ATT7021B User Manual

2009-5 V1.0

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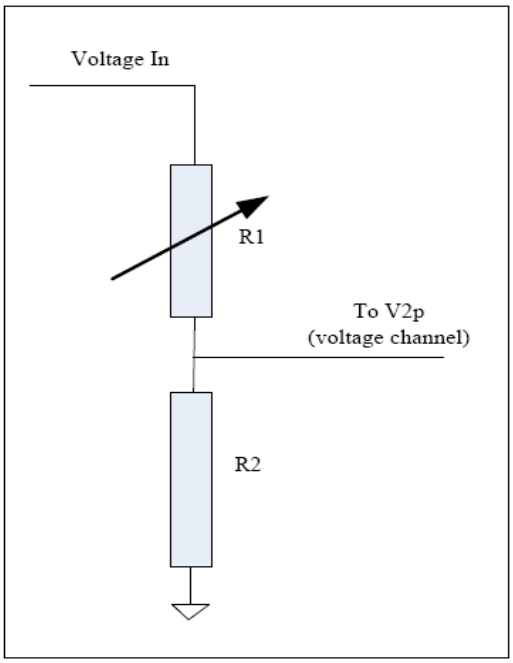
--------update ATT7021

ATT7021B is update version of ATT7021, it use .35um produce technique achieved lower power consumption and more stabile capability. ATT7021B is pin to pin full compatible with ATT7021 and ADE7755.

Compare with ATT7021, mainly reinforced points are following: 1，Lower power consumption. Power consumption of ATT7021B typical value is 3.3mA. 2，Better coherence of VREF, include central value and temperature coefficient. TC TYP: 25ppm, max 50ppm. 3，Full scale nearly same with ADE7755.

IC output frequency is in inverse proportion to full scale square (input same signal). ADC full scale will make an impact for the central value of the resistance fractional network (R1) of voltage channel.

ADC full scale has relation with ADC conversion factor and VREF, etc. Full scale is in direct proportion to VREF for one IC. For VREF has +, - 4% bias, R1 value adjust range requires upper +, - 8%.



Average full scale:

	ATT7021B	ATT7021	ADE7755
Average full scale（mV）	860	810	880

When hardware calibration:

- To replace ATT7021 by ATT7021B, the central value of resistance

  fractional network R1 should down regulate about 10%.

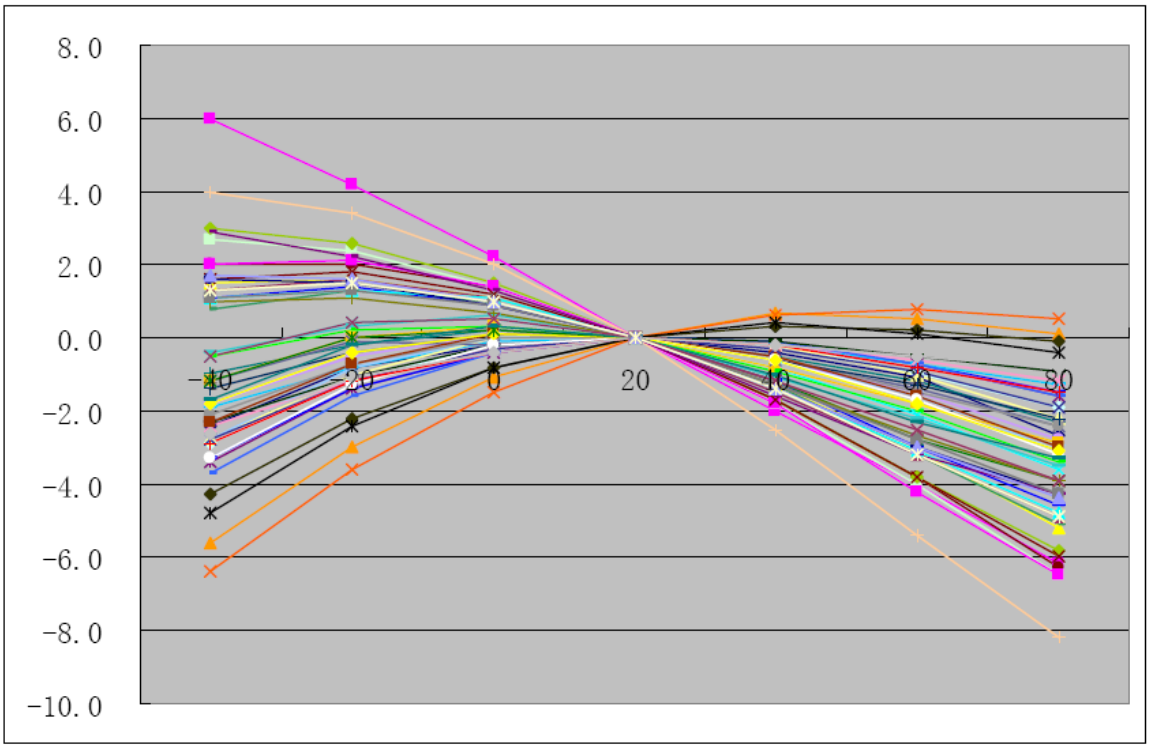
- To replace ADE7755 by ATT7021B, it needs not to change.

Annex 1: Temperature variation curves of 50 samples ATT7021B

The VREF variation values relative to 20 degree.

X: Temperature;

Y: variation values of VREF (mv)



Annex 2: Test data of typical customer meter:

Current in positive direction

I	PF	IC: ATT7021B					
		1#	2#	3#	4#	5#	6#
Imax	1.0	-0.006	-0.023	0.006	-0.029	0.012	0.053
Imax	0.5L	-0.012	0.000	0.035	-0.012	0.07	0.059
Imax	0.8C	-0.012	-0.035	0.00	-0.041	-0.017	0.059
100%	1.0	0.002	-0.022	0.022	-0.039	0.012	0.064
100%	0.5L	0.005	0.021	0.058	-0.002	0.074	0.066
100%	0.8C	-0.012	-0.037	0.005	-0.044	-0.024	0.066
50%	1.0	0	-0.01	0.028	-0.021	0.007	0.064
50%	0.5L	0.007	0.028	0.078	-0.003	0.088	0.078
50%	0.8C	0.01	-0.031	0.024	-0.042	-0.014	0.071
20%	0.5L	0.029	0.063	0.053	0.03	-0.099	0.088
20%	0.8C	0.005	-0.033	0.013	-0.008	0.016	0.074
10%	1.0	0.034	0.021	0.038	-0.004	0.064	0.073
10%	0.5L	0.09	0.091	0.126	0.111	0.181	0.096
10%	0.8C	0.04	0.024	0.048	0.044	0.045	0.102
5%	1.0	0.066	0.064	0.106	0.102	0.093	0.141
5%	0.5L	0.166	0.157	0.186	0.212	0.281	0.156

2%	1.0	0.221	0.216	0.211	0.242	0.284	0.191
1%	1.0	0.492	0.528	0.51	0.545	0.519	0.346

Current in reverse direction

I	PF	IC: ATT7021B					
		1#	2#	3#	4#	5#	6#
Imax	1.0	0.006	-0.06	0.029	-0.017	0.023	0.076
Imax	0.5L	0.006	0.035	0.059	0.006	0.082	0.07
Imax	0.8C	0	-0.041	0.006	-0.053	-0.012	0.065
100%	1.0	-0.015	-0.02	0.016	-0.044	0.01	0.058
100%	0.5L	-0.007	0.012	0.042	-0.01	0.057	0.046
100%	0.8C	-0.017	-0.049	-0.004	-0.069	-0.024	0.058
50%	1.0	-0.021	-0.042	-0.004	-0.056	-0.003	0.056
50%	0.5L	-0.039	-0.01	0.049	-0.035	0.049	0.035
50%	0.8C	-0.024	-0.06	0.007	-0.078	-0.01	0.057
20%	0.5L	-0.04	-0.07	-0.018	-0.048	-0.027	0.012
20%	0.8C	-0.058	-0.082	-0.032	-0.091	-0.065	0.036
10%	1.0	-0.078	-0.108	-0.026	-0.125	-0.061	-0.001
10%	0.5L	-0.158	-0.104	-0.073	-0.137	-0.078	-0.032
10%	0.8C	-0.069	-0.094	-0.033	-0.111	-0.102	0.039
5%	1.0	-0.126	-0.139	-0.081	-0.135	-0.146	-0.021
5%	0.5L	-0.212	-0.226	-0.115	-0.262	-0.15	-0.05
2%	1.0	-0.266	-0.286	-0.204	-0.435	-0.346	-0.098
1%	1.0	-0.656	-0.668	-0.493	-0.696	-0.693	-0.411

Hi-Trend Technology(Shanghai) Co., Ltd

ATT7021

User's Manual

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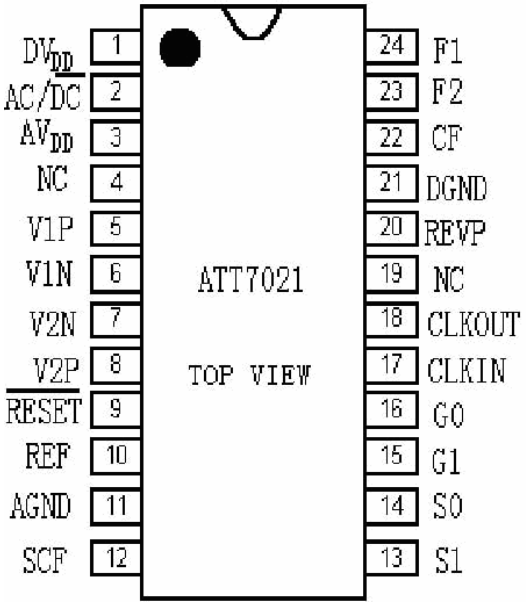
■ FEATURE

- High Accuracy, Wide Dynamic Range
- The High Frequency Output CF is intended for calibration.The Low Frequency Output F1 and F2 can be used to drive for Electromechanical Counters or Two Phase Stepper Motors.
- A Programmable Gain Amplifier(PGA) in the current channel Allows the Use of Small Values Shunt.
- The logic output REVP can be used to indicate a potential miswiring or negative power, the ATT7021 may measure positive and negative direction power, and energy can be accumulated according to the same direction.
- On – Chip Creep Protection.
- High Stability, Longevity Over 20 Years.
- Single +5V Power Supply, Low Power (Typical 15mW).
- On – Chip Power Supply Monitoring, On-chip reference voltage with external overdriven capability.
- No Leap Output CF make the Calibratioin Quickly and Correctly.
- Proprietary IP and 4 Patents.
- Fully Compatible With ADE7755

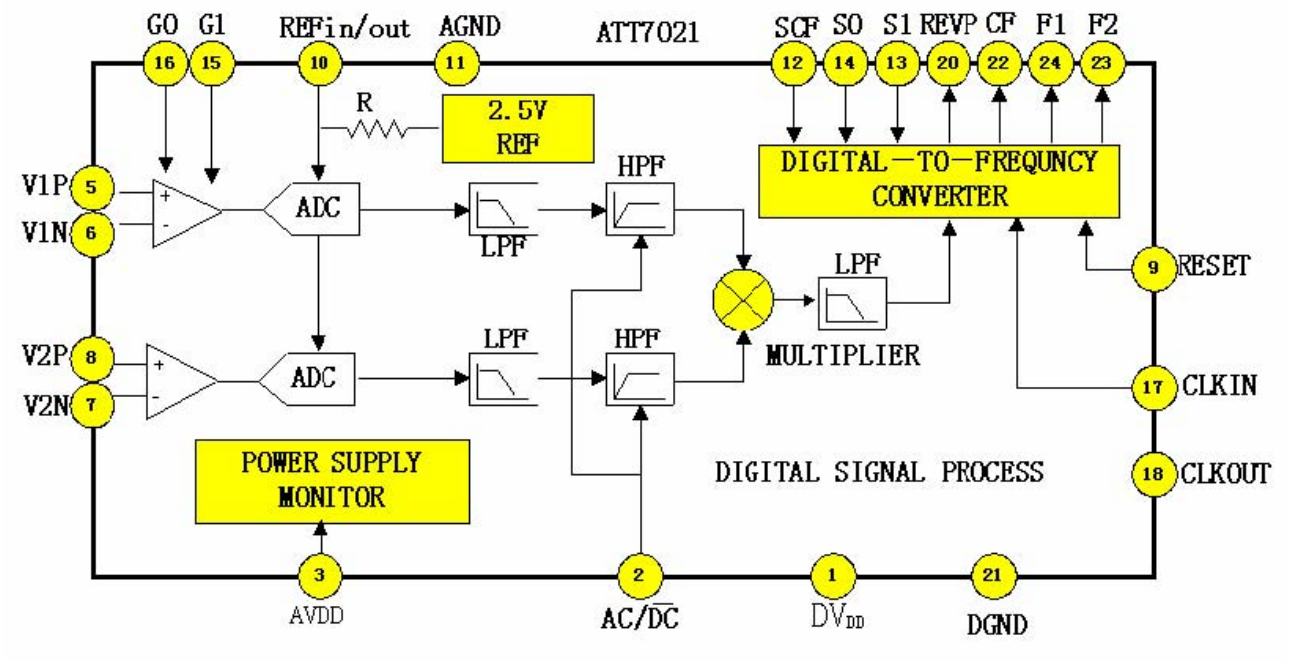
Have Applied for 4 Patents :02131733.X ;02131732.1 ;02249293.3 ;02500093.4

The ATT7021 is available in 24 - lead DIP and SSOP Packa



PIN CONFIGURATION （ DIP and SSOP Packages ）

■ ATT7021 IC DIAGRAM:



■ PIN FUNCTIONS DESCRIPTIONS

Pin Number	Mnemonic	Description
1, 3	AV_{DD} , DV_{DD}	Analog Power Supply and Digital Power Supply
2	AC/ $\overline{DC}$	High Pass Filter Select
4,19	NC	No Connect
5, 6	V_{1P} , V_{1N},	Analog Input for Current Channel
7, 8	V_{2N} , V_{2P},	Analog Input for Voltage Channel
9	$\overline{RESET}$	System Reset Pin
10	REF_{IN}	The Reference Voltage Output
11,21	AGND ,DGND	Analog Ground and Digital Ground.
12	SCF	Select Calibration Frequencies
13,14	S1,S0	Select the Frequencies for The digital to Frequency Conversion.
15,16	G1,G0	PGA Select
17,18	CLKIN ,CLKOUT	Crystal Pin
20	REVP	Negative active power flag
22	CF	The High Frequency Output
23,24	F2 , F1	The Low Frequency Output

Note ： the CF is the Calibration output. As below in the application circuit.

■ DIGITAL CHARACTERISTICS

Electrical Characteristics (Ta=25℃ ,AV_{DD} =5V, DV_{DD} =5V, f_{OSC}=3.579545MHz, θ (V_i~V_v) = 0)

Items	Mnemonic	Test Conditions	Test Point	Min.	Typical	Max	Unit
Current	Idd	Vv=0.248V Vi=1.75mV	Power output		4	5.5	mA
Reference Voltage	Vref	Vv,Vi=0	Pin10	2.3	2.5	2.7	V
Vref Temperature Coefficient	δ	Variable Temperature From -40~+80	Pin10		30	60	ppm/ ℃
Logic Outputs	REVP	Φ= π , I_{SOURCE}=10mA,DV_{DD}=5 V	Pin9	4.5			V
		φ=0,I_{SINK}=10mA,DV_{DD}=5V				0.5	V
	F1 F2 CF	I_{SOURCE}=10mA,DV_{DD}=5V	Pin22 Pin23 Pin24	High 4			V
		I_{SINK}=10mA,DV_{DD}=5V				Low 0.5	
Logic Inputs	SCF S0,S1 G0,G1 AC/DC Reset	DV_{DD}=5V±5%		High 4.5			
						Low 0.8	
Start-up Current	I_{START}	DV_{DD}=5V			10		mA
Accuracy error	e	Dynamic Range 500 :1 G=1,2,8,16.	Pin22			0.1	%

Absolute Maximum Ratings (T = 25 ℃)

ITEMS	Mnemonic	Range	Unit
Digital Power	DV_{DD}	-0.3 ~+ 7	V
Analog Power	AV_{DD}	-0.3 ~+ 7	V
Current Channel Voltage	V_V	-6 ~ +6	V
Voltage Channel Voltage	V_i	-6 ~ +6	V
Work Temperature	T_{opr}	-40 ~ +85	℃
Store Temperature	T_{str}	-65 ~ +150	℃

■ PERFORMANCE PARAMETER

1) Frequency Outputs F1 and F2 The ATT7021's output frequency or pulse rate is related to the input voltage signals by the following equation

$$\text{Frequency} = \quad F=(8.06\times V1\times V2\times G\times F_{1-4})/V^{2}_{REF}$$

2) Error as e N % of reading The ATT7021's percentage error is defined as:

$$\text{Frequency Error} = \frac{Energy\,\text{Re}\,gistedByATT7021-TrueEnergy}{TrueEnergy}\times 100\%$$

3) Start – up Current and No load Threshold The ATT7021 also includes a Start-up Current and No load threshold feature that will eliminate any creep effects in the meter. The ATT7021 is designed to issue a minimum output frequency on all modes except when SCF = 0 and S1 = S0 = 1. The no-load detection threshold is disabled on this output mode to accommodate specialized application of the ATT7021. Any load generating a frequency lower than this minimum frequency will not cause a pulse to be issued on F1, F2 or CF. The minimum output frequency is given as 0.0014% of the full-scale output frequency for each of the F1–4 frequency selections. A start-up current 10 mA at 220 V and PF=1.

■ APPLICATION NOTES:

Table I

F1 and F2 Frequency at 100imp/kWhr

I_{MAX}	F1 and F2 (Hz)
12.5 A	0.076
25 A	0.153
40 A	0.244
60 A	0.367
80 A	0.489
120 A	0.733

Table II

S1 , S0 SCF VS CF Frequency (full input)

SCF,S1,S0	F_{1-4} F1/2 (Hz)		CF(Hz)
100 000	1.7	0.34	128×F1,F2 64×F1,F2
101 001	3.4	0.68	64×F1,F2 32×F1,F2
110 010	6.8	1.36	32×F1,F2 16×F1,F2
111 011	13.6	2.72	16×F1,F2 2048×F1,F2

Note : 1) User can select the frequency of F1 according to the table.

2) The CF logic output gives instantaneous real power information. The output is intended to be used for calibration purpose, or interfacing to an MCU.

3) Performance Parameter Sections The Equation where:

Freq = Output frequency on F1 and F2 *(Hz)*

*V*1 = Differential rms voltage signal on Channel 1 (volts)

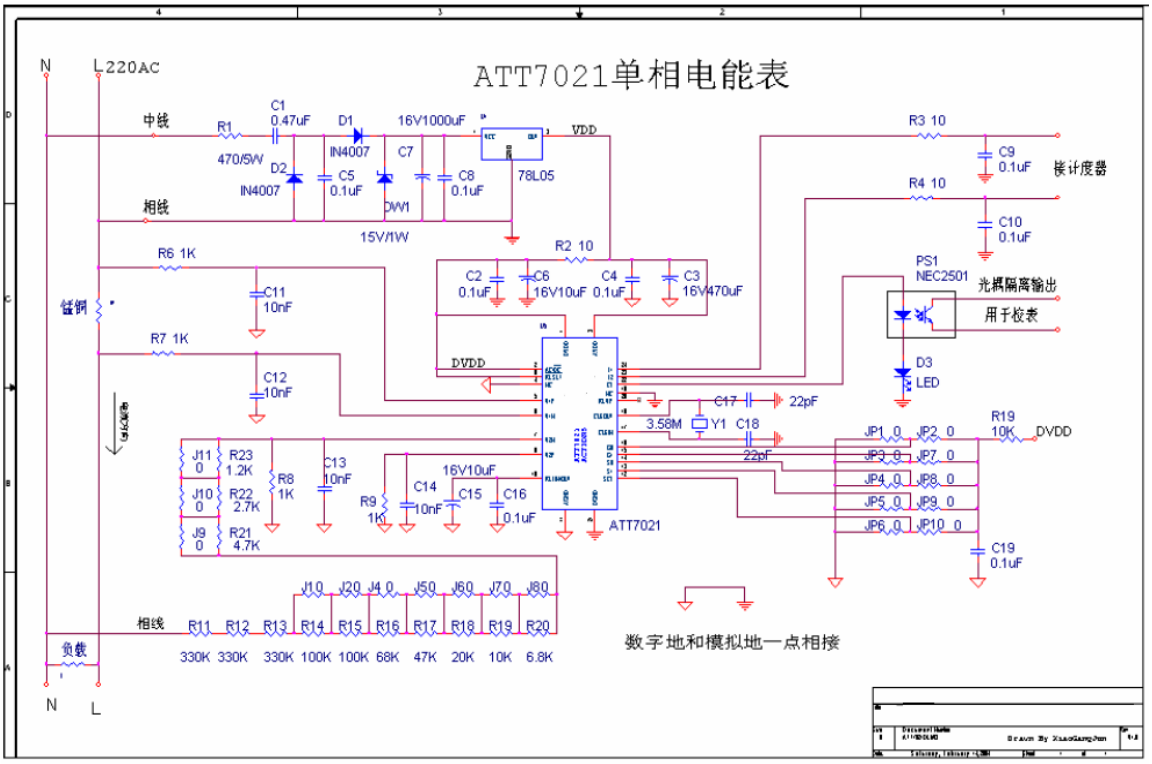
*V*2 = Differential rms voltage signal on Channel 2 (volts)

Gain = 1, 2, 8 or 16, depending on the PGA gain selection made using logic inputs G0 and G1

VREF = The reference voltage (2.5 V ± 8%) (volts)

F_{1-4} = One of four possible frequencies selected by using the logic inputs S0 and S1 see Table II

■ Typical Application Circuit



■ Application Example

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Design parameters:

Line voltage = 220 V (nominal)

IMAX = 40 A (Ib = 5 A)

Counter = 100 imp/kWh

Meter constant = 3200 imp/kWh

Shunt size = 350 μΩ

100 imp/hour = 100/3600 sec = 0.027777 Hz

Meter will be calibrated at Ib (5A)

Power dissipation at Ib = 220 V ×5 A = 1.1 kW

Frequency on F1 (and F2) at Ib = 1.1 ×0.027777 Hz= 0.0305555 Hz

Voltage across shunt (V1) at Ib = 5 A ×350 μΩ = 1.75 mV.

In this example, with ac voltages of ± 1.75 mV Rms applied to V1 and X mV Rms applied to V2, the expected output frequency is calculated as follows:

Gain = 1, G0 = G1 = 1

F1-4 = 3.4 Hz, S0 =0, S1 = 1, SCF=0

V1 = rms of 1.75 mV = 1.75×10^{-3} volts

V2 = rms ofX mV = X ×10^{-3} volts

VREF = 2.5 V (nominal reference value).

$$\therefore Freq = \frac{8.06 \times G \times V1 \times V2 \times F_{1-4}}{2.5^2} = \frac{8.06 \times 16 \times 1.75 \times 10^{-3} \times X \times 3.4}{2.5^2}$$

■ $$\therefore 0.030555HZ = \frac{8.06 \times 16 \times 1.75 \times 10^{-3} \times X \times 3.4}{2.5^2}$$

∴ X = 0.249 V rms

∴ V2 = 249 mV rms

Therefore, in order to calibrate the meter the line voltage needs to be attenuated down to 249 mV rms.

Note: To select the F1-4 frequency for the above Equation see the Table I and TableII,Application Note section. From Tables I and II it can be seen that the best choice of frequency for a meter with IMAX = 40 A is 3.4 Hz (F1/2). This frequency selection is made by the logic inputs S0 and S1 see Table II . The CF frequency selection (meter constant) is selected by using the logic input SCF. The two available options are 64× F1(6400 imp/kWh) or 32 ×F1(3200 imp/kWh). For this design, 3200 imp/kWh is selected by setting SCF logic low.

< End >

BOM:

Part	Used	PartType	Designators
1	2		DW1 XT1
2	21	0	J1 J2 J3 J4 J5 J6 J7 J8 J9 J10 J11 JP1 JP2 JP3 JP4 JP5 JP6 JP7 JP8 JP9 JP10
3	8	0.1U	C2 C4 C5 C8 C9 C10 C16 C19
4	4	0.033U	C11 C12 C13 C14
5	1	0.47UF/250V	C1
6	1	1.2K	R23
7	4	1K	R6 R7 R8 R9
8	1	2.7K	R22
9	1	4.7K	R21
10	1	6.2K	R20
11	2	10K	R5 R19
12	2	10U/50V	C3 C15
13	1	14K420	RV1
14	1	20K	R18
15	2	22P	C17 C18
16	1	47K	R17

17	1	68K	R16
18	3	100	R2 R3 R4
19	3	100K	R13 R14 R15
20	2	330K	R11 R12
21	1	470/5W	R1
22	1	470U/16V	C6
23	1	510	R10
24	1	1000U/25V	C7
25	1	ATT7021	U2
26	2	IN4007	D1 D2
27	1	LED	D3
28	1	NEC2501	PS1
29	8	TP	TP1 TP2 TP3 TP4 TP5 TP6 TP7 TP8
30	1	WS78L05	U1
31	5	Z	Z1 Z2 Z3 Z4 Z5