LAMPIRAN

Lampiran 1 Listing Program Arduino

1. Listing Program Pembacaan Nilai ADC

```
int adc_max,adc_min;
int adc_vpp;
void setup() {
 Serial.begin(9600);}
void loop() {
  int cnt;
  adc_max = 0;
  adc_min = 1024;
  for(int cnt=0;cnt<300;cnt++)  {
    int adc = analogRead(A0);
    if(adc > adc_max)    {
      adc_max = adc;    }
    if(adc < adc_min)    {
      adc_min = adc;    } }
  adc_vpp = (adc_max-adc_min);
Serial.println(adc_vpp);}
```

2. Listing Program sensor tegangan A

```
int adc_max,adc_min;
int adc_vpp;
float kons;
float adc1;
int v;
void setup() {
 Serial.begin(9600);}
void loop() {
  int cnt;
  adc_max = 0;
  adc_min = 1024;
  for(int cnt=0;cnt<300;cnt++)  {
    int adc = analogRead(A0);
    if(adc > adc_max)    {
      adc_max = adc;    }
    if(adc < adc_min)    {
      adc_min = adc;    } }
  adc_vpp = (adc_max-adc_min);
  adc1 = (((1.11149*adc_vpp)+5.3894));
  kons = adc_vpp/adc1;
  v = (adc_vpp*kons);
Serial.println(v);}
```

3. Listing program sensor tegangan B

```
int adc_max,adc_min;
int adc_vpp;
float kons;
float adc1;
int v;
void setup() {
 Serial.begin(9600);}
void loop() {
  int cnt;
  adc_max = 0;
  adc_min = 1024;
  for(int cnt=0;cnt<300;cnt++)  {
    int adc = analogRead(A0);
    if(adc > adc_max)    {
      adc_max = adc;    }
    if(adc < adc_min)    {
      adc_min = adc;    }  }
  adc_vpp = (adc_max-adc_min);
  adc1 = ((1.11149*adc_vpp)+5.3894);
  kons = adc_vpp/adc1;
  v = (adc_vpp*kons);
Serial.println(v);}
```

4. Listing program pengendali arah putaran motor

```
// connect motor controller pins to Arduino digital pins
// motor one
int enA = 12;
int in1 = 11;
int in2 = 10;
// motor two
void setup(){
  // set all the motor control pins to outputs
  pinMode(enA, OUTPUT);
  pinMode(in1, OUTPUT);
  pinMode(in2, OUTPUT);}
void loop(){
  // this function will run the motors in both directions at a fixed speed
  // turn on motor A
  digitalWrite(in1, LOW);
  digitalWrite(in2, HIGH);
  // set speed to 200 out of possible range 0~38 = 0-255
  analogWrite(enA, 200);
  delay(5000);
  // now change motor directions
  digitalWrite(in1, HIGH);
  digitalWrite(in2, LOW);
  delay(5000);
  // now turn off motors
  digitalWrite(in1, LOW);
  digitalWrite(in2, LOW);  }
```

5. Listing program alat keseluruhan

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
#include <Keypad.h>
#include <String.h>
int n = 0;
ISR(TIMER2_COMPA_vect){
  n++;}
String gabung;
const int P1 =  11;    // pin motor
const int P2 =  12;
int adc_max, adc_min;
float adc_vpp;
float kons;
float adc1;
int v;
int v_masukan;
int toleransi = 4;
LiquidCrystal_I2C lcd(0x3F , 2, 1, 0, 4, 5, 6, 7, 3, POSITIVE);
const byte numRows = 4;
const byte numCols = 4;
char keymap[numRows][numCols] ={
  {'1', '2', '3', 'A'},
  {'4', '5', '6', 'B'},
  {'7', '8', '9', 'C'},
  {'*', '0', '#', 'D'}
}; //code yg menampilkan koneksi keypad ke arduino
byte rowPins[numRows] = {9, 8, 7, 6}; //Rows 0 ke 3
byte colPins[numCols] = {5, 4, 3, 2}; //Colums 0 ke 3
Keypad keypad = Keypad (makeKeymap(keymap), rowPins, colPins, numRows,
numCols);
void setup () {
  //Seting Timer 2 Atmega328
  TCCR2A = 0x83;
  TCCR2B = 0x0A;
  OCR2A = 0xFF;
  TIMSK2 = 0x02;
  // motor
  pinMode(P1, OUTPUT);
  pinMode(P2, OUTPUT);
  //LCD
  Serial.begin(9600);
  lcd.begin(16, 2);
  lcd.noAutoscroll();
  keypad.setDebounceTime(20);
  ambil_nilai_tegangan();
  v_masukan = v;}
void initLCDKeys(){
```

```
  for (int i = 0; i < sizeof(rowPins); i++)
    pinMode(rowPins[i], OUTPUT);
  for  (int i = 0; i < sizeof(colPins); i++)  {
    pinMode(colPins[i], INPUT);
    digitalWrite(colPins[i], LOW);  }}
void ambil_nilai_tegangan(){
  adc_max = 0;
  adc_min = 1024;
  for (int cnt = 0; cnt < 300; cnt++)  {
    int adc = analogRead(A0);
    if (adc > adc_max) {
      adc_max = adc;    }
    if (adc < adc_min)    {
      adc_min = adc; }  }
  adc_vpp = (adc_max - adc_min);
  adc1 = (((1.11149 * adc_vpp) + 5.3894));
  kons = adc_vpp / adc1;
  v = (adc_vpp * kons);}
void eksekusi_motor(){
  if (v_masukan > v - toleransi && v_masukan < v + toleransi ) //motor mati {
    mati();  }
  else if (v_masukan < v - toleransi) //kanan  {
    ngiri();}
  else if (v_masukan > v + toleransi) //kiri  {
    nganan();  }}
void nganan(){
  digitalWrite(P2, LOW);
  digitalWrite(P1, HIGH);}
void ngiri(){
  digitalWrite(P2, HIGH);
  digitalWrite(P1, HIGH);}
void mati(){
  digitalWrite(P1, LOW);}
void loop() {
  //Hitung tegangan
  ambil_nilai_tegangan();
  //Tampilkan LCD tiap 1 detik
  if ( n >= 3921) //f=16000000/2/N/0xFF => (N=8; 0xFF=256) 7842= 1 det  {
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("INPUT V: ");
    lcd.setCursor(10, 0);
    lcd.print(gabung);
    lcd.setCursor(0, 1);
    lcd.print("Tegangan:");
    lcd.setCursor(10, 1);
    lcd.print(v);
    Serial.println(v_masukan);
```

```
  n = 0;  }
//keypad
char key = keypad.getKey();
if (key == '#' && key) {
  v_masukan = gabung.toInt();
  if (v_masukan<40) {
    v_masukan=40; }
      if (v_masukan>200){
    v_masukan=200; }
  gabung = "";  }
else if (key == '*' && key) {
 gabung = ""; }
else   if (key){
 gabung += key;  }
eksekusi_motor();}
```

Lampiran 2 Lampiran Data

Tabel dan gambar perhitungan puli dan sabuk-v

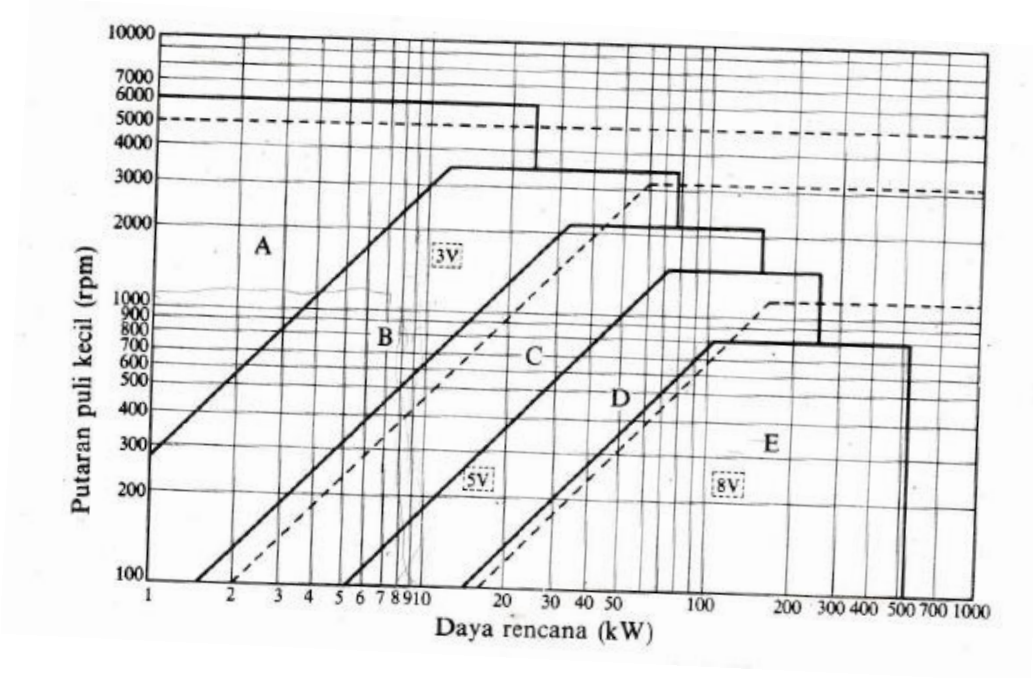


Diagram pemilihan sabuk

Tabel faktor koreksi

Mesin yang digerakkan		Penggerak					
		Momen puntir puncak 200%			Momen puntir puncak > 200%		
		Motor arus bolak-balik (momen normal, sangkar bajing, sinkron), motor arus searah (shunt)			Motor arus bolak-balik (momen tinggi, fasa tunggal, seri), motor arus searah (kompon, seri), mesin torak, kopling tak tetap		
		Jumlah jam kerja tiap hari			Jumlah jam kerja tiap hari		
		3-5	8-10	16-24	3-5	8-10	16-24
Variasi beban sangat kecil	Pengaduk zat cair, kipas angin, blower (maks. 7,5 KW), pompa sentrifugal, konveyor tugas ringan	1,0	1,1	1,2	1,2	1,3	1,4
Variasi beban kecil	Konveyor sabuk (pasir, batu bara), penagduk, kipas angin (>7,4 KW), mesin torak, peluncur, mesin perkakas, mesin percetakan.	1,2	1,3	1,4	1,4	1,5	1,6
Variasi beban sedang	Konveyor lember, skrup, pompa torak, kompressor, gilingan palu, pengocok, roots-blower, mesin tekstil, mesin kayu.	1,3	1,4	1,5	1,6	1,7	1,8
Variasi beban besar	Penghancur, gilingan bola/batang, pengangkat, mesin pabrik karet (rol, kalender).	1,5	1,6	1,7	1,8	1,9	2,0

Tabel Sabuk V standar bertanda*

Penampang A			Penampang B		
13	*65	117	16	*68	*120
14	*66	*118	17	*69	121
15	*67	119	18	*70	*122
16	*68	*120	19	*71	123
*17	*69	121	20	*72	124
*18	*70	*122	21	*73	*125
*19	*71	123	22	*74	126
*20	*72	124	23	*75	127
*21	*73	*125	24	*76	*128
*22	*74	126	*25	*77	129
*23	*75	127	*26	*78	*130
*24	*76	*128	*27	*79	131
*25	*77	129	*28	*80	*132
*26	*78	*130	*29	*81	133
*27	*79	131	*30	*82	134
*28	*80	132	*31	*83	*135
*29	*81	133	*32	*84	136
*30	*82	134	*33	*85	137
*31	*83	*135	*34	*86	*138
*32	*84	136	*35	*87	139
*33	*85	137	*36	*88	*140
*34	*86	*138	*37	*89	141
*35	*87	139	*38	*90	*142
*36	*88	*140	*39	*91	143
*37	*89	141	*40	*92	144
*38	*90	142	*41	*93	*145
*39	*91	143	*42	*94	146
*40	*92	144	*43	*95	147
*41	*93	*145	*44	*96	*148
*42	*94	146	*45	*97	149
*43	*95	147	*46	*98	*150
*44	*96	148	*47	*99	151
*45	*97	149	*48	*100	152
*46	*98	*150	*49	101	153
*47	*99	151	*50	*102	154
*48	100	152	*51	103	*155
*49	101	153	*52	104	156

*50	*102	154	*53	*105	157
*51	103	*155	*54	106	158
*52	104	156	*55	107	159
*53	*105	157	*56	*108	*160
*54	106	158	*57	109	161
*55	107	159	*58	*110	162
*56	*108	*160	*59	111	163
*57	109	161	*60	*112	164
*58	*110	162	*61	113	*165
*59	111	163	*62	114	166
*60	*112	164	*63	*115	167
*61	113	*165	*64	116	168
*62	114	166	*65	117	169
*63	*115	167	*66	*118	*170
*64	116	168	*67	119	171

Tabel Panjang sabuk-v standart

Nomor nominal		Nomor nominal		Nomor nominal		Nomor nominal	
inch	mm	inch	mm	inch	mm	inch	mm
10	254	45	1143	80	2032	115	2921
11	279	46	1168	81	2057	116	2946
12	305	47	1194	82	2083	117	2972
13	330	48	1219	83	2108	118	2997
14	356	49	1245	84	2134	119	3023
15	381	50	1270	85	2159	120	3048
16	406	51	1295	86	2184	121	3073
17	432	52	1321	87	2210	122	3099
18	457	53	1346	88	2235	123	3124
19	483	54	1372	89	2261	124	3150
20	508	55	1397	90	2286	125	3175
21	533	56	1422	91	2311	126	3200
22	559	57	1448	92	2337	127	3226
23	584	58	1473	93	2362	128	3251
24	610	59	1499	94	2388	129	3277
25	635	60	1524	95	2413	130	3302
26	660	61	1549	96	2438	131	3327
27	686	62	1575	97	2464	132	3353
28	711	63	1600	98	2489	133	3378
29	737	64	1626	99	2515	134	3404
30	762	65	1651	100	2540	135	3429
31	787	66	1676	101	2565	136	3454
32	813	67	1702	102	2591	137	3480
33	838	68	1727	103	2616	138	3505
34	864	69	1753	104	2642	139	3531
35	889	70	1778	105	2667	140	3556
36	914	71	1803	106	2692	141	3581
37	940	72	1829	107	2718	142	3607
38	965	73	1854	108	2743	143	3632
39	991	74	1880	109	2769	144	3658
40	1016	75	1905	110	2794	155	3683
41	1041	76	1930	111	2819	156	3708
42	1067	77	1956	112	2845	157	3734
43	1092	78	1981	113	2870	158	3759
44	1118	79	2007	114	2896	159	3785

Tabel panjang sabuk-V sempit

3V			5V		
Nomor nominal sabuk	Panjang keliling (mm)	Panjang keliling pada jarak bagi sabuk (mm)	Nomor nominal sabuk	Panjang keliling (mm)	Panjang keliling pada jarak bagi sabuk (mm)
3V 250	635	631	5V 500	1270	1262
3V 265	673	669	5V 530	1346	1338
3V 280	711	707	5V 560	1422	1414
3V 300	762	58	5V 600	1542	1516
3V 315	800	796	5V 630	1600	1592
3V 355	851	847	5V 670	1702	1694
3V 355	902	898	5V 710	1803	1795
3V 375	953	949	5V 750	1905	1897
3V 400	1016	1012	5V 800	2032	2024
3V 425	1080	1076	5V 850	2159	2151
3V 450	1143	1139	5V 900	2286	2278
3V 475	1207	1203	5V 950	2413	2405
3V 500	1270	1266	5V 1000	2540	2532
3V 530	1346	1342	5V 1060	2692	2684
3V 560	1422	1418	5V 1120	2854	2837

Tabel Daerah penyetalan jarak sumbu poros

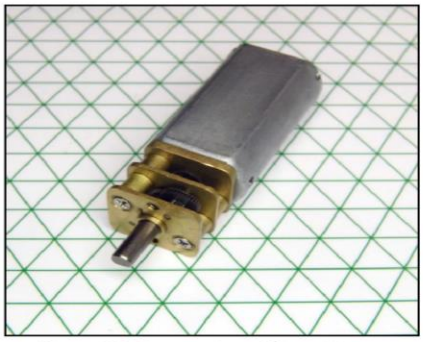
Nomor nominal sabuk	Panjang keliling sabuk	Ke sebelah dalam dari letak standart ΔC_i					Ke sebelh luar dari letak standar ΔC_t (umum untuk semua tipe)
		A	B	C	D	E	
11 - 38	280 – 970	20	25				25
38 – 60	970 – 1500	20	25	40			40
60 – 90	1500 – 2200	20	35	40			50
90 – 120	2200 – 3000	25	35	40			65
120 - 158	3000 - 4000	25	35	40	50		75

Tabel Faktor koreksi k0

$\frac{D_p - d_p}{C}$	Sudut kontak puli keil θ(°)	Faktor koreksi K_θ
0,00	180	1,00
0,10	174	0,99
0,20	169	0,97
0,30	163	0,96
0,40	167	0,94
0,50	151	0,93
0,60	145	0,91
0,70	139	0,89
0,80	133	0,87
0,90	127	0,85
1,00	120	0,82
1,10	113	0,80
1,20	106	0,77
1,30	99	0,73
1,40	91	0,70
1,50	83	0,65

Lampiran 3 Datasheet Kmponen

1. Datasheet motor arus searah



16mm DC Gearmotor - 38mm Type
Shown on 6mm Isometric Grid

PRECISION MICRODRIVES™

Product Data Sheet
Micro Spur™
16mm DC Gearmotor - 38mm Type

Model: 215-400

Ordering Information

The model number 215-400 fully defines the model, variant and additional features of the product. Please quote this number when ordering.
For stocked types, testing and evaluation samples can be ordered directly through our online store.

Datasheet Versions

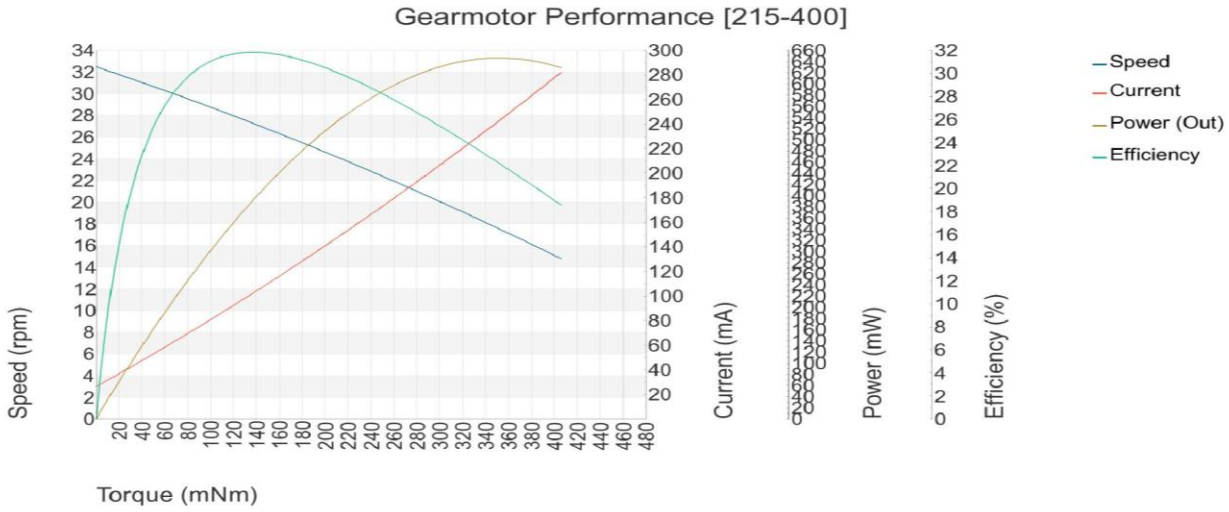
It is our intention to provide our customers with the best information available to ensure the successful integration between our products and your application. Therefore, our publications will be updated and enhanced as improvements to the data and product updates are introduced.
To obtain the most up-to-date version of this datasheet, please visit our website at:
www.precisionmicrodrives.com
The version number of this datasheet can be found on the bottom left hand corner of any page of the datasheet and is referenced with an ascending R-number (e.g. R002 is newer than R001). Please contact us if you require a copy of the engineering change notice between revisions.

If you have any questions, suggestions or comments regarding this publication or need technical assistance, please contact us via email at:
enquiries@precisionmicrodrives.com or call us on +44 (0) 1932 252 482

Key Features

Body Diameter:	15.6 mm [+/- 0.2]
Body Length:	37.7 mm [+/- 0.3]
Shaft Orientation:	Inline
Gear Ratio:	360.0 :1
Gearhead Type:	Spur
Rated Operating Voltage:	12 V
Rated Load:	140 mN·m
Rated Load Speed:	27 rpm
Typical Max. Output Power:	660 mW

Typical DC Gearmotor Performance Characteristics



Physical Specification

PARAMETER	CONDITIONS	SPECIFICATION
Body Diameter	Max body diameter or max face dimension where non-circular	15.6 mm [+/- 0.2]
Body Length	Excl. shafts, leads and terminals	37.7 mm [+/- 0.3]
Unit Weight		23 g
No. of Output Shafts		1
Shaft Diameter		3 mm [+ 0 /- 0.05]
Shaft Orientation		Inline
Shaft Length	Measured from motor body face	8.2 mm [+/- 0.2]

Construction Specification

PARAMETER	CONDITIONS	SPECIFICATION
Motor Construction		Iron Core
Gear Ratio		360.0 :1
Gearhead Type		Spur
Commutation		Precious Metal Brush
Rotation Direction	As viewed from the primary shaft end / or motor top	CCW
No. of Poles		3
Bearing Type		Sintered Bronze

Operational Specification

PARAMETER	CONDITIONS	SPECIFICATION
Rated Operating Voltage		12 V
Rated Load	Maximum continuous torque	140 mN·m
Rated Load Speed	At rated voltage under fixed torque at rated load	27 rpm
N/L Speed	Measured at rated voltage	32 rpm [+/- 4]
Max. N/L Current	Measured at rated voltage	45 mA
Max. Start Current	At rated voltage	600 mA
Max. Rated Load Current	At rated voltage under fixed torque at rated load	130 mA
Min. Insulation Resistance	At 50V DC between motor terminal and case	10 MOhm

Important: The characteristics of the motor is the typical operating parameters of the product. The data herein offers design guidance information only and supplied batches are validated for conformity against the specifications on the previous page.

Typical Performance Characteristics

PARAMETER	CONDITIONS	SPECIFICATION
Typical Rated Load Power Consumption	At rated voltage and load	1,200 mW
Typical N/L Current	At rated voltage	30 mA
Typical Peak Efficiency		33 %
Typical Start Current	At rated voltage	420 mA
Typical Peak Eff. Torque		140 mN·m
Typical Peak Eff. Speed		27 rpm
Typical Peak Eff. Current		100 mA
Typical Peak Eff. Power Out	Power out at rated voltage at the peak efficiency torque point	400 mW
Typical Max. Output Power		660 mW
Typical Terminal Resistance		22 Ohm
Typical Terminal Inductance		5,900 uH

Environmental Characteristics

PARAMETER	CONDITIONS	SPECIFICATION
Max. Operating Temp.		50 Deg.C
Min. Operating Temp.		-10 Deg.C
Max. Storage & Transportation Temp.		70 Deg.C
Min. Storage & Transportation Temp.		-20 Deg.C

Typical Packing Conditions

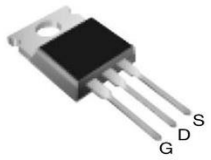
PARAMETER	CONDITIONS	SPECIFICATION
Carton Type		Boxed Trays

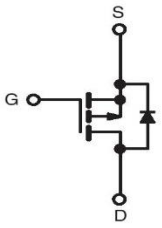
2. Datasheet power mosfet IRF 9540

Power MOSFET

PRODUCT SUMMARY		
V_{DS} (V)	- 100	
$R_{DS(on)}$ (Ω)	V_{GS} = - 10 V	0.20
Q_g (Max.) (nC)	61	
Q_{gs} (nC)	14	
Q_{gd} (nC)	29	
Configuration	Single	

TO-220AB





P-Channel MOSFET

FEATURES

- Dynamic dV/dt Rating
- Repetitive Avalanche Rated
- P-Channel
- 175 °C Operating Temperature
- Fast Switching
- Ease of Paralleling
- Simple Drive Requirements
- Compliant to RoHS Directive 2002/95/EC

Available

RoHS* COMPLIANT

DESCRIPTION

Third generation Power MOSFETs from Vishay provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

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

ORDERING INFORMATION	
Package	TO-220AB
Lead (Pb)-free	IRF9540PbF
	SiHF9540-E3
SnPb	IRF9540
	SiHF9540

ABSOLUTE MAXIMUM RATINGS (T_C = 25 °C, unless otherwise noted)

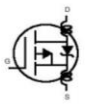
PARAMETER			SYMBOL	LIMIT	UNIT
Drain-Source Voltage			V_{DS}	- 100	V
Gate-Source Voltage			V_{GS}	± 20	
Continuous Drain Current	V_{GS} at - 10 V	T_C = 25 °C	I_D	- 19	A
		T_C = 100 °C		- 13	
Pulsed Drain Current[a]			I_{DM}	- 72	
Linear Derating Factor				1.0	W/°C
Single Pulse Avalanche Energy[b]			E_{AS}	640	mJ
Repetitive Avalanche Current[a]			I_{AR}	- 19	A
Repetitive Avalanche Energy[a]			E_{AR}	15	mJ
Maximum Power Dissipation	T_C = 25 °C		P_D	150	W
Peak Diode Recovery dV/dt[c]			dV/dt	- 5.5	V/ns
Operating Junction and Storage Temperature Range			T_J, T_{stg}	- 55 to + 175	°C
Soldering Recommendations (Peak Temperature)	for 10 s			300[d]	
Mounting Torque	6-32 or M3 screw			10	lbf · in
				1.1	N · m

Notes

a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
b. V_{DD} = - 25 V, starting T_J = 25 °C, L = 2.7 mH, R_g = 25 Ω, I_{AS} = - 19 A (see fig. 12).
c. $I_{SD} \leq$ - 19 A, dI/dt ≤ 200 A/μs, $V_{DD} \leq V_{DS}$, $T_J \leq$ 175 °C.
d. 1.6 mm from case.

* Pb containing terminations are not RoHS compliant, exemptions may apply

THERMAL RESISTANCE RATINGS				
PARAMETER	**SYMBOL**	**TYP.**	**MAX.**	**UNIT**
Maximum Junction-to-Ambient	R_{thJA}	-	62	°C/W
Case-to-Sink, Flat, Greased Surface	R_{thCS}	0.50	-	
Maximum Junction-to-Case (Drain)	R_{thJC}	-	1.0	

SPECIFICATIONS (T_J = 25 °C, unless otherwise noted)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Static						
Drain-Source Breakdown Voltage	V_{DS}	V_{GS} = 0 V, I_D = - 250 µA	- 100	-	-	V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to 25 °C, I_D = - 1 mA	-	- 0.087	-	V/°C
Gate-Source Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = - 250 µA	- 2.0	-	- 4.0	V
Gate-Source Leakage	I_{GSS}	V_{GS} = ± 20 V	-	-	± 100	nA
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = - 100 V, V_{GS} = 0 V	-	-	- 100	µA
		V_{DS} = - 80 V, V_{GS} = 0 V, T_J = 150 °C	-	-	- 500	
Drain-Source On-State Resistance	$R_{DS(on)}$	V_{GS} = - 10 V, I_D = - 11 A[b]	-	-	0.20	Ω
Forward Transconductance	g_{fs}	V_{DS} = - 50 V, I_D = - 11 A[b]	6.2	-	-	S
Dynamic						
Input Capacitance	C_{iss}	V_{GS} = 0 V, V_{DS} = - 25 V, f = 1.0 MHz, see fig. 5	-	1400	-	pF
Output Capacitance	C_{oss}		-	590	-	
Reverse Transfer Capacitance	C_{rss}		-	140	-	
Total Gate Charge	Q_g	V_{GS} = - 10 V, I_D = - 19 A, V_{DS} = - 80 V, see fig. 6 and 13[b]	-	-	61	nC
Gate-Source Charge	Q_{gs}		-	-	14	
Gate-Drain Charge	Q_{gd}		-	-	29	
Turn-On Delay Time	$t_{d(on)}$	V_{DD} = - 50 V, I_D = - 19 A, R_g = 9.1 Ω, R_D = 2.4 Ω, see fig. 10[b]	-	16	-	ns
Rise Time	t_r		-	73	-	
Turn-Off Delay Time	$t_{d(off)}$		-	34	-	
Fall Time	t_f		-	57	-	
Internal Drain Inductance	L_D	Between lead, 6 mm (0.25") from package and center of die contact 	-	4.5	-	nH
Internal Source Inductance	L_S		-	7.5	-	
Drain-Source Body Diode Characteristics						
Continuous Source-Drain Diode Current	I_S	MOSFET symbol showing the integral reverse p - n junction diode 	-	-	- 19	A
Pulsed Diode Forward Current[a]	I_{SM}		-	-	- 72	
Body Diode Voltage	V_{SD}	T_J = 25 °C, I_S = - 19 A, V_{GS} = 0 V[b]	-	-	- 5.0	V
Body Diode Reverse Recovery Time	t_{rr}	T_J = 25 °C, I_F = - 19 A, dI/dt = 100 A/µs[b]	-	130	260	ns
Body Diode Reverse Recovery Charge	Q_{rr}		-	0.35	0.70	µC
Forward Turn-On Time	t_{on}	Intrinsic turn-on time is negligible (turn-on is dominated by L_S and L_D)				

Notes

a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).

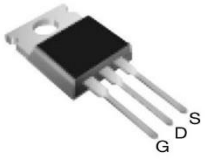
b. Pulse width ≤ 300 µs; duty cycle ≤ 2 %.

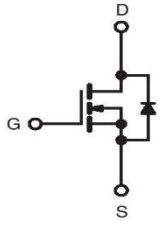
3. Datasheet power mosfet IRF 540

Power MOSFET

PRODUCT SUMMARY		
V_{DS} (V)	100	
$R_{DS(on)}$ (Ω)	V_{GS} = 10 V	0.077
Q_g (Max.) (nC)	72	
Q_{gs} (nC)	11	
Q_{gd} (nC)	32	
Configuration	Single	

TO-220AB





N-Channel MOSFET

FEATURES

- Dynamic dV/dt Rating
- Repetitive Avalanche Rated
- 175 °C Operating Temperature
- Fast Switching
- Ease of Paralleling
- Simple Drive Requirements
- Compliant to RoHS Directive 2002/95/EC

Available
RoHS*
COMPLIANT

DESCRIPTION

Third generation Power MOSFETs from Vishay provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

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

ORDERING INFORMATION	
Package	TO-220AB
Lead (Pb)-free	IRF540PbF
	SiHF540-E3
SnPb	IRF540
	SiHF540

ABSOLUTE MAXIMUM RATINGS (T_C = 25 °C, unless otherwise noted)

PARAMETER			SYMBOL	LIMIT	UNIT
Drain-Source Voltage			V_{DS}	100	V
Gate-Source Voltage			V_{GS}	± 20	
Continuous Drain Current	V_{GS} at 10 V	T_C = 25 °C	I_D	28	A
		T_C = 100 °C		20	
Pulsed Drain Current[a]			I_{DM}	110	
Linear Derating Factor				1.0	W/°C
Single Pulse Avalanche Energy[b]			E_{AS}	230	mJ
Repetitive Avalanche Current[a]			I_{AR}	28	A
Repetitive Avalanche Energy[a]			E_{AR}	15	mJ
Maximum Power Dissipation	T_C = 25 °C		P_D	150	W
Peak Diode Recovery dV/dt[c]			dV/dt	5.5	V/ns
Operating Junction and Storage Temperature Range			T_J, T_{stg}	- 55 to + 175	°C
Soldering Recommendations (Peak Temperature)	for 10 s			300[d]	
Mounting Torque	6-32 or M3 screw			10	lbf · in
				1.1	N · m

Notes

a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
b. V_{DD} = 25 V, starting T_J = 25 °C, L = 440 µH, R_g = 25 Ω, I_{AS} = 28 A (see fig. 12).
c. $I_{SD} \leq$ 28 A, dI/dt ≤ 170 A/µs, $V_{DD} \leq V_{DS}$, $T_J \leq$ 175 °C.
d. 1.6 mm from case.

* Pb containing terminations are not RoHS compliant, exemptions may apply

THERMAL RESISTANCE RATINGS				
PARAMETER	**SYMBOL**	**TYP.**	**MAX.**	**UNIT**
Maximum Junction-to-Ambient	R_{thJA}	-	62	°C/W
Case-to-Sink, Flat, Greased Surface	R_{thCS}	0.50	-	
Maximum Junction-to-Case (Drain)	R_{thJC}	-	1.0	

SPECIFICATIONS (T_J = 25 °C, unless otherwise noted)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Static						
Drain-Source Breakdown Voltage	V_{DS}	V_{GS} = 0 V, I_D = 250 µA	100	-	-	V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to 25 °C, I_D = 1 mA	-	0.13	-	V/°C
Gate-Source Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250 µA	2.0	-	4.0	V
Gate-Source Leakage	I_{GSS}	V_{GS} = ± 20 V	-	-	± 100	nA
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 100 V, V_{GS} = 0 V	-	-	25	µA
		V_{DS} = 80 V, V_{GS} = 0 V, T_J = 150 °C	-	-	250	
Drain-Source On-State Resistance	$R_{DS(on)}$	V_{GS} = 10 V; I_D = 17 A[b]	-	-	0.077	Ω
Forward Transconductance	g_{fs}	V_{DS} = 50 V, I_D = 17 A[b]	8.7	-	-	S
Dynamic						
Input Capacitance	C_{iss}	V_{GS} = 0 V, V_{DS} = 25 V, f = 1.0 MHz, see fig. 5	-	1700	-	pF
Output Capacitance	C_{oss}		-	560	-	
Reverse Transfer Capacitance	C_{rss}		-	120	-	
Total Gate Charge	Q_g	V_{GS} = 10 V; I_D = 17 A, V_{DS} = 80 V, see fig. 6 and 13[b]	-	-	72	nC
Gate-Source Charge	Q_{gs}		-	-	11	
Gate-Drain Charge	Q_{gd}		-	-	32	
Turn-On Delay Time	$t_{d(on)}$	V_{DD} = 50 V, I_D = 17 A, R_g = 9.1 Ω, R_D = 2.9 Ω, see fig. 10[b]	-	11	-	ns
Rise Time	t_r		-	44	-	
Turn-Off Delay Time	$t_{d(off)}$		-	53	-	
Fall Time	t_f		-	43	-	
Internal Drain Inductance	L_D	Between lead, 6 mm (0.25") from package and center of die contact 	-	4.5	-	nH
Internal Source Inductance	L_S		-	7.5	-	
Drain-Source Body Diode Characteristics						
Continuous Source-Drain Diode Current	I_S	MOSFET symbol showing the integral reverse p - n junction diode 	-	-	28	A
Pulsed Diode Forward Current[a]	I_{SM}		-	-	110	
Body Diode Voltage	V_{SD}	T_J = 25 °C, I_S = 28 A, V_{GS} = 0 V[b]	-	-	2.5	V
Body Diode Reverse Recovery Time	t_{rr}	T_J = 25 °C, I_F = 17 A, dI/dt = 100 A/µs[b]	-	180	360	ns
Body Diode Reverse Recovery Charge	Q_{rr}		-	1.3	2.8	µC
Forward Turn-On Time	t_{on}	Intrinsic turn-on time is negligible (turn-on is dominated by L_S and L_D)				

Notes

a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).

b. Pulse width ≤ 300 µs; duty cycle ≤ 2 %.

4. Datasheet transistor P2N2222A

P2N2222A

Amplifier Transistors

NPN Silicon

Features

- These are Pb–Free Devices*

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Value	Unit
Collector – Emitter Voltage	V_{CEO}	40	Vdc
Collector – Base Voltage	V_{CBO}	75	Vdc
Emitter – Base Voltage	V_{EBO}	6.0	Vdc
Collector Current – Continuous	I_C	600	mAdc
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D	625 5.0	mW mW/°C
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	1.5 12	W mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	–55 to +150	°C

THERMAL CHARACTERISTICS

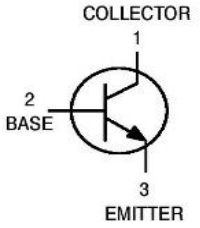
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

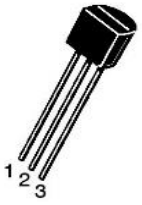
*For additional information on our Pb–Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

ON Semiconductor®

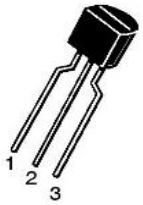
http://onsemi.com



TO–92
CASE 29
STYLE 17

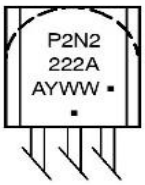


STRAIGHT LEAD
BULK PACK



BENT LEAD
TAPE & REEL
AMMO PACK

MARKING DIAGRAM



A = Assembly Location
Y = Year
WW = Work Week
▪ = Pb–Free Package
(Note: Microdot may be in either location)

ORDERING INFORMATION

Device	Package	Shipping†
P2N2222AG	TO–92 (Pb–Free)	5000 Units/Bulk
P2N2222ARL1G	TO–92 (Pb–Free)	2000/Tape & Ammo

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector – Emitter Breakdown Voltage (I_C = 10 mAdc, I_B = 0)	$V_{(BR)CEO}$	40	–	Vdc
Collector – Base Breakdown Voltage (I_C = 10 μAdc, I_E = 0)	$V_{(BR)CBO}$	75	–	Vdc
Emitter – Base Breakdown Voltage (I_E = 10 μAdc, I_C = 0)	$V_{(BR)EBO}$	6.0	–	Vdc
Collector Cutoff Current (V_{CE} = 60 Vdc, $V_{EB(off)}$ = 3.0 Vdc)	I_{CEX}	–	10	nAdc
Collector Cutoff Current (V_{CB} = 60 Vdc, I_E = 0) (V_{CB} = 60 Vdc, I_E = 0, T_A = 150°C)	I_{CBO}	– –	0.01 10	μAdc
Emitter Cutoff Current (V_{EB} = 3.0 Vdc, I_C = 0)	I_{EBO}	–	10	nAdc
Collector Cutoff Current (V_{CE} = 10 V)	I_{CEO}	–	10	nAdc
Base Cutoff Current (V_{CE} = 60 Vdc, $V_{EB(off)}$ = 3.0 Vdc)	I_{BEX}	–	20	nAdc
ON CHARACTERISTICS				
DC Current Gain (I_C = 0.1 mAdc, V_{CE} = 10 Vdc) (I_C = 1.0 mAdc, V_{CE} = 10 Vdc) (I_C = 10 mAdc, V_{CE} = 10 Vdc) (I_C = 10 mAdc, V_{CE} = 10 Vdc, T_A = −55°C) (I_C = 150 mAdc, V_{CE} = 10 Vdc) (Note 1) (I_C = 150 mAdc, V_{CE} = 1.0 Vdc) (Note 1) (I_C = 500 mAdc, V_{CE} = 10 Vdc) (Note 1)	h_{FE}	 35 50 75 35 100 50 40	 – – – – 300 – –	–
Collector – Emitter Saturation Voltage (Note 1) (I_C = 150 mAdc, I_B = 15 mAdc) (I_C = 500 mAdc, I_B = 50 mAdc)	$V_{CE(sat)}$	 – –	 0.3 1.0	Vdc
Base – Emitter Saturation Voltage (Note 1) (I_C = 150 mAdc, I_B = 15 mAdc) (I_C = 500 mAdc, I_B = 50 mAdc)	$V_{BE(sat)}$	 0.6 –	 1.2 2.0	Vdc
SMALL–SIGNAL CHARACTERISTICS				
Current – Gain – Bandwidth Product (Note 2) (I_C = 20 mAdc, V_{CE} = 20 Vdc, f = 100 MHz)C	f_T	300	–	MHz
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)	C_{obo}	–	8.0	pF
Input Capacitance (V_{EB} = 0.5 Vdc, I_C = 0, f = 1.0 MHz)	C_{ibo}	–	25	pF
Input Impedance (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) (I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	h_{ie}	 2.0 0.25	 8.0 1.25	kΩ
Voltage Feedback Ratio (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) (I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	h_{re}	 – –	 8.0 4.0	X 10^{-4}
Small–Signal Current Gain (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) (I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	h_{fe}	 50 75	 300 375	–
Output Admittance (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) (I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	h_{oe}	 5.0 25	 35 200	μMhos
Collector Base Time Constant (I_E = 20 mAdc, V_{CB} = 20 Vdc, f = 31.8 MHz)	$rb'C_c$	–	150	ps
Noise Figure (I_C = 100 μAdc, V_{CE} = 10 Vdc, R_S = 1.0 kΩ, f = 1.0 kHz)	N_F	–	4.0	dB

1. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.
2. f_T is defined as the frequency at which $|h_{fe}|$ extrapolates to unity.

5. Datasheet LM812

TIGER ELECTRONIC CO.,LTD

Product specification

3-Terminal 1A Positive Voltage Regulator

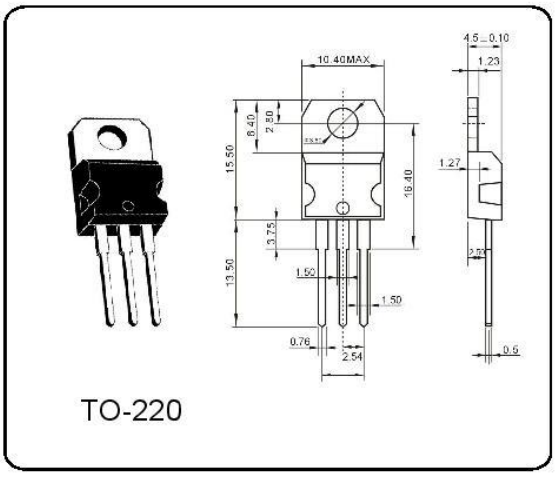
LM7812

GENERAL DESCRIPTION

The LM7812 series of three terminal positive regulators are available in the TO-220 package and with several fixed output voltages, making them useful in a wide range of applications. Each type employs internal current limiting, thermal shut down and safe operating area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.

ABSOLUTE MAXIMUM RATINGS (Ta = 25 °C)

Parameter	Symbol	Typ	Unit
Input Voltage	V_I	35	V
Output Voltage	V_O	12.0	V
Peak Current	I_{PK}	2.2	A
Operating Temperature Range	T_{OPR}	0~125	°C
Storage Temperature Range	T_{STG}	-65~150	°C



TO-220

ELECTRICAL CHARACTERISTICS (Ta = 25 °C)

(Refer to test circuit, Io = 500mA, Vi = 19V, Ci= 0.33uF, Co=0.1uF unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Output Voltage	V_O	V_I = 14.5V to 30V	11.64	12.0	12.36	V
Line Regulation (Note1)	Regline	V_I = 14.5V to 30V		10	240	mV
		V_I = 16V to 22V		3.0	120	
Load Regulation (Note1)	Regload	I_O = 5.0mA to1.5A		11	240	mV
		I_O =250mA to 750mA		5	120	
Quiescent Current	I_Q	T_J =+25 °C		5.1	8	mA
Ripple Rejection	RR	f = 120Hz, V_O = 15V to 30V	56	73		dB
Dropout Voltage	V_{Drop}	I_O = 1A, T_J =+25 °C		2		V
Output Resistance	r_O	f = 1KHz		0.018		Ω
Short Circuit Current	I_{SC}	V_I = 35V, T_A =+25 °C		230		mA
Peak Current	I_{PK}	T_J =+25 °C		2.2		A

6. Datasheet dioda 1N4004

1N4001, 1N4002, 1N4003, 1N4004, 1N4005, 1N4006, 1N4007

Axial Lead Standard Recovery Rectifiers

This data sheet provides information on subminiature size, axial lead mounted rectifiers for general−purpose low−power applications.

Features

- Shipped in Plastic Bags, 1000 per bag
- Available Tape and Reeled, 5000 per reel, by adding a "RL" suffix to the part number
- Available in Fan−Fold Packaging, 3000 per box, by adding a "FF" suffix to the part number
- Pb−Free Packages are Available

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 0.4 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds, 1/16 in. from case
- Polarity: Cathode Indicated by Polarity Band

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

ON Semiconductor®

http://onsemi.com

LEAD MOUNTED RECTIFIERS
50−1000 VOLTS
DIFFUSED JUNCTION

CASE 59−10
AXIAL LEAD
PLASTIC

MARKING DIAGRAM

A = Assembly Location
1N400x = Device Number
x = 1, 2, 3, 4, 5, 6 or 7
YY = Year
WW = Work Week
▪ = Pb−Free Package
(Note: Microdot may be in either location)

ORDERING INFORMATION

See detailed ordering and shipping information on page 5 of this data sheet.

MAXIMUM RATINGS

Rating	Symbol	1N4001	1N4002	1N4003	1N4004	1N4005	1N4006	1N4007	Unit
†Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	800	1000	V
†Non−Repetitive Peak Reverse Voltage (halfwave, single phase, 60 Hz)	V_{RSM}	60	120	240	480	720	1000	1200	V
†RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	280	420	560	700	V
†Average Rectified Forward Current (single phase, resistive load, 60 Hz, T_A = 75°C)	I_O	1.0							A
†Non−Repetitive Peak Surge Current (surge applied at rated load conditions)	I_{FSM}	30 (for 1 cycle)							A
Operating and Storage Junction Temperature Range	T_J T_{stg}	−65 to +175							°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

†Indicates JEDEC Registered Data

THERMAL CHARACTERISTICS

Rating	Symbol	Max	Unit
Maximum Thermal Resistance, Junction−to−Ambient	$R_{\theta JA}$	Note 1	°C/W

ELECTRICAL CHARACTERISTICS†

Rating	Symbol	Typ	Max	Unit
Maximum Instantaneous Forward Voltage Drop, (i_F = 1.0 Amp, T_J = 25°C)	v_F	0.93	1.1	V
Maximum Full−Cycle Average Forward Voltage Drop, (I_O = 1.0 Amp, T_L = 75°C, 1 inch leads)	$V_{F(AV)}$	–	0.8	V
Maximum Reverse Current (rated DC voltage) (T_J = 25°C) (T_J = 100°C)	I_R	 0.05 1.0	 10 50	μA
Maximum Full−Cycle Average Reverse Current, (I_O = 1.0 Amp, T_L = 75°C, 1 inch leads)	$I_{R(AV)}$	–	30	μA

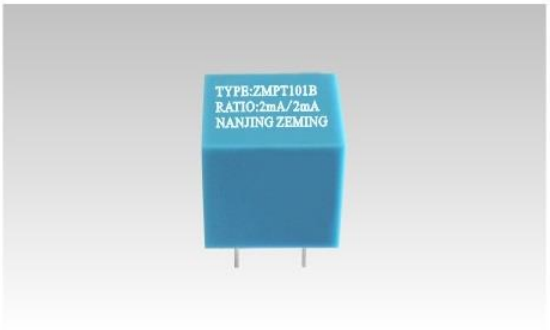
†Indicates JEDEC Registered Data

7. Datasheed Sensor Tegangan ZMPT101B

ZMPT101B VOLTAGE TRANSFORMER

Applications

* Sensing Overload Current
* Ground fault detection
* Metering
* Analog to Digital Circuits



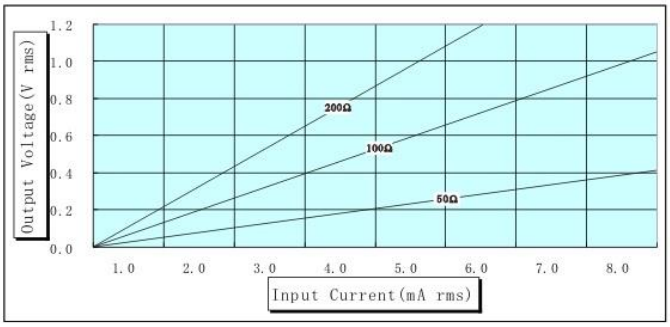
Product Illustration

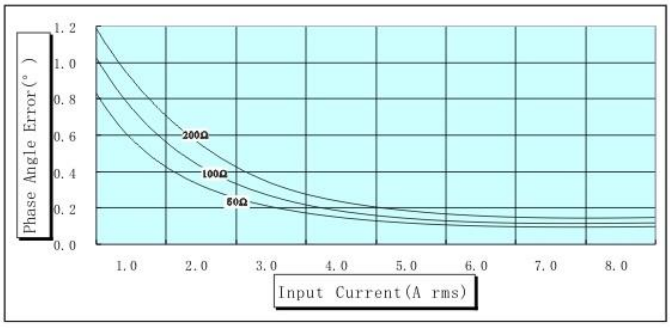
Electrical Specification	
Primary Current	2mA
Secondary Current	2mA
Turns Ratio	1000:1000
Phase Angle Error	≤20'(50Ω)
Current Range	0 ~ 3mA
Linearity	0.1%
Accuracy Class	0.2
Rated Burden	≤200 Ω
Frequency Range	50 ~ 60Hz
Dielectric Level	3000VAC/min
DC Resistance at 20℃	110 Ω

Mechanical Specification	
Cup	PBT
Encapsulant	Epoxy
Terminals	Pin φ0.80mm
Tolerance	±0.2 mm
Approx.Weight	13g
Case	Carton

Environment Specification	
Storage Temperature	**-40℃ ~ +130℃**
Insulation Resistance	>100 MΩ

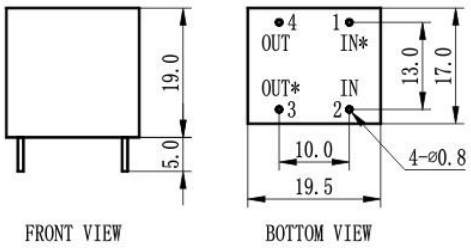
Output Characteristic





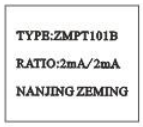
Dimensions(mm)

Same Polarity *



FRONT VIEW BOTTOM VIEW

Label



Description: Micro Precision Voltage Transformers, with low price, small size and easy PCB mounting, are mainly used in electrical energy meters, household electrical equipment, industrial apparatuses, electrical testing equipment and relay protection, widely acclaimed as well.

8. Datasheed Arduino Uno R3

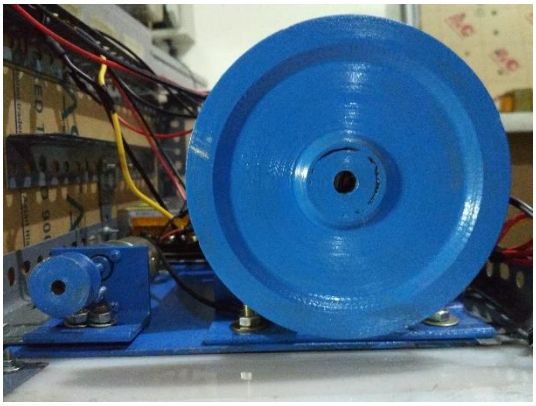
Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
Length	68.6 mm
Width	53.4 mm
Weight	25 g

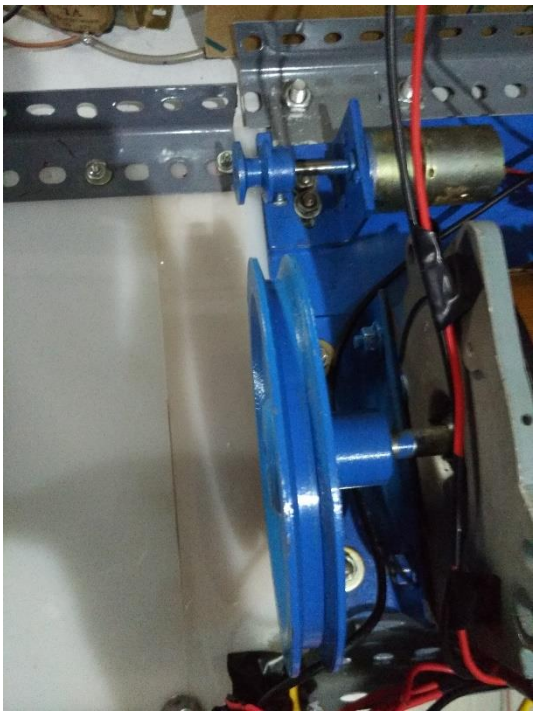
9. Tabel Pin LCD

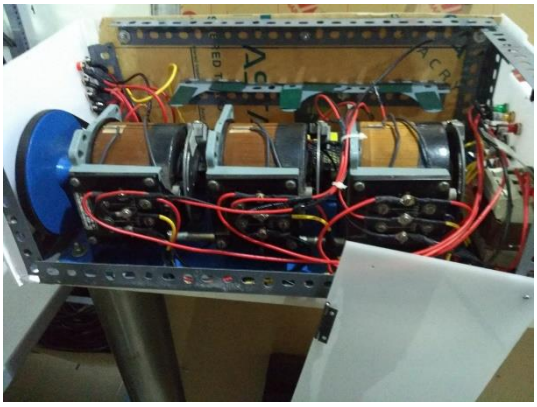
Pin LCD	**Pin Arduino**
Pin 1 (GND)	GND
Pin 2 (VCC)	VCC
Pin 3 (VSS)	Potentio 50K
Pin 4 (RS)	PORT 12
Pin 5 (R/W)	GND
Pin 6 (E)	PORT 11
Pin 11 (D4)	PORT 5
Pin 12 (D5)	PORT 4
Pin 13 (D6)	PORT 3
Pin 14 (D7)	PORT 2
Pin 15 (LED +)	+5V
Pin 16 (LED -)	GND

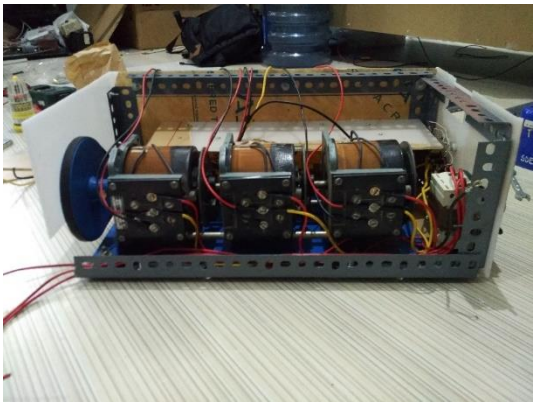
Lampiran 4 Perancangan Alat dan Pengujian

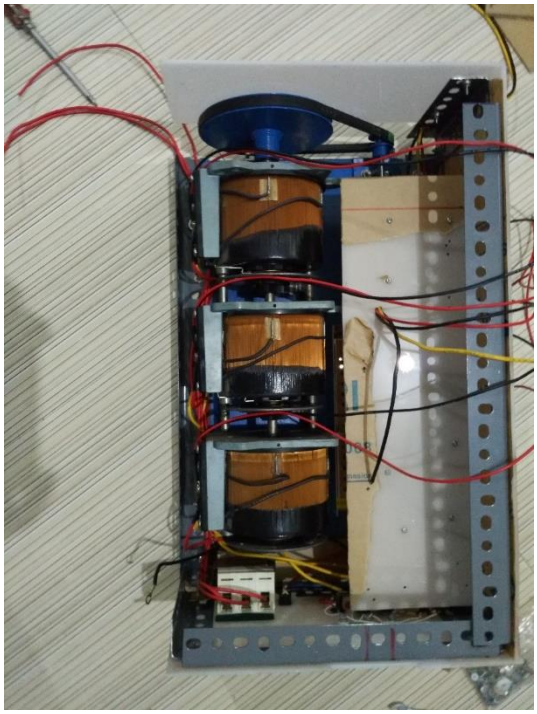
1. Perancangan Alat

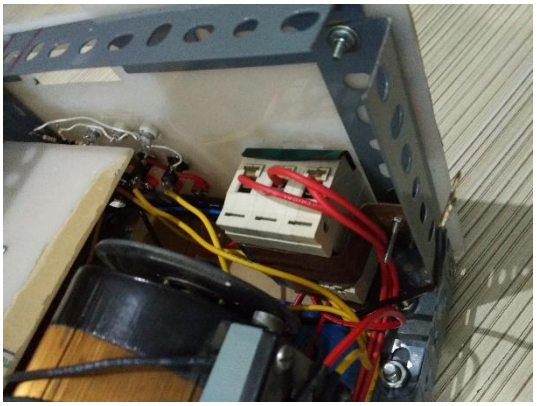


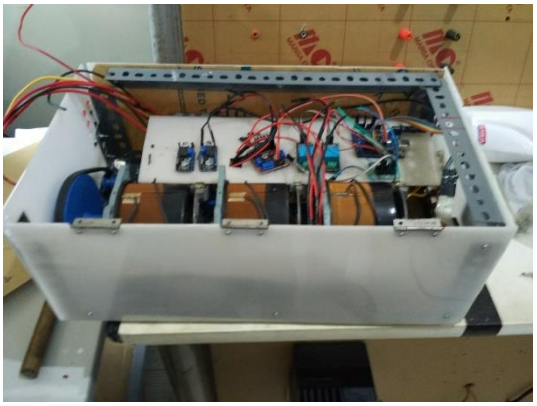




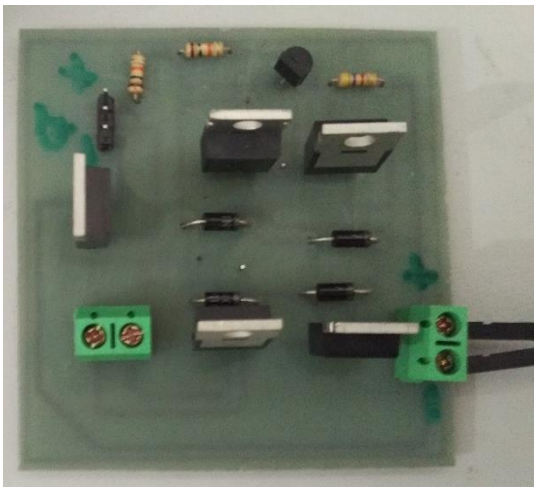


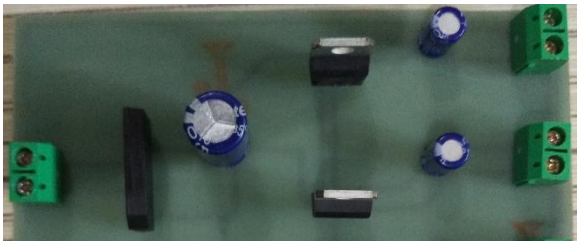




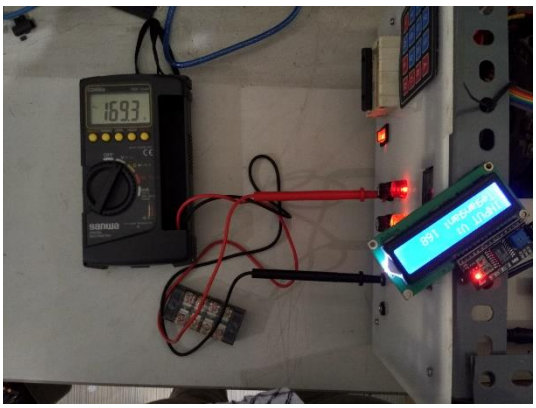


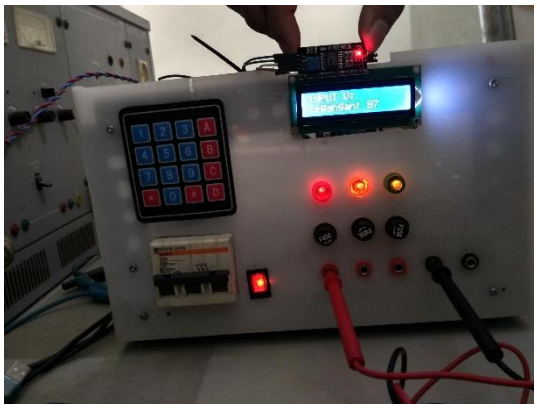

1 2 3 A
4 5 6 B
7 8 9 C
* 0 # D

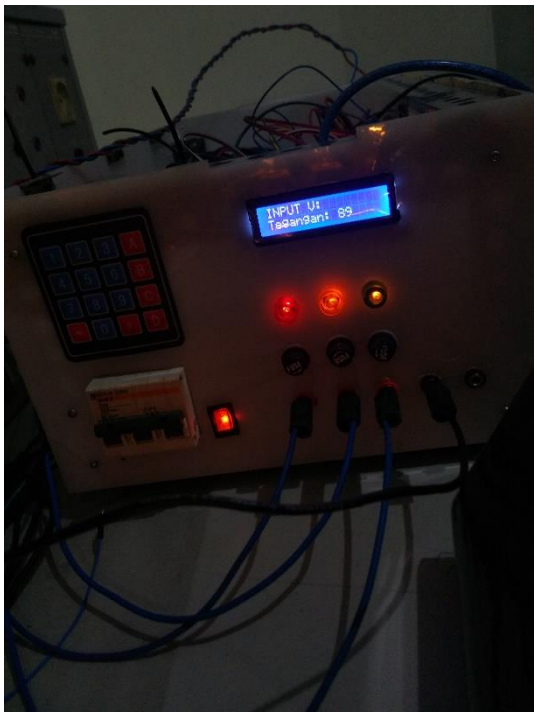




2. Pengujian Alat






INPUT U:
Tegangan: 89