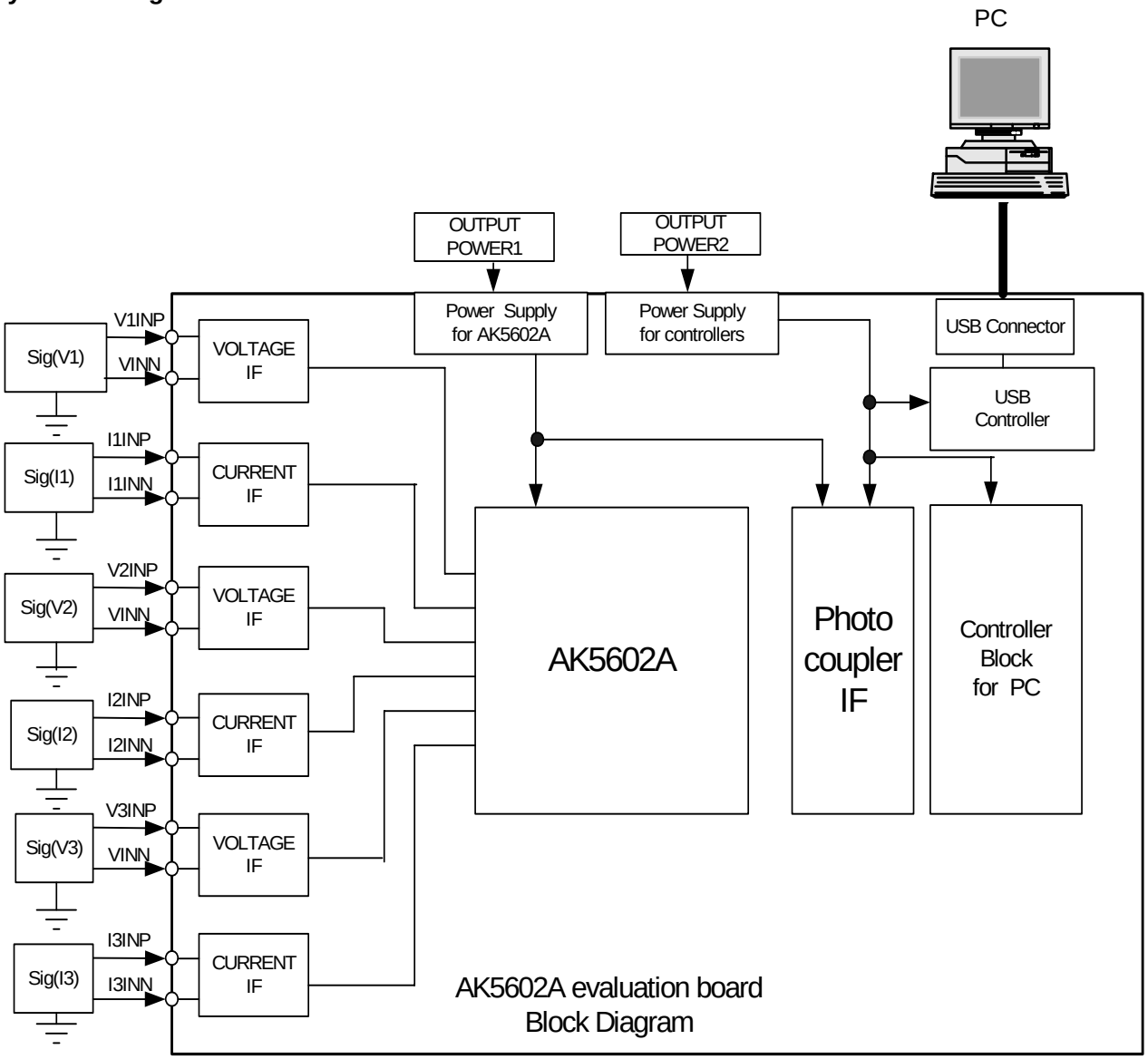
AKD5602A

Evaluation board for AK5602A

1. General Description

This manual explains that the function and the way of operating AK5602A evaluation board. This board enables writing and reading of AK5602A's registers and displaying of the result of measurement and calculation.

2. System configuration



< Hardware operating conditions >

(1) Power supply to the evaluation board

There need two powers in the evaluation board. The one is for measuring block, AK5602A and the other is for IF block to a PC. The power plane and ground plane of measuring block and IF block to PC are separated by photo couplers on the evaluation board.
This separation is needed to prevent from causing possible damage to PC.
Output power1 (DC: 3V or 5V) for AK5602A and output power2 (DC: 3V or 5V) for IF block to the PC should be connected to the power supply block of AK5602A evaluation board respectively.
When AC signal more than 100V is used as the voltage inputs to the evaluation board, AC source of output power1 and output power2 may be separated to prevent from causing possible damage to the PC.

(2) The interface to voltage signal input and current signal input

Voltage signal input: direct input intended for AC voltage such as 115 V power line or BNC input for signal oscillator.
Current signal input: direct input intended for AC current signal at secondary side of Current Transformer or BNC input for signal oscillator. Load resistors of CT on the board should be selected in the direct input connection.
The electrical interface of voltage input and current input of AK5602A is differential.

< Software operating conditions >

OS: Windows 2000 or XP
Screen size: 1024 X 768
USB port: 1 channel

3. Installation of software drivers, the system startup and the exit

3 - 1. Installation of USB drivers (needed to execute only once)

(1) Connect a USB cable between a PC and the evaluation board after DC power being applied to the evaluation board.
(2) If a message, “new hardware is detected” appears on the screen, install AK5602USB.inf file.
(3) If the USB driver will have been installed successfully, the assigned communication port number will be displayed at AK5602 EVABOARD Serial Port Driver of COM and LPT of Device Manager. This port number must be selected when the software of the AK5602A system is started.

3 - 2.Start up (Normal operation)

(1) Feed the power (+3V or +5V) the AK5602A evaluation board.
(2) Connect a USB cable between the evaluation board and the PC.
(3) Boot the software of AK_EvaTool_Eng.exe

3 - 3.Exit

(1) Exit the program of the evaluation board system.
(2) Pull out the USB cable from the evaluation board.
(3) Pull out the power cables from the evaluation board.

3 - 4.Others

Countermeasures against abnormal conditions

When the evaluation board enters in a halt state, try the start up sequence again after conducting the exit sequence written above.

4. Function summary

Software processes running on PC are divided into three software processes, which are initial mode setting process, measuring process, calculating and drawing process.

4 - 1.Initial mode setting process

(1) Set the communication port address of USB for the evaluation board and the rated values of current and voltages to be measured.

(2) Set the initial value of registers of AK5602A and display the registers.
When setting values into registers, set a writing address and data in a hexadecimal format and press the “Writing” button. When reading values from registers, set a reading address in a hexadecimal format and press the “Reading” button. The modes of RESET, STBY and DISABLE at AK5602A can be controlled by pressing corresponding buttons. These buttons are toggle mode buttons.

(3) Set the addresses of displaying data

4 - 2. Measuring process

There are an instantaneous process and time interval process in measuring processes.

The instantaneous process measures the input signal of current and voltage with 62 samples per one cycle at 50Hz or 52 samples per one cycle at 60Hz. Time interval process measures the active and reactive power for every one second. The instantaneous process measures the instantaneous current, instantaneous voltage, RMS current, RMS voltage, input voltage frequency, instantaneous active power, instantaneous reactive power and instantaneous apparent power every one second for 10 seconds (Maximum is 30 seconds) (Graph1). And the values of registers being appointed are read out and displayed in the measured data screen.

Time interval process measures total active power and total reactive power by counting the number of RPO (TPO) or RQO (TQO). It also measures the input voltage frequency, F1, F2 and F3 every one second for 10 seconds (Maximum is 30 seconds). Furthermore, the value of power factor of each input, the phase between input voltage and input current being derived from the power factor and temperature are measured every one second and displayed (Graph2).

4 - 3. Calculation and drawing process

Based on data acquired by measuring process, the result of calculation is displayed in a hexadecimal format at a table and is displayed in a graph format.

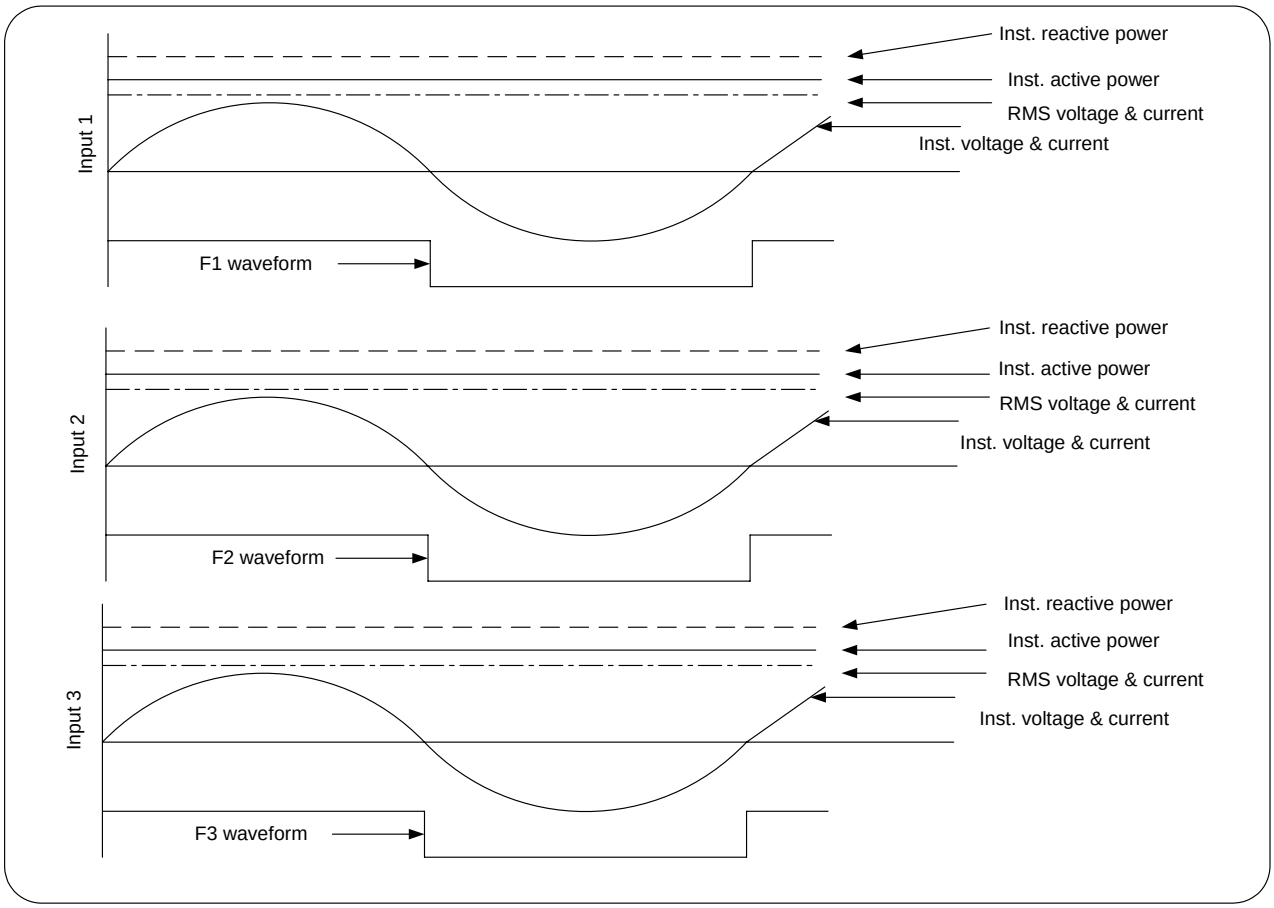
(1) Measured data displaying screen

	V1RMS	V2RMS	-	-										-	-	TEMP
S1																
S2																
-																
-																
-																
S80																

	1S	2S	3S	4S	5S	6S	7S	8S	9S	10S
F1_CNT										
F2_CNT										
F3_CNT										
RPO										
RQO										
TPO										
TQO										

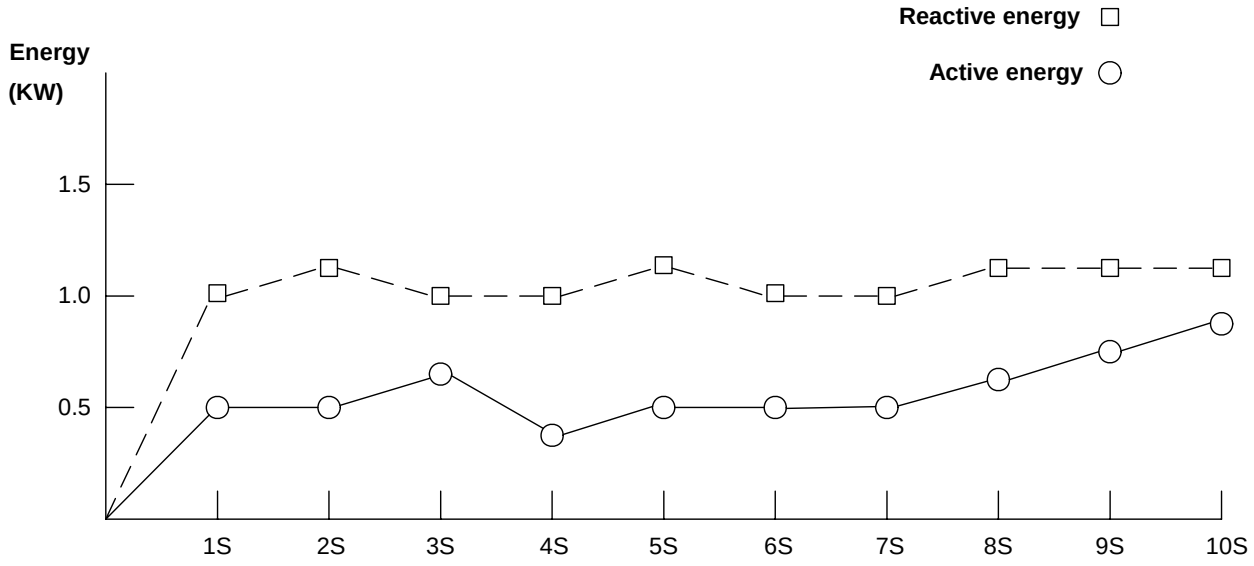
(2) Graph display on each input (Graph1)

The waveform of an instantaneous voltage, instantaneous current, RMS voltage, RMS current, instantaneous active power and instantaneous reactive power and voltage input (Fn) judged by the threshold value are displayed for one cycle.



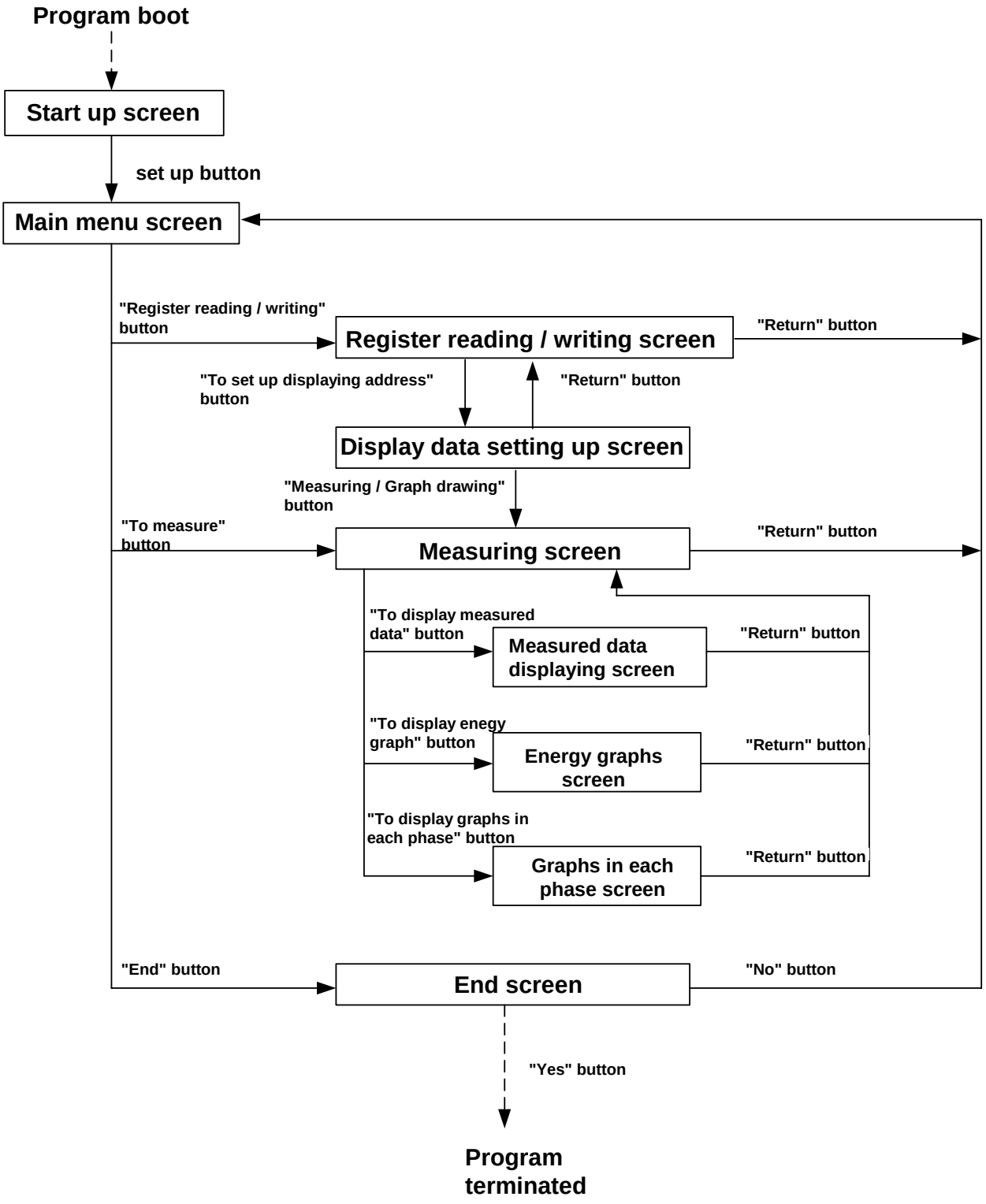
(3) Energy graph display

The value of total active receiving or transmitting energy and total reactive receiving or transmitting energy which are calculated from the counting number of RPO (TPO) and RQO (TQO) as well as power factor, angle between voltage and current on each input, and the temperature of the LSI are plotted in a same graph.

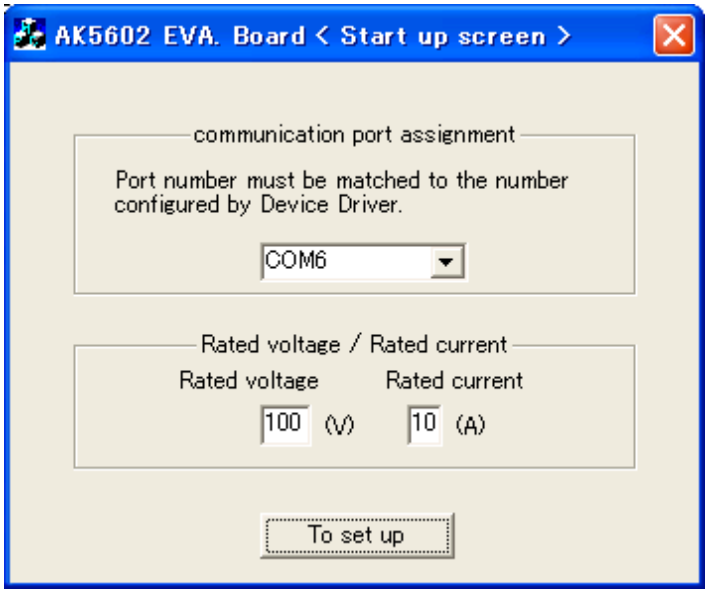


	1S	2S	3S	4S	5S	6S	7S	8S	9S	10S
Active power [RPO]										
Active power [TPO]										
Reactive power[RQO]										
Reactive power[TQO]										
Power factor 1										
θ1										
Power factor 2										
θ2										
Power factor 3										
θ3										
Temperature										

5 – 0. Screen format



5 - 1. Start up screen



(1) Communication port assignment

USB_I/F, which is used for the evaluation board should be assigned to one of communication ports. Assignment of communication port should be matched to one being assigned by the device driver.

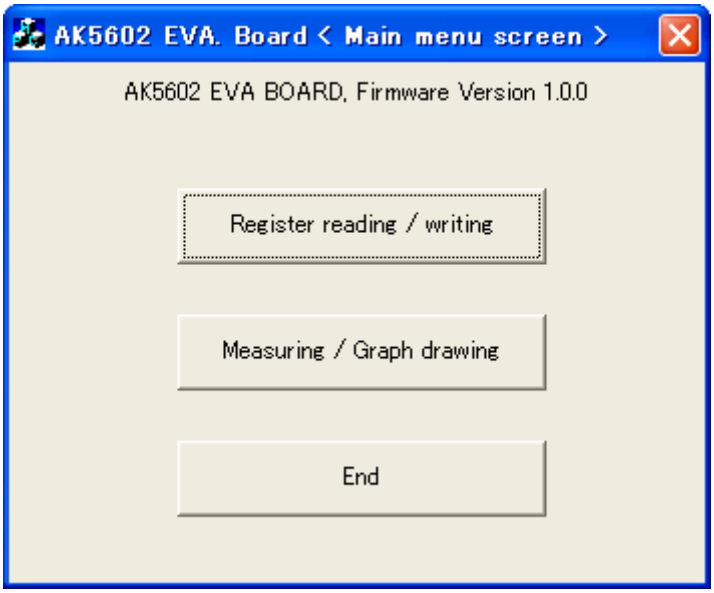
(2) Rated voltage and rated current

Set the value of rated voltage and rated current, which are used for the calculation of active energy and reactive energy.

(3) The screen will jump to "Main menu screen" after storing values being set by (1) & (2) when "To set up" button is pressed.

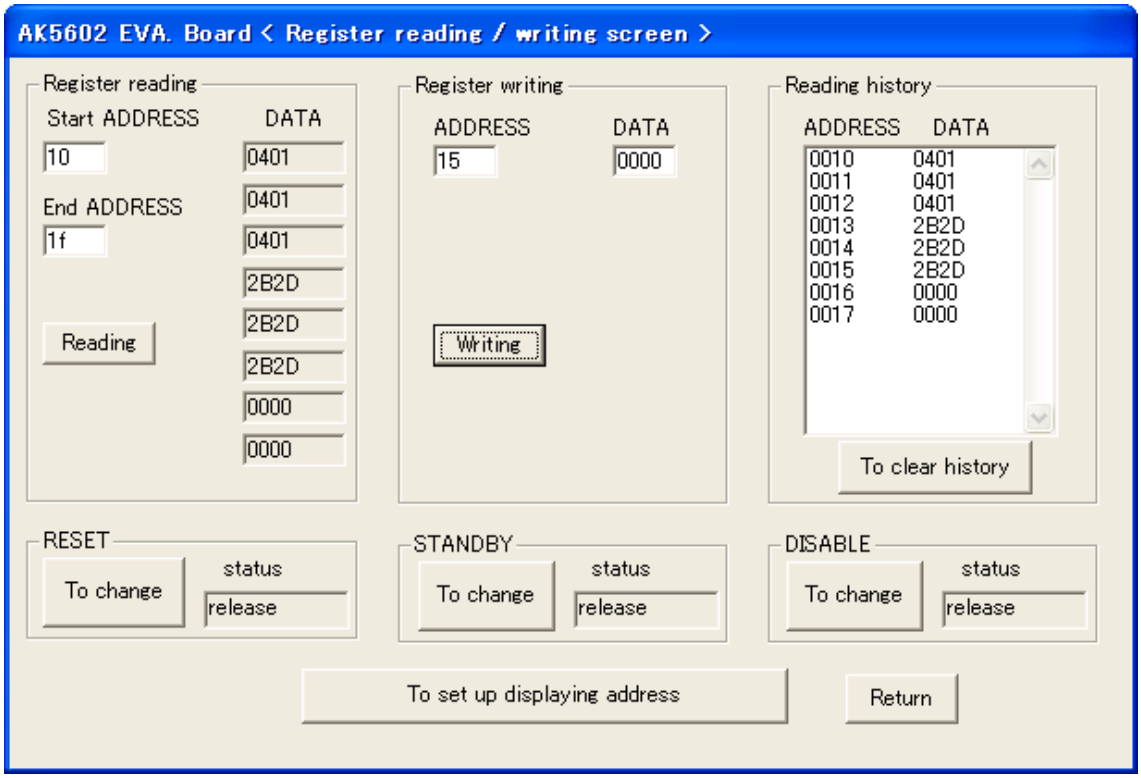
- Stored values will be displayed when the program is booted next time.
- Error message will be displayed when wrong setting is executed.
- The communication port of PC for using USB port is initialized when "To set up" button is pressed.

5 - 2. Main menu screen



(1) The screen will jump to the “Register reading / writing screen” when “Register reading / writing” button is pressed.
(2) The screen will jump to the “Measuring / Graph drawing screen”, where measuring of such routines as active power, reactive power, instantaneous active power, instantaneous reactive power, RMS voltage and RMS current are executed when “Measuring / Graph drawing” button is pressed.
(3) The AK5602A evaluation board program will be terminated when “END” button is pressed.

5 - 3 Register reading / writing screen



Before reading and writing AK5602A's registers properly, it is requested to change the state of RESET, STANDBY and DISABLE into "release" mode.

(1) Register reading

It is possible to read values from registers of AK5602A by writing a reading start address and reading end address in a hexadecimal format and pressing "Reading" button. The maximum number of reading addresses successively is eight. If the input end address is larger than (starting address + 8), the contents of addresses to be read are displayed from the starting address to (starting address + 8).

(2) Register writing

It is possible to write a value into registers of AK5602A by writing a writing address and pressing "Writing" button.

(3) Reading history

It is possible to display the history of data strings which have been read by "Register reading". The reading history can be cleared by pressing "To clear history" button.

(4) RESET block

"To change" button is a toggle mode button. Whenever the button is pressed, the mode of RESET is changed. For example, if the button is pressed in a RESET mode, the mode of RESET is changed into a RESET release mode.

(5) STBY block

"To change" button is a toggle mode button. Whenever "To change" button is pressed, the mode of STBY is changed. For example, when the button is pressed in a STBY mode, the mode of STBY is changed into a STBY release mode.

(6) DISABLE block

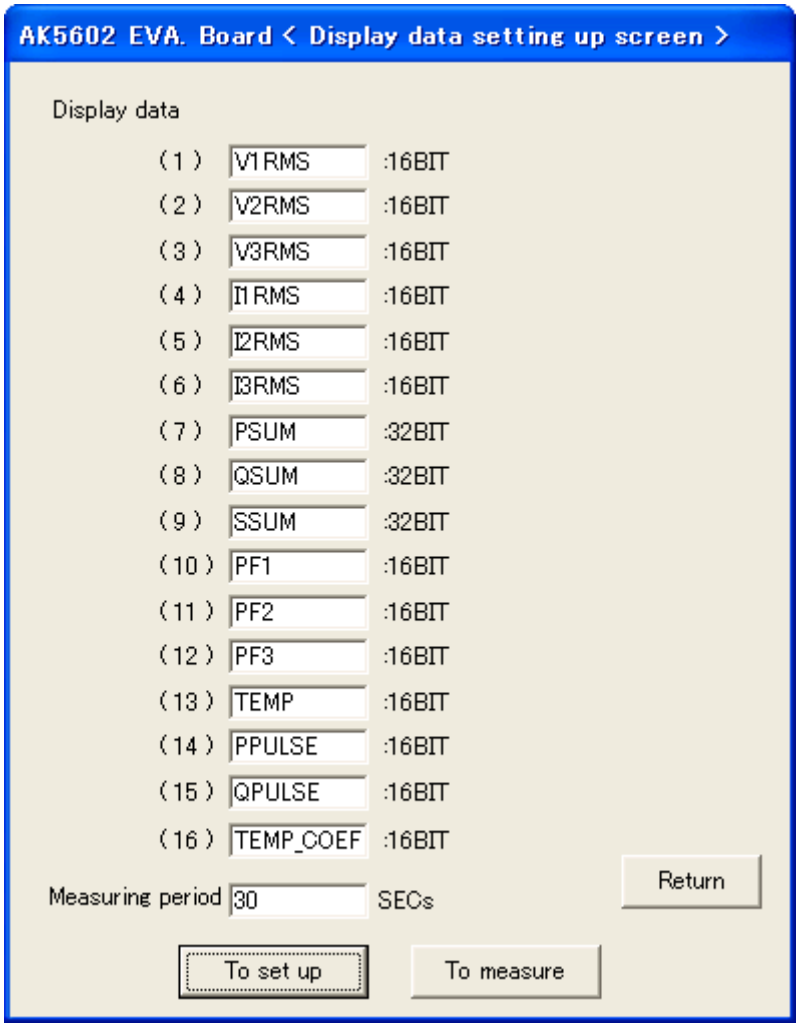
"To change" button is a toggle mode button. Whenever "To change" button is pressed, the mode of DISABLE is changed. For example, when the button is pressed in a DISABLE mode, the mode of DISABLE is changed into a DISABLE release mode.

(7) Setting the addresses of displaying data

The screen will jump to "Measured data displaying screen" when "To set up displaying address" button is pressed.

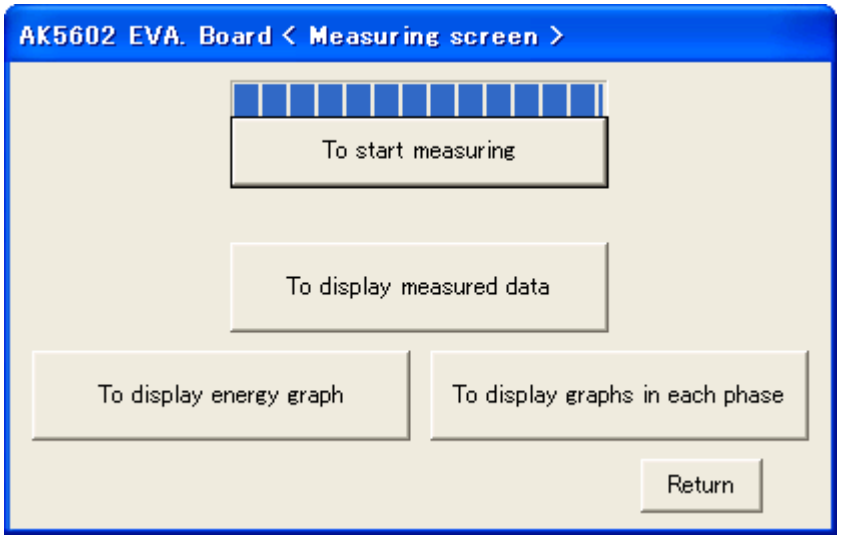
(8) The screen will jump to "Main menu screen" when "Return" button is pressed.

5 - 4. Display data setting up screen



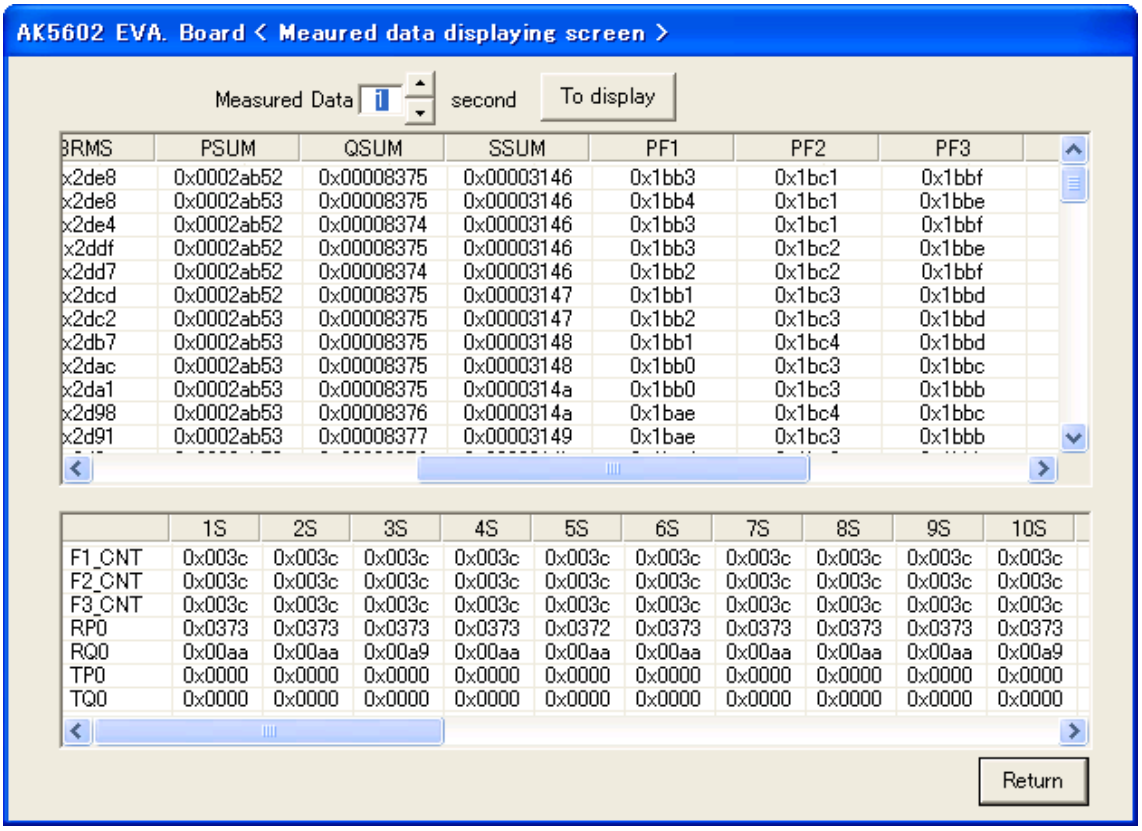
(1) In this display data setting up screen, symbols of displaying 16bit data or 32bit data must be entered .The maximum number of symbols to be displayed is 16.
(2) Initial data display symbols are VIRMS (16BIT), V2RMS (16BIT), V3RMS (16BIT), I1RMS (16BIT), I2RMS (16BIT), I3RMS (16BIT), PSUM (32BIT), QSUM (32BIT), SSUM (32BIT), PF1 (16BIT), PF2 (16BIT), PF3 (16BIT), TEMP (16BIT).
(3) Regarding measuring period, an integer number between 10 and 30 must be entered. Initial number is 10.
(4) Symbols of display data and measuring period are fixed after pressing “To set up” button.
(5) The screen will jump to “Measuring screen” when “To measure” button is pressed.
(6) The screen will jump to “Main menu screen” when “Return” button is pressed.

5 - 5. Measuring screen



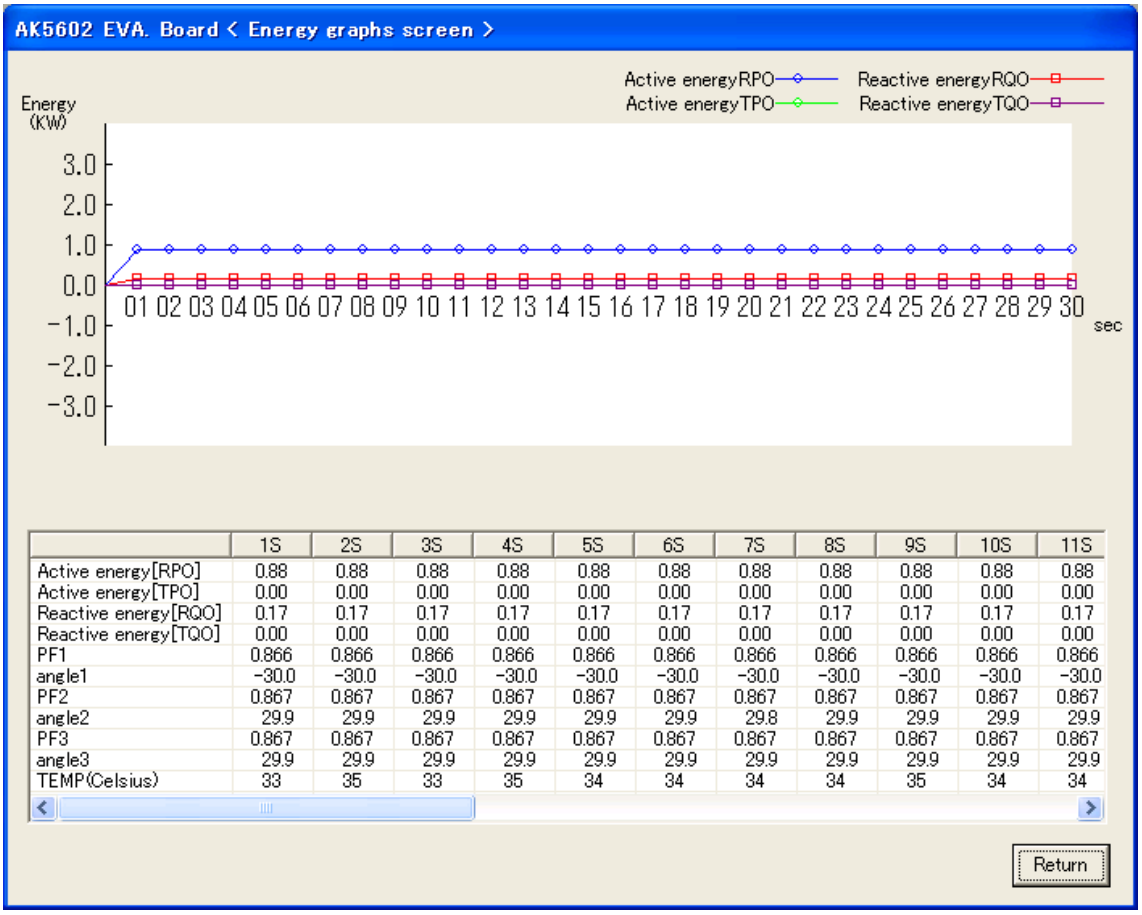
(1) Measurement will be started when “To start measuring” button is pressed. It measures each parameter for every one second from 10 to 30 seconds. Measurement won’t be started under the condition that all of RESET, STBY and DISABLE mode are released.
(2) The screen will jump to “Measured data displaying screen” when “To display measured data” button is pressed.
(3) The screen will jump to “Active energy and reactive energy display screen” when “To display energy graph” button is pressed.
(4) The screen will jump to “Instantaneous waveforms of voltage, current and power display screen” when “To display graphs in each phase” button is pressed.
(5) The screen will jump to “Main menu screen” when “Return” button is pressed.

5 - 6. Measured data displaying screen



(1) Displaying data for one second to be selected from entered period can be specified by manipulating UP/DOWN button. 80 samples of data will be displayed for every measurement.
(2) Specified data will be displayed on the screen when “To display” button is pressed.
(3) Measured data which are specified by symbols are represented in either 16 bit hexadecimal data format or 32 bit hexadecimal data format.
(4) F1_CNT, F2_CONT, and F3_CNT display the number of pulses for one second in hexadecimal format at F1, F2, and F3 pin of the AK5602A respectively. Each number represents the digitized frequency of each voltage input.
(5) RPO, TPO, RQO, and TQO display the number of pulses for one second in hexadecimal format at the respective pin of the AK5602A. RPO and TPO represent the number of pulses for one second of active energy. On the other hand, RQO and TQO represent the number of pulses for one second of reactive energy.
(6) Display period (seconds) of data will be a period set by “Display data setting up screen”. The initial value of the period is 10 seconds.
(7) The screen will jump to “Measuring screen” when “Return” button is pressed.

5 – 7. Energy graph screen



	1S	2S	3S	4S	5S	6S	7S	8S	9S	10S	11S
Active energy[RPO]	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Active energy[TPO]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Reactive energy[RQO]	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Reactive energy[TQO]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PF1	0.866	0.866	0.866	0.866	0.866	0.866	0.866	0.866	0.866	0.866	0.866
angle1	-30.0	-30.0	-30.0	-30.0	-30.0	-30.0	-30.0	-30.0	-30.0	-30.0	-30.0
PF2	0.867	0.867	0.867	0.867	0.867	0.867	0.867	0.867	0.867	0.867	0.867
angle2	29.9	29.9	29.9	29.9	29.9	29.9	29.8	29.9	29.9	29.9	29.9
PF3	0.867	0.867	0.867	0.867	0.867	0.867	0.867	0.867	0.867	0.867	0.867
angle3	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9
TEMP(Celsius)	33	35	33	35	34	34	34	34	35	34	34

Based on the acquired data by the measurement, the numerical value and the graph of active energy and reactive energy are plotted. Furthermore, the numerical value of power factor, the phase angle between each current input and voltage input and the temperature of the LSI are also displayed.
Here, power factor1 is PF1, power factor2 is PF2, and power factor3 is PF3.

<Calculation method of each parameter>

(1) Active energy

Active energy = the counting number of pulses for one second of RPO or TPO / 1000 * the rated current * the rated voltage / 1000 [Unit: KW]
The value of the rated voltage and current used in this equation is set at “Start up screen”.

(2) Reactive energy

Reactive energy = the counting number of pulses for one second of RQO or TQO / 1000 * the rated current * the rated voltage / 1000 [Unit: KW]

(3) Phase angle between each voltage input and each current input

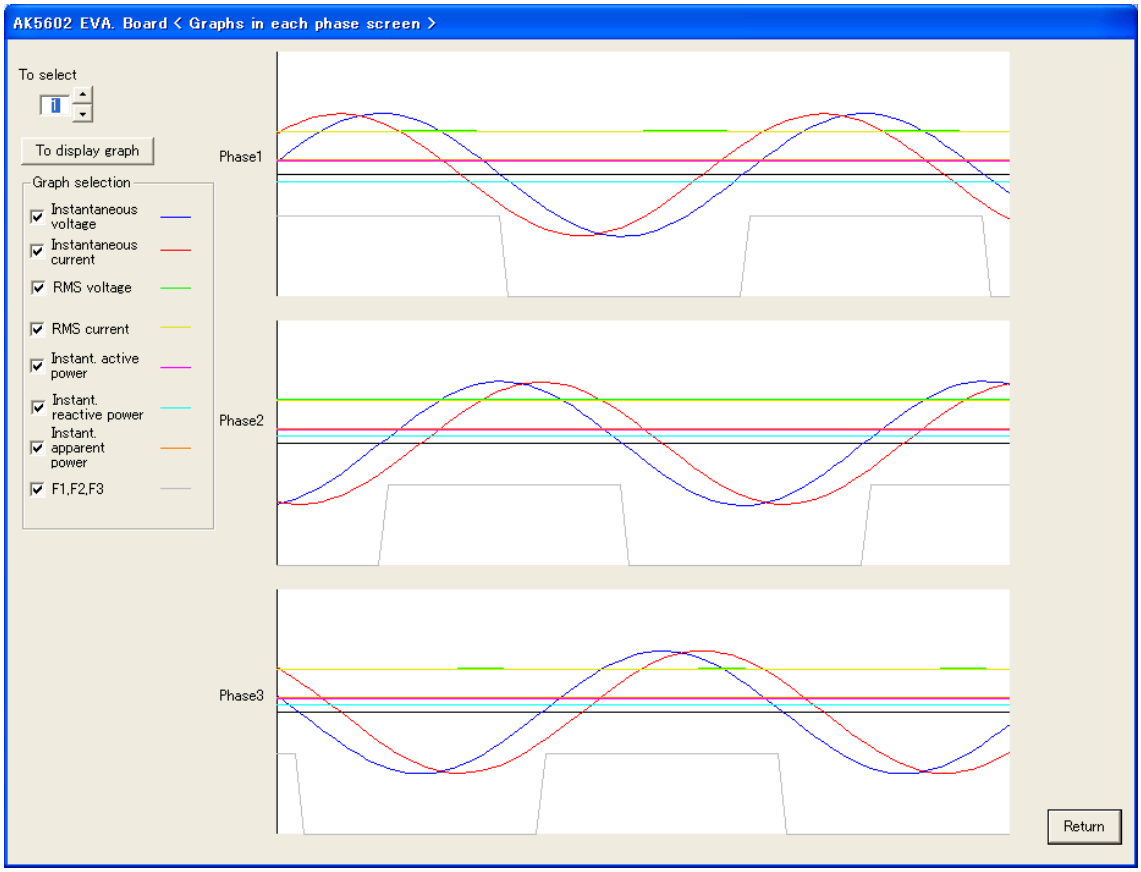
Phase angle n = COS^{-1} PFn (Arc-cosine PFn)

Here, if the polarity of reactive power (Most Significant Bit of Q1 value or Q2 value or Q3 value equals “1”) is negative, the phase angle n is represented in the negative value.

(4) The screen will jump to the “Measuring screen” when “Return” button is pressed.

5 – 8. Instantaneous waveforms of voltage, current and power display screen

Based on the acquired data by the "Measuring screen", the instantaneous value of each parameter per sample is plotted. The value to be plotted is the instantaneous voltage, instantaneous current, RMS voltage, RMS current, instantaneous active power, instantaneous reactive power, instantaneous apparent power, and Fn.



(1) Displaying data for one second to be selected from entered period can be specified by manipulating "UP/DOWN" button.

(2) Specified graph will be displayed on the screen when "To display graph" button is pressed.

(3) Graphs to be displayed are selected by checking the checking box of each graph. The following graphs can be selected.

- Instantaneous voltage graph
- Instantaneous current graph
- RMS voltage graph
- RMS current graph
- Instantaneous active power graph
- Instantaneous reactive power graph
- Instantaneous apparent power graph
- F1,F2,F3 frequency graph

(4) Instantaneous values of input1, input2, input3 are plotted on the screen.

(5) The screen will jump to the "Measuring screen" when "Return" button is pressed.

(6) Displaying graph of each parameter:

- Input1 instantaneous voltage value : 16 bit AD conversion value of V1AD
- Input1 instantaneous current value : 18 bit AD conversion value of I1AD
- Input1 RMS voltage value : 14 bit value of V1RMS
- Input1 RMS current value : 16 bit value of I1RMS
- Input1 instantaneous active power value : 20 bit value of P1 active power
- Input1 instantaneous reactive power value : 20 bit value of Q1 reactive power
- Input1 instantaneous apparent power value : 20 bit value of P1 RMS power

- Input1 F1 frequency : Digital waveform at F1 pin of the LSI
- Input2 instantaneous voltage value : 16 bit AD conversion value of V2AD
- Input2 instantaneous current value : 18 bit AD conversion value of I2AD
- Input2 RMS voltage value : 14 bit value of V2RMS
- Input2 RMS current value : 16 bit value of I2RMS
- Input2 instantaneous active power value : 20 bit value of P2 active power
- Input2 instantaneous reactive power value : 20 bit value of Q2 reactive power
- Input2 instantaneous apparent power value : 20 bit value of P2 RMS power
- Input2 F2 frequency : Digital waveform at F2 pin of the LSI
- Input3 instantaneous voltage value : 16 bit AD conversion value of V3AD
- Input3 instantaneous current value : 18 bit AD conversion value of I3AD
- Input3 RMS voltage value : 14 bit value of V3RMS
- Input3 RMS current value : 16 bit value of I3RMS
- Input3 instantaneous active power value : 20 bit value of P3 active power
- Input3 instantaneous reactive power value : 20 bit value of Q3 reactive power
- Input3 instantaneous apparent power value : 20 bit value of P3 RMS power
- Input1 F3 frequency : Digital waveform at F3 pin of the LSI

6. Jumper Pins Function Table

JP#	Function	Reference
1	Voltage Input 1 resistor selection (inline 400kΩ)	Open when connected to the high voltage power line directly.
2	Voltage Input 1 resistor selection (pull down 1kΩ)	Short when connected to the high voltage power line directly.
3	DVSS-AVSS connection	Normally open
4	Voltage Input 2 resistor selection (inline 400kΩ)	Open when connected to the high voltage power line directly.
5	Voltage Input 2 resistor selection (pull down 1kΩ)	Short when connected to the high voltage power line directly.
6	Voltage Input 3 resistor selection (inline 400kΩ)	Open when connected to the high voltage power line directly.
7	Voltage Input 3 resistor selection (pull down 1kΩ)	Short when connected to the high voltage power line directly.
8	Current positive input 1 resistor selection (75Ω)	Short when CT load is 150Ω.
9	Current positive input 1 resistor selection (22Ω)	Short when CT load is 44Ω.
10	Current negative input 1 resistor selection (75Ω)	Short when CT load is 150Ω.
11	Current negative input 1 resistor selection (22Ω)	Short when CT load is 44Ω.
12	VREFI selection	Normally internal VREF.
13	Current positive input 2 resistor selection (75Ω)	Short when CT load is 150Ω.
14	Current positive input 2 resistor selection (22Ω)	Short when CT load is 44Ω.
15	Current negative input 2 resistor selection (75Ω)	Short when CT load is 150Ω.
16	Current negative input 2 resistor selection (22Ω)	Short when CT load is 44Ω.
17	Current positive input 3 resistor selection (75Ω)	Short when CT load is 150Ω.
18	Current positive input 3 resistor selection (22Ω)	Short when CT load is 44Ω.
19	Current negative input 3 resistor selection (75Ω)	Short when CT load is 150Ω.
20	Current negative input 3 resistor selection (22Ω)	Short when CT load is 44Ω.
21	PWR1-PWR2(+5V) connection	Normally open.
22	DGND(PC)-DVSS(AK5602A) connection	Normally open.
23	DGND(PC)-DVSS(AK5602A) connection	Normally open.
24	For debugging use	Normally open.
25	Operation by USB Vbus power	Normally open.

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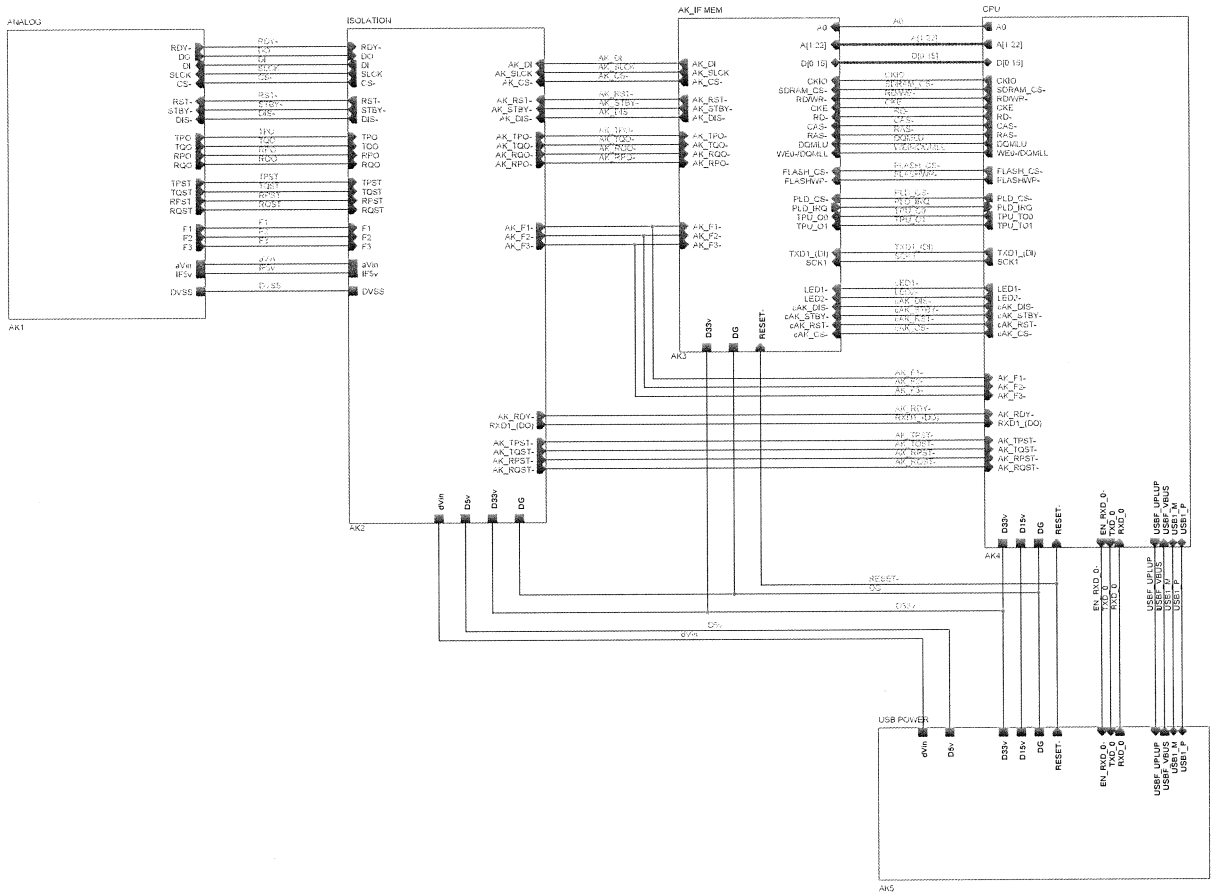
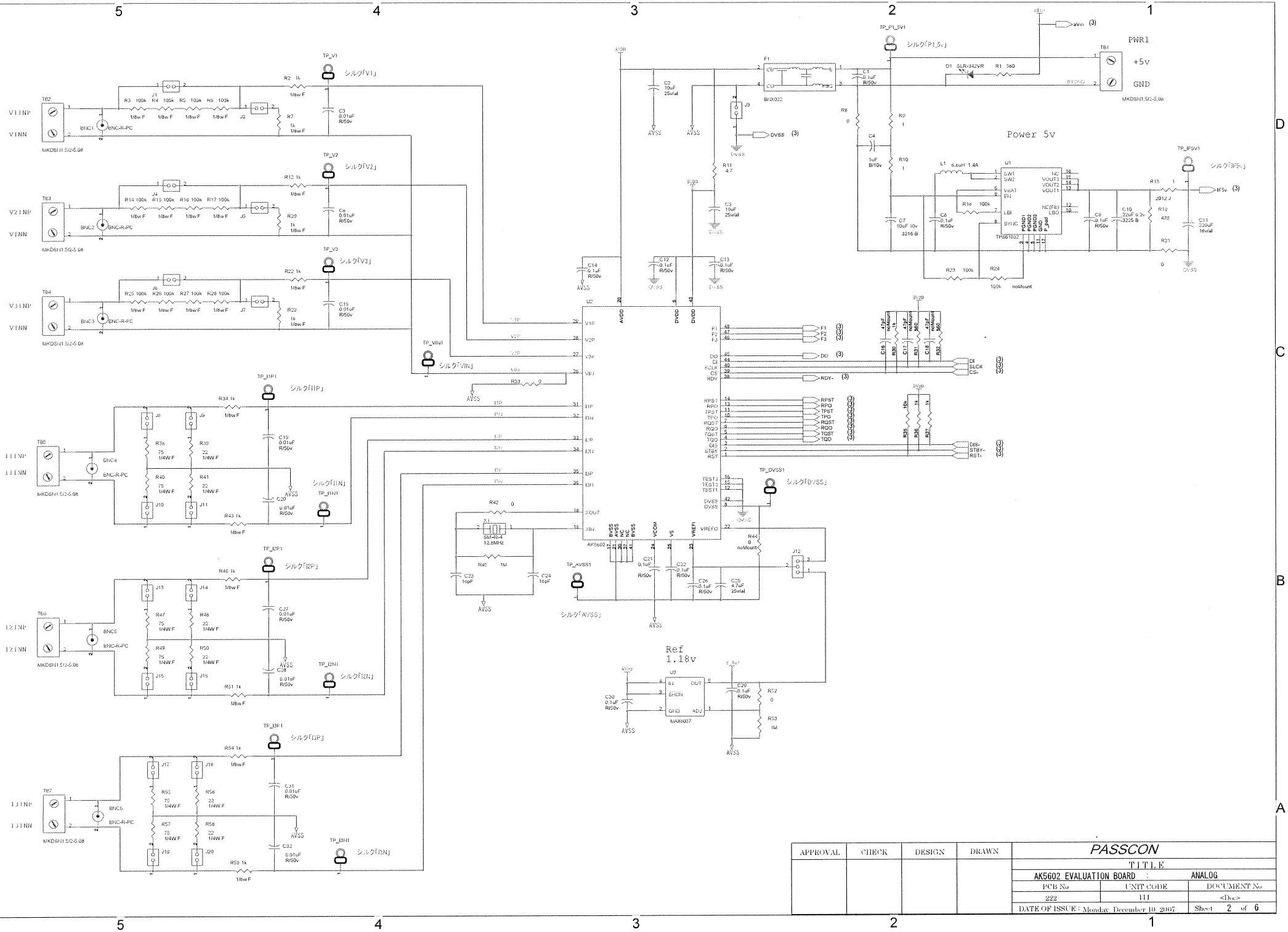
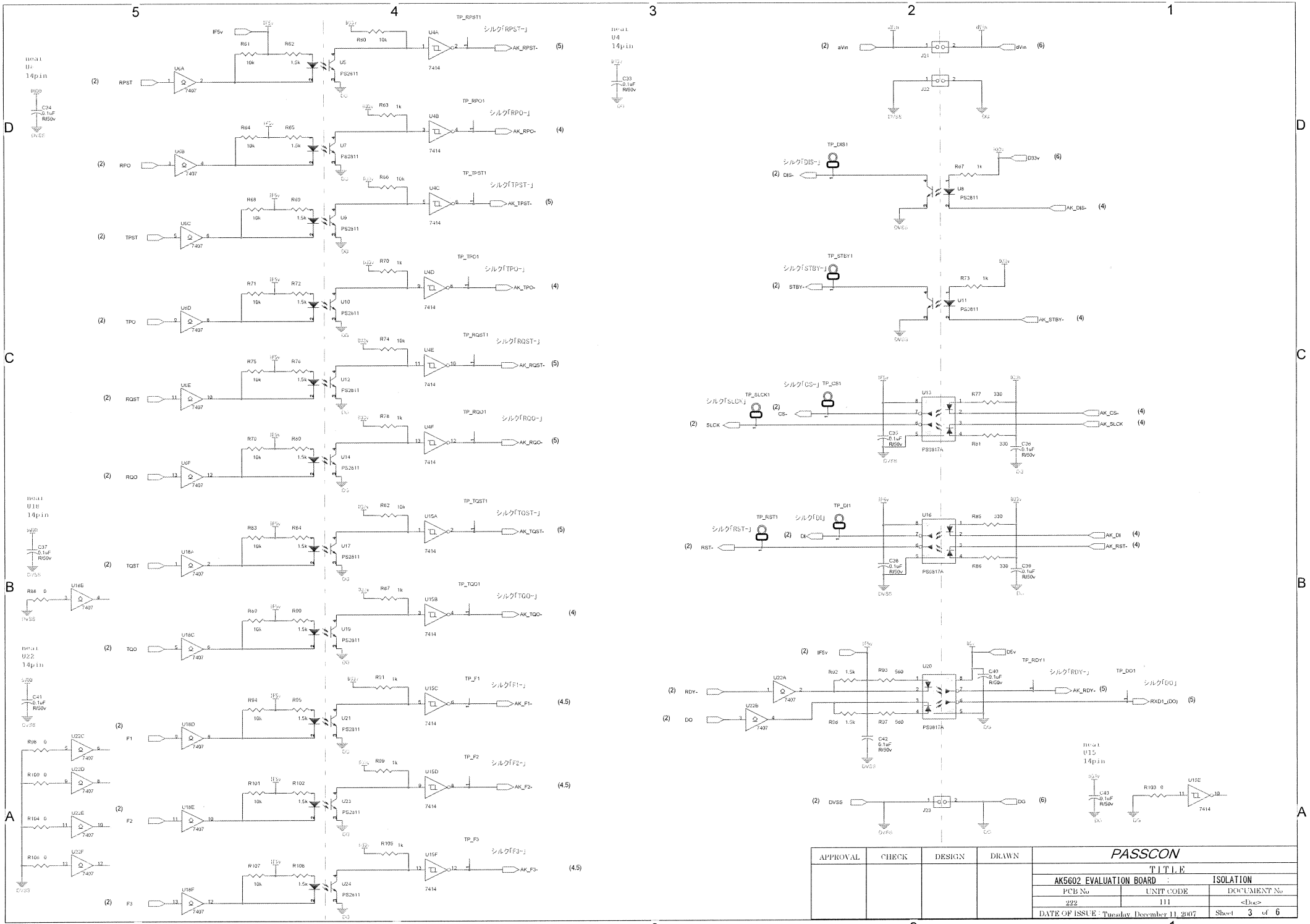


APPROVAL	CHECK	DESIGN	DRAWN	PASSCON
				TITLE
				AK5602 EVALUATION BOARD : BLOCK
				PCB No: 222 / UNIT CODE: 111 / DOCUMENT No: <Doc>
				DATE OF ISSUE : Friday, November 16, 2007 / Sheet 1 of 6


PWR1
+5v
GND
Power 5v
Ref
1.18v
AK5602
TP_V1
TP_V2
TP_V3
TP_VIN1
TP_I1P1
TP_I2P1
TP_I3P1
TP_I1N1
TP_I2N1
TP_I3N1
TP_AVSS1
TP_DVSS1
TP_P1_5V1
TP_IF5V1
シルク「V1」
シルク「V2」
シルク「V3」
シルク「VIN」
シルク「I1P」
シルク「I2P」
シルク「I3P」
シルク「I1N」
シルク「I2N」
シルク「I3N」
シルク「AVSS」
シルク「DVSS」
シルク「P1_5V」
シルク「IF5V」
V1INP
V1INN
V2INP
V2INN
V3INP
V3INN
I1INP
I1INN
I2INP
I2INN
I3INP
I3INN
MKDSN1.5/2-5.08
BNC-R-PC
BRX022
TPS61032
MAX6037
SM-48-4
12.8MHz
AVDD
DVDD
AVSS
DVSS
IF5v
aVin
RPST
RPQ
TPST
TPQ
RQST
RQO
TQST
TQO
DIS
STBY
RST
DI
SCLK
CS-
RDY-
F1
F2
F3
DO
PASSCON
APPROVAL
CHECK
DESIGN
DRAWN
TITLE
AK5602 EVALUATION BOARD : ANALOG
PCB No
222
UNIT CODE
111
DOCUMENT No
<Doc>
DATE OF ISSUE : Monday, December 10, 2007
Sheet 2 of 6



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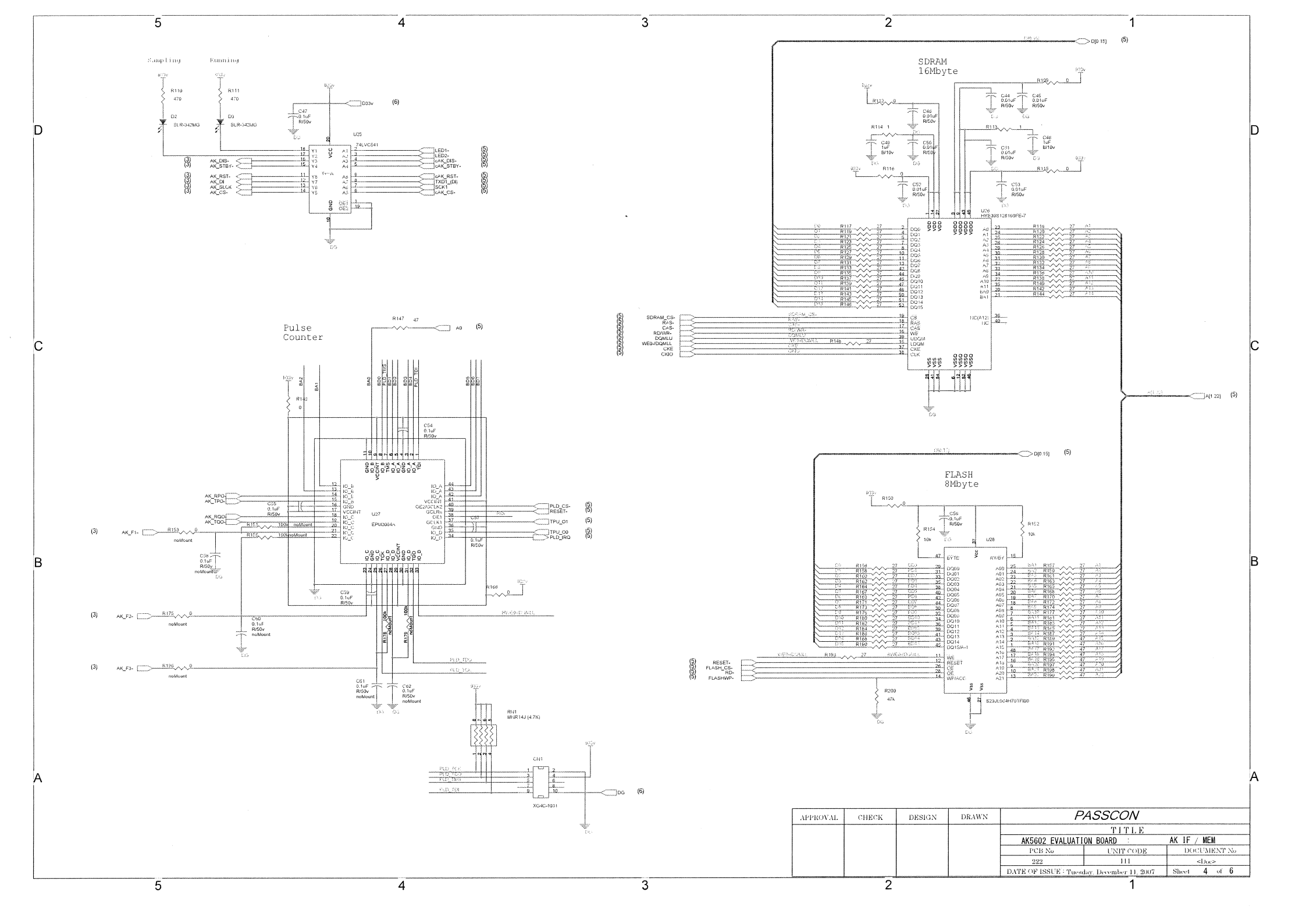
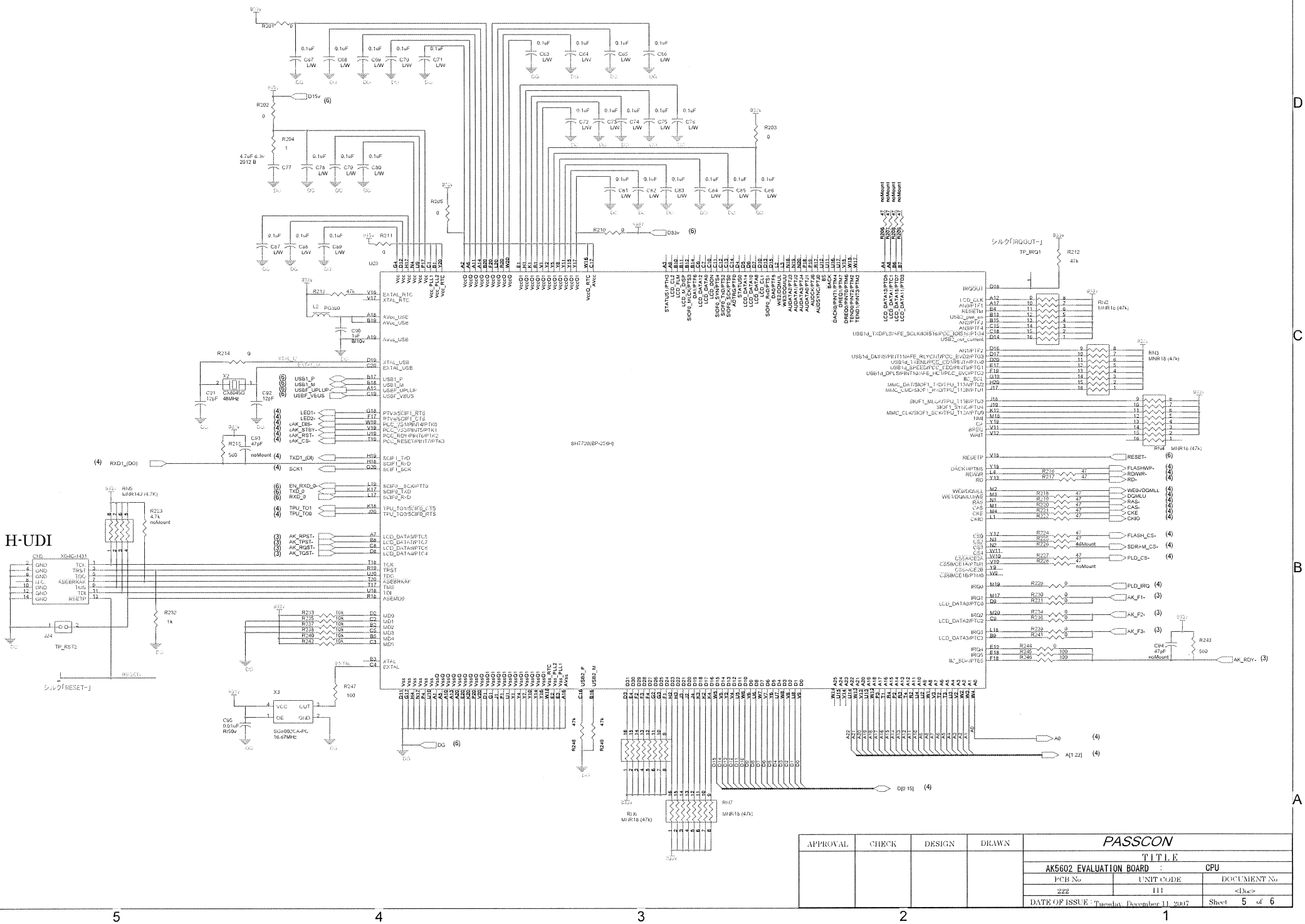
				PCB No: 222 / UNIT CODE: 111 / DOCUMENT No: <Doc>
				DATE OF ISSUE : Tuesday, December 11, 2007 / Sheet 3 of 6


Sampling
Running
SDRAM
16Mbyte
FLASH
8Mbyte
Pulse
Counter
74LVC541
EPM2064A
HYE39S128160FE-7
S29JL064H70TFI00
XGHC-1031
MHR14J (4.7K)
AK5602 EVALUATION BOARD : AK IF / MEM
PASSCON
APPROVAL
CHECK
DESIGN
DRAWN
TITLE
PCB No 222
UNIT CODE 111
DOCUMENT No <Doc>
DATE OF ISSUE : Tuesday, December 11, 2007
Sheet 4 of 6


H-UDI
SH7720(BP-256H)
TP_RST2
シルク(RESET-)
シルク(IRQOUT-)
AK5602 EVALUATION BOARD : CPU
PASSCON
APPROVAL
CHECK
DESIGN
DRAWN
PCB No 222
UNIT CODE 111
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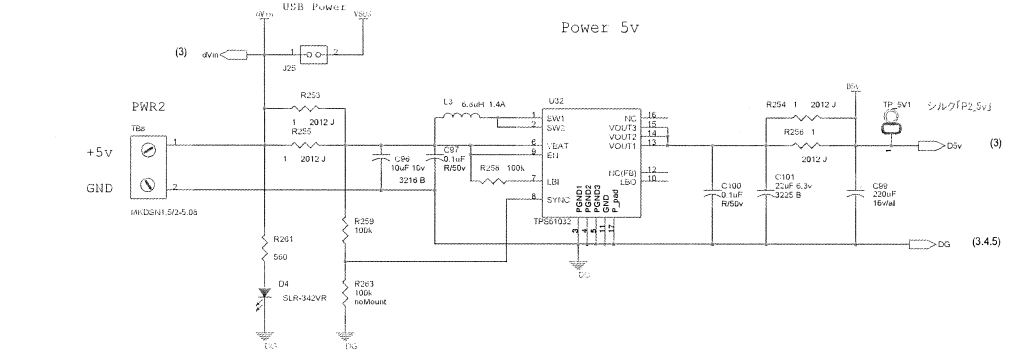
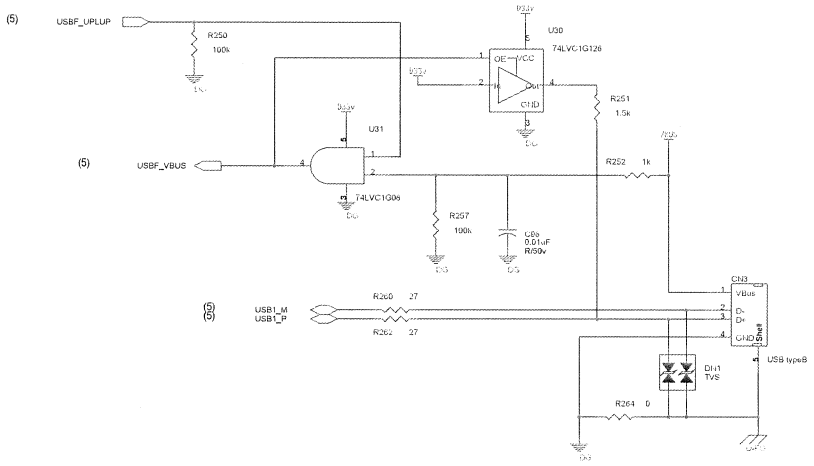
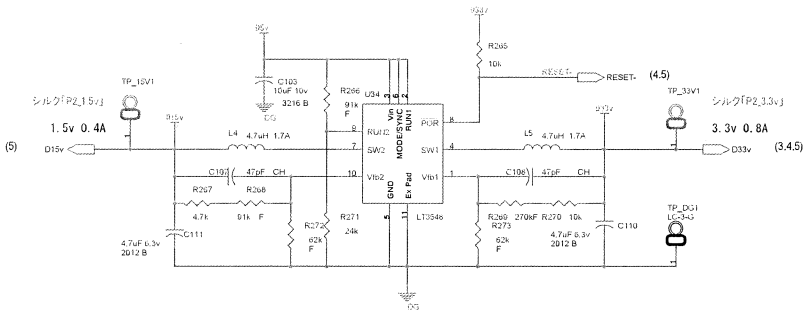
Power 5v



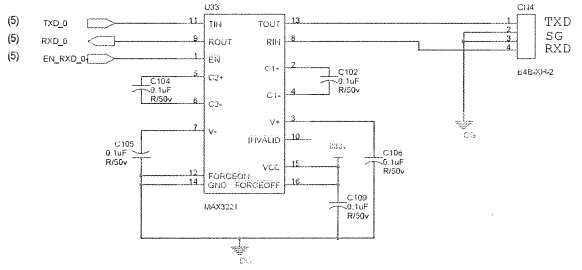
USB I/F



Power 3.3v 1.5v



RS232C(for Debug)



APPROVAL	CHECK	DESIGN	DRAWN	PASSCON	
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				AK5602 EVALUATION BOARD :	USB / POWER
				PCB No	UNIT CODE / DOCUMENT No
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				DATE OF ISSUE : Tuesday, December 11, 2007	Sheet 6 of 6