



**SMARTLAB**  
**USB 16 CHANNELS PHOTO**  
**ISOLATOR INPUT/OUTPUT BOARD**

**OPERATION MANUAL**



**Decision Group Inc.**



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## CHAPTER 1

### INTRODUCTION

The USB 16 channels photo isolator input/output board provides 16 photo couple digital input/output channels, which allow the input/output signals to be completely floated and prevent the ground loop.

The USB 16 channels photo isolator input/output board provides Plug and Play (PnP) features, it is a programmable I/O interface board for PC/486, Pentium, or compatibles. The on board high speed 8051 uC provides USB functions run at 12Mbps full speed or 1.5Mbps low speed.

❖ **The features of USB 16 channels photo isolator input/output board are:**

- USB 2.0with Plug and Play (PnP) features.
- High speed 8051 uC core.
- Support USB ID selection to identify USB device.
- Support 16 photo couple input/output channels.
- Allow the photo input/output signals to be completely floated and prevent the ground loops.
- 32 LED correspond to 16 input and 16 output ports activation status.
- By using PC817 photo couple chips.
- Power supplied from external DC +5V.
- 5000V isolation voltage.
- 



- Output voltage :  $V_{cd} = 35V$ ,  $V_{ec} = 6V$ , and maximum collector current is 50mA. (Maximum current restrict below 30mA.)
- Output voltage range from 0V to 30V, where 0 to 4V is OFF and 5V to 30V is ON.
- Maximum load voltage is 30V.
- Maximum 50mA forward input current.
- Input voltage range from 0V to 30V.
- Activation voltage of photo input:
  - When short jumpers (input range from 0 to 20V DC)
    - 0 to 3.3V inactive
    - 4.5 to 20V active
  - When open jumpers (input range from 0 to 30V DC)
    - 0 to 17.6V inactive
    - 18 to 30V active
- Suitable for Linux, MS/Windows ... etc.
- Operating temperature range from 0 to 55° C.
- Relative humidity rage from 0 to 90%.

❖ **PACKAGE CONTENTS:**

- SMARTLAB USB 16 channels photo isolator input/output board.
  - USB cable.
  - Decision Studio and User's manual CD.
  - Two Different Connector Types can be selected:
    - Standard: European P.C.B type terminal blocks
    - Professional: Pluggable terminal blocks
- Optional
- Extension board with DB9 : RS232 or RS422/485
  - PCB Carrier

## CHAPTER 2

# HARDWARE CONFIGURATION

Before you use the USB 16 channels photo couple input/output board, Please ensure that the jumpers and switches setting. The proper jumper and switches settings for the 16 channels photo couple input/output adapter are described in the following.

### 2.1 Switch Settings

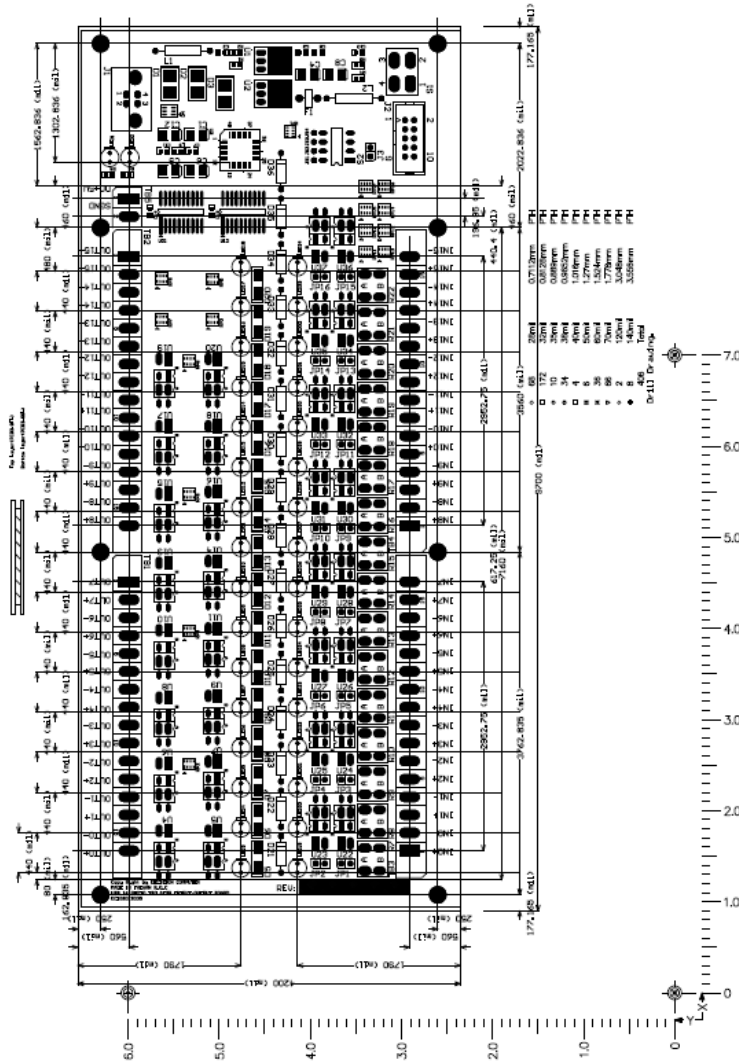
1. S1 Reset



The S1 switch is used to reset 8051, the signal assignments are shown in the following.

Pin	Signals
3,4	Reset SW+
1,2	Reset SW-

2. S2 USB ID





The S2 switch is used to identify USB board ID. Please set different board ID to each board (do not duplicate board ID setting).

1	2	3	4	ID
ON	ON	ON	ON	--
OFF	ON	ON	ON	14
ON	OFF	ON	ON	13
OFF	OFF	ON	ON	12
ON	ON	OFF	ON	11
OFF	ON	OFF	ON	10
ON	OFF	OFF	ON	9
OFF	OFF	OFF	ON	8
ON	ON	ON	OFF	7
OFF	ON	ON	OFF	6
ON	OFF	ON	OFF	5
OFF	OFF	ON	OFF	4
ON	ON	OFF	OFF	3
OFF	ON	OFF	OFF	2
ON	OFF	OFF	OFF	1
OFF	OFF	OFF	OFF	0

### 3. Down load revised firmware

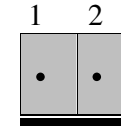
When the S2 switch is set to ON ON ON ON status, means down load revised firmware. please follow the steps shown in the following:

1. Set S2 to ON ON ON ON.
2. Run USBBootloader program to down load revised firmware.



## 2.2 Jumper Settings

Input Voltage Range Selection (JP1 to JP16)



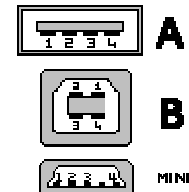
JP1 to JP16 are used to select input voltage range. The JP1 is used to select photo couple input channel 0, and JP2 is used to select photo couple input channel 1, ... etc. When short the jumper, the input voltage range from 0 to 20V, and the active voltage form 4.5 to 20V. When open the jumper, the input voltage range from 0 to 30V, and the active voltage from 18 to 30V.

Jumper	Input Voltage	Inactive Voltage	Active Voltage
open	0 to 30V	0 to 17.6V	18 to 30V
short	0 to 20V	0 to 3.3V	4.5 to 20V

## 2.3 USB Connector

1. USB Connector

The USB connector is connected to computer USB port by using USB cable.



## 2.4 LED Status

1. LED1

The LED1 is an indicator to show the power is supplied normally.

2. LED2

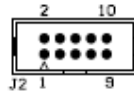


The LED2 is an indicator to warning the USB link status. When it lights, it means USB connection works normally, otherwise it is fail.

### 2.5 Connector and Jumper for Serial Communication

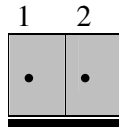
If there isn't a 2x5 header on the board, it means this version doesn't support for serial communication.

1. The connector of serial communication(J2)



To use RS422/RS485/RS232, please connect J2 to extension board by 10 pins flat cable. (Optional)

2. Enable Serial Port (J3)



J3 is used enable serial port communication, when short the J3, means enable serial port, otherwise, when open the J3, the serial port communication is disable.



### 2.6 Connector Assignments

The photo isolator input signal and output signal pin assignments are shown in the below.

#### 1. Input Signal Assignments

Pin	Signal	Description
1	IN-00+	Opto-isolator Ch. 00 + Input
2	IN-00-	Opto-isolator Ch. 00 - Input
3	IN-01+	Opto-isolator Ch. 01 + Input
4	IN-01-	Opto-isolator Ch. 01 - Input
5	IN-02+	Opto-isolator Ch. 02 + Input
6	IN-02-	Opto-isolator Ch. 02 - Input
7	IN-03+	Opto-isolator Ch. 03 + Input
8	IN-03-	Opto-isolator Ch. 03 - Input
9	IN-04+	Opto-isolator Ch. 04 + Input
10	IN-04-	Opto-isolator Ch. 04 - Input
11	IN-05+	Opto-isolator Ch. 05 + Input
12	IN-05-	Opto-isolator Ch. 05 - Input
13	IN-06+	Opto-isolator Ch. 06 + Input
14	IN-06-	Opto-isolator Ch. 06 - Input
15	IN-07+	Opto-isolator Ch. 07 + Input
16	IN-07-	Opto-isolator Ch. 07 - Input

Pin	Signal	Description
1	IN-08+	Opto-isolator Ch. 08 + Input
2	IN-08-	Opto-isolator Ch. 08 - Input
3	IN-09+	Opto-isolator Ch. 09 + Input
4	IN-09-	Opto-isolator Ch. 09 - Input
5	IN-10+	Opto-isolator Ch. 10 + Input
6	IN-10-	Opto-isolator Ch. 10 - Input



7	IN-11+	Opto-isolator Ch. 11 + Input
8	IN-11-	Opto-isolator Ch. 11 - Input
9	IN-12+	Opto-isolator Ch. 12 + Input
10	IN-12-	Opto-isolator Ch. 12 - Input
11	IN-13+	Opto-isolator Ch. 13 + Input
12	IN-13-	Opto-isolator Ch. 13 - Input
13	IN-14+	Opto-isolator Ch. 14 + Input
14	IN-14-	Opto-isolator Ch. 14 - Input
15	IN-15+	Opto-isolator Ch. 15 + Input
16	IN-15-	Opto-isolator Ch. 15 - Input

**2. Output Signal Assignments**

Pin	Signal	Description
1	OUT-00+	Opto-isolator Ch. 00 + Output
2	OUT-00-	Opto-isolator Ch. 00 - Output
3	OUT-01+	Opto-isolator Ch. 01 + Output
4	OUT-01-	Opto-isolator Ch. 01 - Output
5	OUT-02+	Opto-isolator Ch. 02 + Output
6	OUT-02-	Opto-isolator Ch. 02 - Output
7	OUT-03+	Opto-isolator Ch. 03 + Output
8	OUT-03-	Opto-isolator Ch. 03 - Output
9	OUT-04+	Opto-isolator Ch. 04 + Output
10	OUT-04-	Opto-isolator Ch. 04 - Output
11	OUT-05+	Opto-isolator Ch. 05 + Output
12	OUT-05-	Opto-isolator Ch. 05 - Output
13	OUT-06+	Opto-isolator Ch. 06 + Output
14	OUT-06-	Opto-isolator Ch. 06 - Output
15	OUT-07+	Opto-isolator Ch. 07 + Output
16	OUT-07-	Opto-isolator Ch. 07 - Output



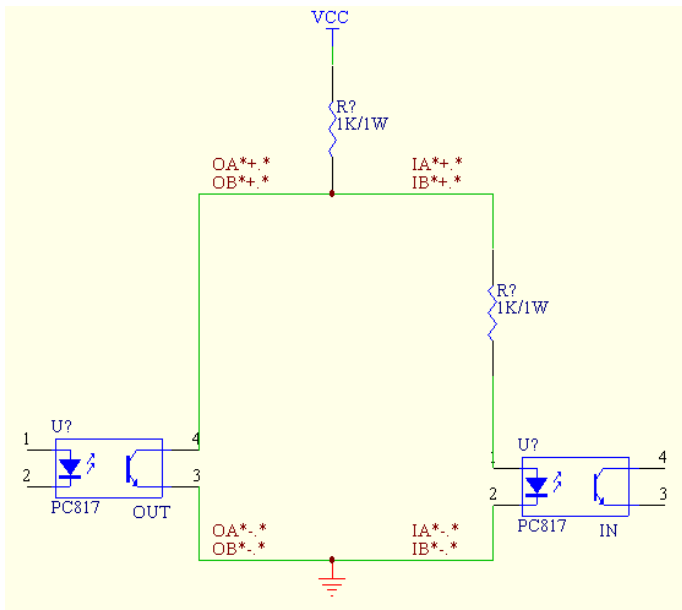
Pin	Signal	Description
1	OUT-08+	Opto-isolator Ch. 08 + Output
2	OUT-08-	Opto-isolator Ch. 08 - Output
3	OUT-09+	Opto-isolator Ch. 09 + Output
4	OUT-09-	Opto-isolator Ch. 09 - Output
5	OUT-10+	Opto-isolator Ch. 10 + Output
6	OUT-10-	Opto-isolator Ch. 10 - Output
7	OUT-11+	Opto-isolator Ch. 11 + Output
8	OUT-11-	Opto-isolator Ch. 11 - Output
9	OUT-12+	Opto-isolator Ch. 12 + Output
10	OUT-12-	Opto-isolator Ch. 12 - Output
11	OUT-13+	Opto-isolator Ch. 13 + Output
12	OUT-13-	Opto-isolator Ch. 13 - Output
13	OUT-14+	Opto-isolator Ch. 14 + Output
14	OUT-14-	Opto-isolator Ch. 14 - Output
15	OUT-15+	Opto-isolator Ch. 15 + Output
16	OUT-15-	Opto-isolator Ch. 15 - Output



2.7 Loopback Diagnostic

To test your 16 channel photo isolator input/output board, we recommend you use loopback circuit shown in below. Where IA\*+ means input channel+ and IA\*- means input channel-, OA\*+ means output channel+ and OA\*- means output channel-. \* means channel number. Please note that, if you use IA2+, you must connect its pair IA2- ...,otherwise if may short the circuit.

In this experiment, if VCC larger than 10V, then it input HIGH to input channel, otherwise it input LOW; your program can get this digital signal easily. If no VCC voltage input, the output channel will be loopback to input channel, it means when output HIGH then input channel get HIGH, when output LOW then input channel get LOW.



CHAPTER 3

**DIAGNOSTIC UNDER WINDOWS**

USB Test Program.exe is a diagnostic program to test your USB devices under Windows/XP.

User can get USB Test Program.exe programs from Decision Studio CD.

CHAPTER 4

**SOFTWARE PROGRAMMING UNDER  
WINDOWS AND LINUX**

Under Windows, we provide function library and dll file for users to program the device in supported language. You can find manual “USBDI1\_Manual.pdf” and demo code in VB/VC/Delphi from Decision Studio CD.

Under Linux, we provide C source to allow user directly to access device. You can find manual and example in “dcihid-0.5.2.tgz”.



## APPENDIX A

### WARRANTY INFORMATION

#### A.1 Copyright

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Corporate licensing agreements allow duplication and distribution of specific number of copies within the licensed institution. Duplication of multiple copies is not allowed except through execution of a licensing agreement. Welcome call for details.

#### A.2 Warranty Information

SmartLab warrants that for a period of one year from the date of purchase (unless otherwise specified in the warranty card) that the goods supplied will perform according to the specifications defined in the user manual. Furthermore that the SmartLab product will be supplied free from defects



in materials and workmanship and be fully functional under normal usage.

In the event of the failure of a SmartLab product within the specified warranty period, SmartLab will, at its option, replace or repair the item at no additional charge. This limited warranty does not cover damage resulting from incorrect use, electrical interference, accident, or modification of the product.

All goods returned for warranty repair must have the serial number intact. Goods without serial numbers attached will not be covered by the warranty.

The purchaser must pay transportation costs for goods returned. Repaired goods will be dispatched at the expense of SmartLab.

To ensure that your SmartLab product is covered by the warranty provisions, it is necessary that you return the Warranty card.

Under this Limited Warranty, SmartLab's obligations will be limited to repair or replacement only, of goods found to be defective a specified above during the warranty period. SmartLab is not liable to the purchaser for any damages or losses of any kind, through the use of, or inability to use, the SmartLab product. SmartLab reserves the right to determine what constitutes warranty repair or replacement.

Return Authorization: It is necessary that any returned goods are clearly marked with an RA number that has been issued by SmartLab. Goods returned without this authorization will not be attended to.





**APPENDIX B**  
**DATA SHEET**

**SHARP**

PC817 Series

**PC817 Series**

- Lead forming type (I type) and taping reel type (P type) are also available. (PC817/PC817P)
- TUV (VDE0884) approved type is also available as an option.

■ Features

1. Current transfer ratio  
(CTR: MIN. 50% at  $I_F = 5\text{mA}$ ,  $V_{CE} = 5\text{V}$ )
2. High isolation voltage between input and output ( $V_{iso} : 5000\text{V}$ )
3. Compact dual-in-line package  
PC817 : 1-channel type  
PC827 : 2-channel type  
PC837 : 3-channel type  
PC847 : 4-channel type
4. Recognized by UL, file No. E64380

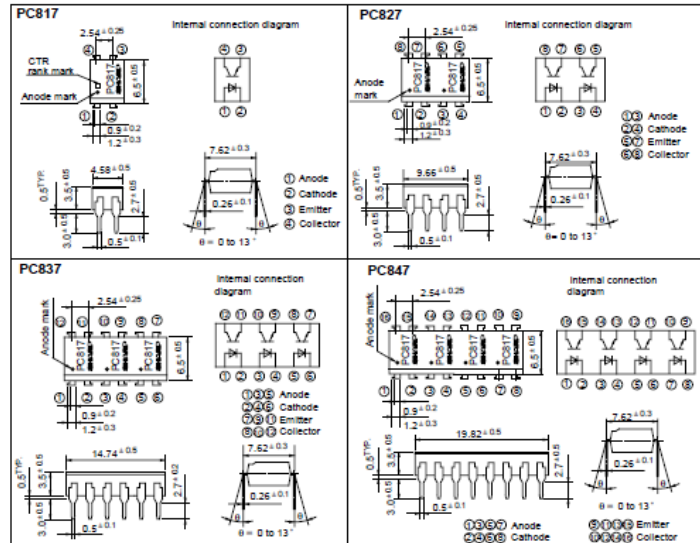
■ Outline Dimensions

(Unit : mm)

**High Density Mounting Type  
Photocoupler**

■ Applications

1. Computer terminals
2. System appliances, measuring instruments
3. Registers, copiers, automatic vending machines
4. Electric home appliances, such as fan heaters, etc.
5. Signal transmission between circuits of different potentials and impedances



In the absence of confirmation by device specification sheets, SHARP takes no responsibility for any defects that occur in equipment using any of SHARP's devices, shown in catalogs, data books, etc. Contact SHARP in order to obtain the latest version of the device specification sheets before using any SHARP's device.

**SHARP**

PC817 Series

■ Absolute Maximum Ratings

( $T_a = 25^\circ\text{C}$ )

Parameter	Symbol	Rating	Unit
Forward current	$I_F$	50	mA
*Peak forward current	$I_{FM}$	1	A
Reverse voltage	$V_R$	6	V
Power dissipation	P	70	mW
Collector-emitter voltage	$V_{CEO}$	35	V
Emitter-collector voltage	$V_{ECO}$	6	V
Collector current	$I_C$	50	mA
Collector power dissipation	$P_C$	150	mW
Total power dissipation	$P_{tot}$	200	mW
*Isolation voltage	$V_{iso}$	5 000	$V_{rms}$
Operating temperature	$T_{op}$	-30 to +100	$^\circ\text{C}$
Storage temperature	$T_{stg}$	-55 to +125	$^\circ\text{C}$
*Soldering temperature	$T_{st}$	260	$^\circ\text{C}$

- \*1 Pulse width=100 $\mu\text{s}$ , Duty ratio : 0.001
- \*2 40 to 60% RH, AC for 1 minute
- \*3 For 10 seconds

■ Electro-optical Characteristics

( $T_a = 25^\circ\text{C}$ )

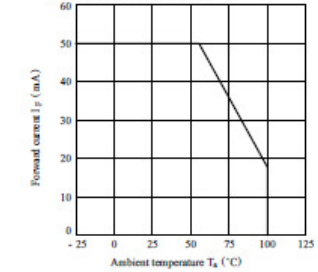
Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Forward voltage	$V_F$	$I_F = 20\text{mA}$	-	1.2	1.4	V
Peak forward voltage	$V_{FM}$	$I_{FM} = 0.5\text{A}$	-	-	3.0	V
Reverse current	$I_R$	$V_R = 4\text{V}$	-	-	10	$\mu\text{A}$
Terminal capacitance	$C_T$	$V = 0, f = 1\text{kHz}$	-	30	250	pF
Collector dark current	$I_{CDO}$	$V_{CE} = 20\text{V}$	-	-	$10^{-7}$	A
*Current transfer ratio	CTR	$I_F = 5\text{mA}, V_{CE} = 5\text{V}$	50	-	600	%
Collector-emitter saturation voltage	$V_{CE(sat)}$	$I_F = 20\text{mA}, I_C = 1\text{mA}$	-	0.1	0.2	V
Isolation resistance	$R_{iso}$	DC500V, 40 to 60%RH	$5 \times 10^{10}$	$10^{11}$	-	$\Omega$
Floating capacitance	$C_f$	$V = 0, f = 1\text{MHz}$	-	0.6	1.0	pF
Cut-off frequency	$f_c$	$V_{CE} = 5\text{V}, I_C = 2\text{mA}, R_L = 100\Omega, -3\text{dB}$	-	80	-	kHz
Response time	Rise time	$V_{CE} = 2\text{V}, I_C = 2\text{mA}, R_L = 100\Omega$	-	4	18	$\mu\text{s}$
	Fall time		-	3	18	$\mu\text{s}$

\*4 Classification table of current transfer ratio is shown below.

Model No.	Rank mark	CTR (%)
PC817A	A	80 to 160
PC817B	B	130 to 260
PC817C	C	200 to 400
PC817D	D	300 to 600
PC8#7AB	A or B	80 to 260
PC8#7BC	B or C	130 to 400
PC8#7CD	C or D	200 to 600
PC8#7AC	A, B or C	80 to 400
PC8#7BD	B, C or D	130 to 600
PC8#7AD	A, B, C or D	80 to 600
PC8#7	A, B, C, D or No mark	50 to 600

● : 1 or 2 or 3 or 4

Fig. 1 Forward Current vs. Ambient Temperature





SHARP

PC817 Series

Fig. 2 Collector Power Dissipation vs. Ambient Temperature

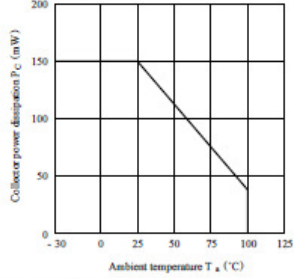


Fig. 3 Peak Forward Current vs. Duty Ratio

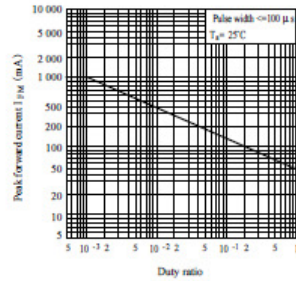


Fig. 4 Current Transfer Ratio vs. Forward Current

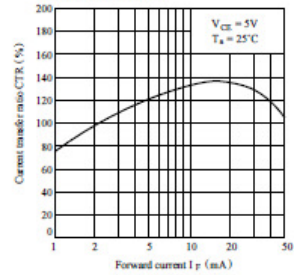


Fig. 5 Forward Current vs. Forward Voltage

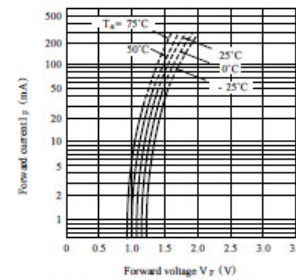


Fig. 6 Collector Current vs. Collector-emitter Voltage

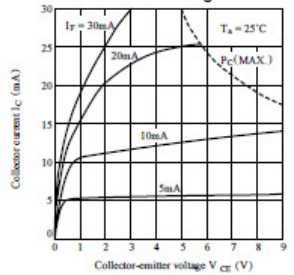
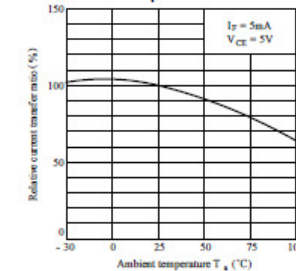


Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature



SHARP

PC817 Series

Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

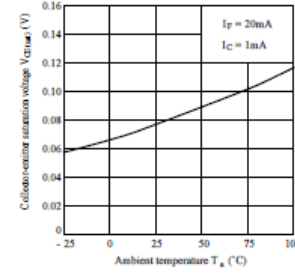


Fig. 9 Collector Dark Current vs. Ambient Temperature

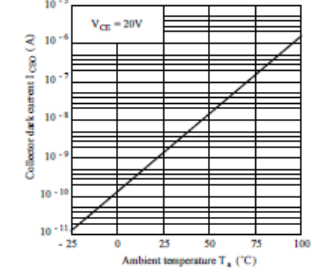


Fig.10 Response Time vs. Load Resistance

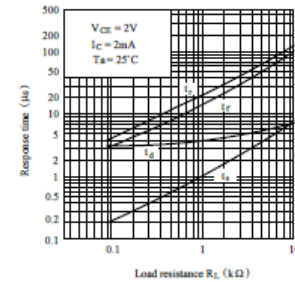
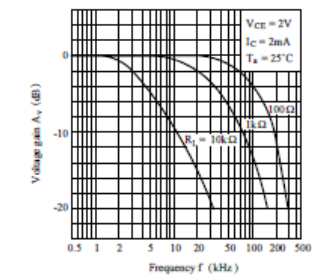
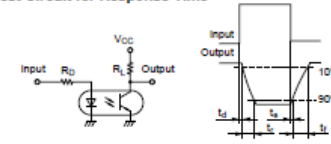


Fig.11 Frequency Response



Test Circuit for Response Time



Test Circuit for Frequency Response

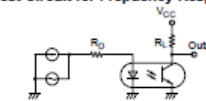
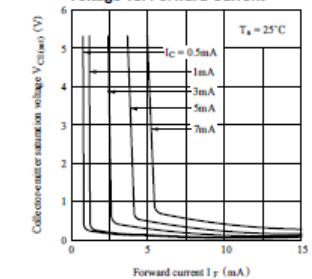


Fig.12 Collector-emitter Saturation Voltage vs. Forward Current



● Please refer to the chapter "Precautions for Use"



### APPENDIX C

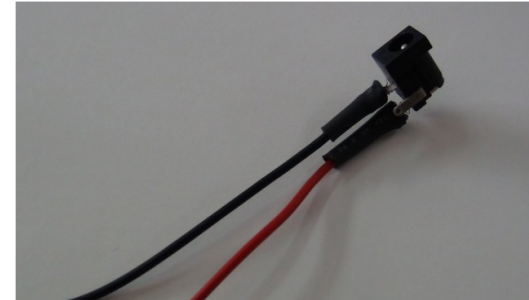
#### External Power Installation

*\*\*Optional for Decision Group USB I/O series of items  
\*\* The materials of the external power for Decision Group  
USB I/O series items are customer-self-supplied or optional  
purchase, they are not covered in the standard package of  
Decision Group USB I/O series items.*

#### 1. The Materials of the external power (customer-self-supplied)



*\* 5V / 1A AC adapter (Power plug type is subject to the  
different varieties in different country.).*



\* AC power cord



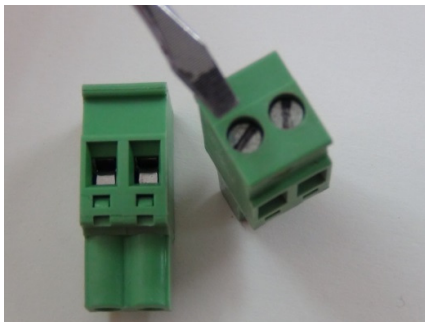


## 2. Terminal blocks built-in on Decision Group USB I/O series of Items:

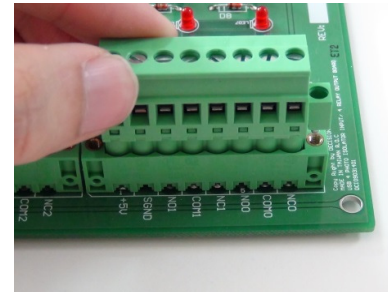


e.g. PCB pluggable terminal blocks. (for PRO type only)

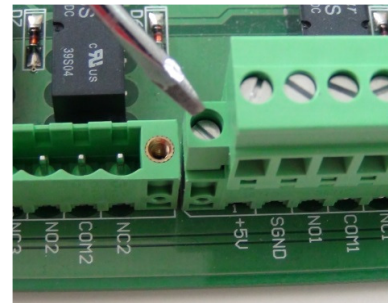
## 3. External Power Installation procedure:



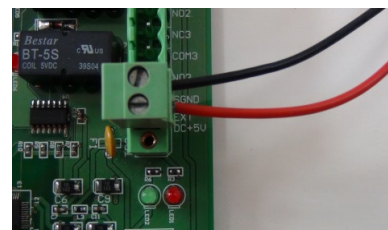
To tight / loose the terminal with a minus screwdriver.



Plug the terminal blocks into the socket. (PRO type only)

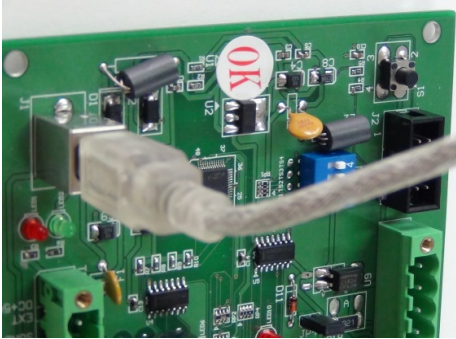


Fasten both sides of the screws (PRO type only)

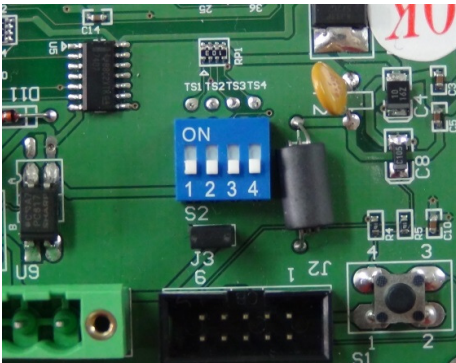


Attach the **black** cord to the SGND and the **red** cord to the **EXT DC+5V.**, as well as the signals cords





Connect your device to the computer with a USB cable



To confirm all the switches and jumper setting are correct in compliance

