈0	RM10/I-3F3
3H3 des	400 ±3%	≈147	≈300	RM10/I-3H3-A400
	630 ±3%	≈232	≈150	RM10/I-3H3-A630
	1000 ±10%	≈368	≈120	RM10/I-3H3-A1000
	4400 ±25%	≈1620	≈0	RM10/I-3H3

Core sets of high permeability grades

Clamping force for AL measurements, 60 ±20 N.

GRADE	A_L() (nH)	μ_e	TYPE NUMBER
3E1 sup	8000 ±25%	≈2900	RM10/I-3E1
3E27	10700 ±25%	≈3880	RM10/I-3E27
3E4 sup	11000 +40/–30%	≈4040	RM10/I-3E4
3E5	16000 +40/–30%	≈5900	RM10/I-3E5

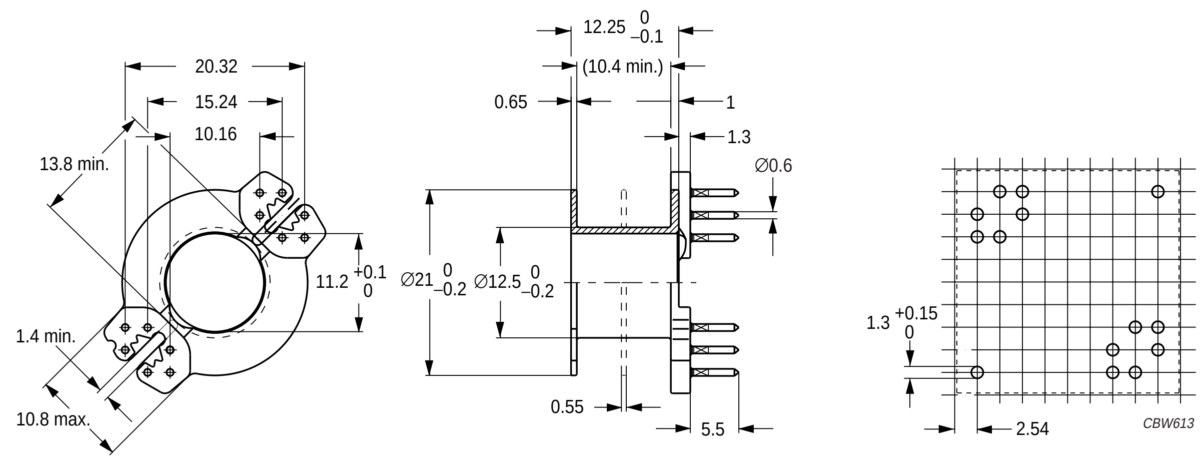
Properties of core sets under power conditions

GRADE	B (mT) at	CORE LOSS (W) at			
	H = 250 A/m; f = 25 kHz; T = 100 °C	f = 25 kHz; $\hat{B}$ = 200 mT; T = 100 °C	f = 100 kHz; $\hat{B}$ = 100 mT; T = 100 °C	f = 100 kHz; $\hat{B}$ = 200 mT; T = 100 °C	f = 400 kHz; $\hat{B}$ = 50 mT; T = 100 °C
3C81	≥315	≤1.0	–	–	–
3C90	≥320	≤0.52	≤0.55	–	–
3C91	≥315	–	≈0.50	≈2.6	–
3C94	≥320	–	≤0.41	≈1.9	≈0.9
3C96	≥320	–	≈0.3	≈1.4	≈0.65
3F3	≥315	–	≤0.48	–	≤0.82

COIL FORMER

General data

PARAMETER	SPECIFICATION
Coil former material	polyester (UP), glass-reinforced, flame retardant in accordance with *"UL 94V-0"*; UL file number E61040(M)
Pin material	copper-tin alloy (CuSn), tin-lead alloy (SnPb) plated
Maximum operating temperature	180 °C, *"IEC 60085"*, class H
Resistance to soldering heat	*"IEC 60068-2-20"*, Part 2, Test Tb, method 1B, 350 °C, 3.5 s
Solderability	*"IEC 60068-2-20"*, Part 2, Test Ta, method 1



Dimensions in mm.

Fig.3 RM10/I coil former.

Winding data for RM10/I coil former

NUMBER OF SECTIONS	NUMBER OF PINS	PIN POSITIONS USED	AVERAGE LENGTH OF TURN (mm)	WINDING AREA (mm^2)	WINDING WIDTH (mm)	TYPE NUMBER
1	12	all	52.3	42.7	10.3	CSV-RM10-1S-12P