Development Guide for DCT_100 Basic I/O Board V1.0

May,2013

Amp Display Inc.

1   General Information

DCT_100 I/O extension Device is designed for expand the functionalities of DGUS LCM. Seamless working with host device -DGUS LCM, a mid-small industrial automation system which is highly reliable and high cost effective can be easily built-up.

The typical features of DCT_100:

◇   On-board DC/DC converter, support DC 7-42V power input.

Powering DCT_100 with 24V, the current of entire DCT_100 is less than 10mA.

◇   4-way 0-5V/0-20mA unfenced analog input, with accuracy of ±1mV.

◇   8-way dry contact, 3.3V TTL / 5V TTL compatible, voltage or pulse input, the minimum pulse width is 10ms.

◇   8-way optical isolated 24V TTL voltage / pulse input, the minimum pulse width is 10ms.

◇   8-way optical isolated Open Collector Gate output.

◇   4-way unfenced, 16-bit PWM output, max output current of one way is 1A.

◇   A RS232 interface, the fixed value of baud rate is 115200bps.

◇   A RS485 interface baud rate ranges from 4800bps to 691200bps.

◇   8 16-bit software timers, 4 32-bit software timers, 4 32-bit BCD format counters.

◇   Communication protocol is compatible with DGUS LCM.

◇   Support re-development, the code of 8051 can be directly used to run with DCT_100 which have 52KB code space, 2.75KB RAM, 32MIPS

◇   LEDs show the status of power, communication, input and output.

◇   Connect other devices with 3.81mm Phoenix Connector.

◇   Wide working temperature of -40/+85℃.

◇   Install the DCT_100 by rail.
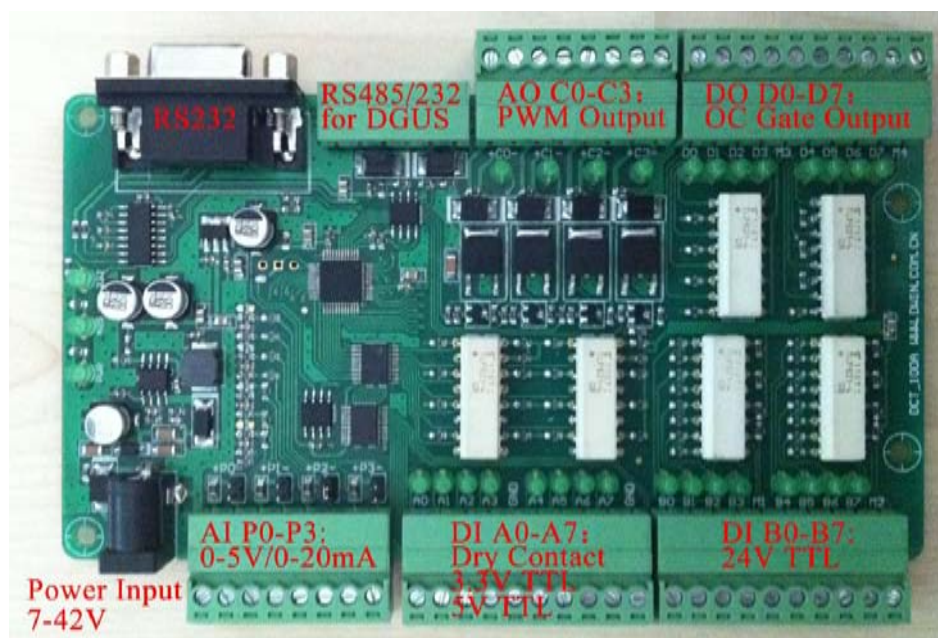
DWIN DCT_100

2 Variable Memory

Every DCT_100 will take 64 words to store the device properties. When DGUS LCM is connected with it, DGUS LCM will allocate 64 words in the memory for mapping the variables in DCT_100 correspondingly.

| Type	Variable Add.		Length (Bytes)	Definition	Description
	Byte	DGUS			
I/O	0x00	0x00	16	Model、version and I/O	DCT_100 V1.0 4211 Note：4211=16DI、8DO、4AI、4AO
DI	0x10	0x08:H	1	PA.0-PA.7: Input State	Dry contact、3.3V CMOS/TTL、5V CMOS/TTL，Max. 50Hz； When input is low, LED is powered on.
	0x11	0x08:L	1	PB.0-PB.7: Input State	8-way optical isolated 24V TTL input； When input is high, LED is powered on.
	0x12	0x09:H	1	PA.0: The number of upward pulse	Using command 0x82 or 0x8F, the value of DI will be reset.
	0x13	0x09:L	1	PA.0: The number of downward pulse	
	0x14	0x0A	2	PA.1: The number of upward and downward pulse	
	0x16	0x0B	2	PA.2: Same as PA.1	
	0x18	0x0C	2	PA.3: Same as PA.1	
	0x1A	0x0D	2	PA.4: Same as PA.1	
	0x1C	0x0E	2	PA.5: Same as PA.1	
	0x1E	0x0F	2	PA.6: Same as PA.1	
	0x20	0x10	2	PA.7: Same as PA.1	
	0x22	0x11	2	PB.0: Same as PA.1	
	0x24	0x12	2	PB.1: Same as PA.1	
	0x26	0x13	2	PB.2: Same as PA.1	
	0x28	0x14	2	PB.3: Same as PA.1	
	0x2A	0x15	2	PB.4: Same as PA.1	
	0x2C	0x16	2	PB.5: Same as PA.1	
	0x2E	0x17	2	PB.6: Same as PA.1	
	0x30	0x18	2	PB.7: Same as PA.1	
AI	0x32	0x19	2	P0: Input voltage，mV	Voltage：0-5.3V Current：0-21mA（When jumper is short, the inside resistance is 250） Accuracy of measurement: +/-1mV, it can be calibrated by 0x8E via RS232.
	0x34	0x1A	2	P1: Input voltage，mV	
	0x36	0x1B	2	P2: Input voltage，mV	
	0x38	0x1C	2	P3: Input voltage，mV	
AO	0x3A	0x1D	2	C0: proportion of output, integer	16bit PWM output，0x8000is GND，0x0000 is half of voltage，0x7FFF is voltage； The carrier frequency of PWM is 732Hz，The carrier frequency of PWM is 732Hz，the maximum load current is 1A； The brightness of LED depends on the output voltage.
	0x3C	0x1E	2	C1:proportion of output, integer	
	0x3E	0x1F	2	C2:proportion of output, integer	
	0x40	0x20	2	C3:proportion of output, integer	
DO	0x42	0x21:H	1	PD.0-PD.7: output state	8-way optical isolated Open Collector Gate output,0 is short，1 is open circuit. When OC gate is short，LED is powered on.
		0x21:L	1	Undefined	
Timer	0x44	0x22	2	Timer0	16bit counter timer of the software： Time base is 1mS, the max value is 65.535 seconds. The time counter decrements to 0 so far.
	0x46	0x23	2	Timer1	
	0x48	0x24	2	Timer2	
	0x4A	0x25	2	Timer3	
	0x4C	0x26	2	Timer4	
	0x4E	0x27	2	Timer5	
	0x50	0x28	2	Timer6	
	0x52	0x29	2	Timer7	
	0x54	0x2A	4	Timer8	32bit counter timer of the software： Time base is 1mS, the max value is 4294967.295 seconds. The time counter decrements to 0 so far.
	0x58	0x2C	4	Timer9	
	0x5C	0x2E	4	Timer10	
	0x60	0x30	4	Timer11	
	0x64	0x32	4	Timer12	Clock counter: Hour: Minute: Second: 0.1S，BCD encoding The counter decrements to 00:00:00:00 so far.
	0x68	0x34	4	Timer13	

	0x6C	0x36	4	Timer14	Hour: Minute: Second: 0.1S，BCD encoding
	0x70	0x38	4	Timer15	The counter adds to 00:00:00:00 so far.
Reserved Bits	0x74	0x3A	12	Undefined	

Note: During the storage and transmission, all the data are sent by MSB.

3 Schematic Diagram
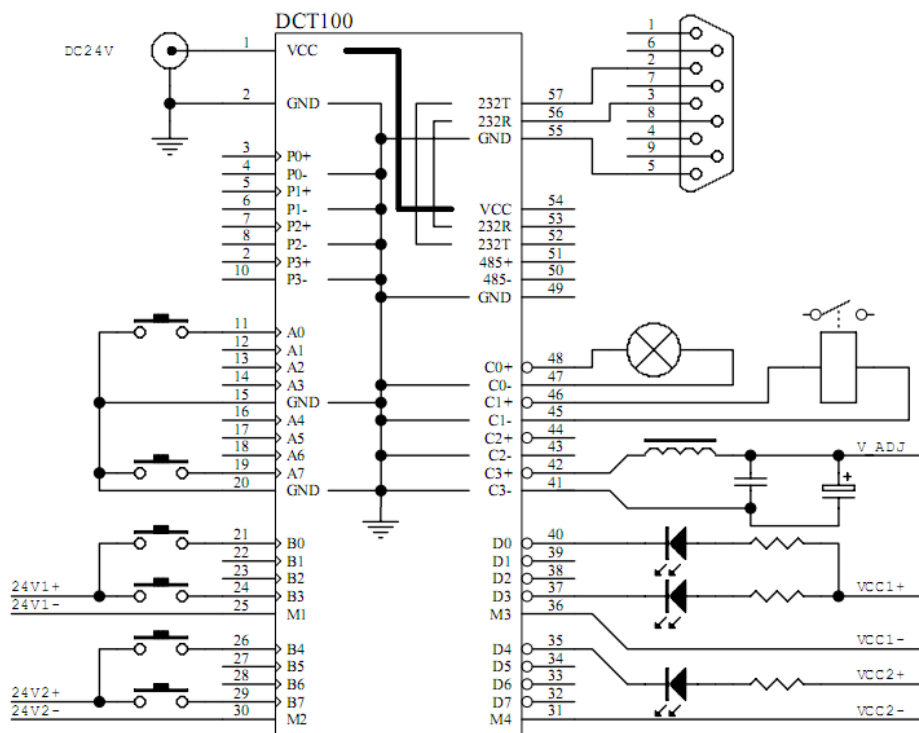
Equivalent Diagram B0-B7 and D0-D7:
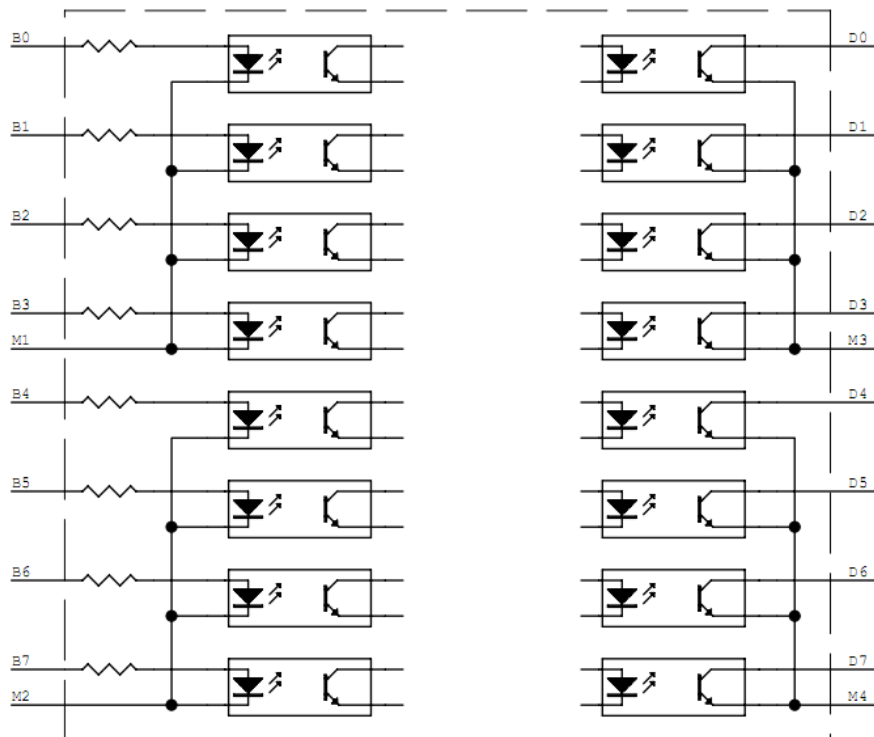
4 Basic Performance Parameters

Type	Parameters	Test Condition	Min	Type	Max	Unit
Power Supply	Voltage		7	24	42	V
	Current	24V, input and output is floating		10		mA
AI（P0-P3）	Input Voltage	Jumper is open circuit, measure the voltage.	0		5.3	V
	Input Impedance			85		KΩ
	Input Current	Jumper is open circuit, measure the current.	0		21	mA
	Input Impedance			250		Ω
	Resolution			1		mV
	Measurement	2.500V input.	-1	0	+1	mV
	Cut-off frequency of DGUS			2.5		Hz
DI（A0-A7）	Low voltage of input	Input 3.3V or 5V TTL	-0.7	0	0.7	V
	High voltage of input		2.5	5	30	V
	Conduction resistance of input	Input is connected to the dry contact or the output of OC gate.			500	Ω
	Cut-off resistance		30			KΩ
	Source Current	Input is connected to the dry contact, short circuit.		-1		mA
	Pulse width of input	High voltage or low voltage	10			mS
DI（B0-B7）	Low voltage of input	Input 24V TTL	-30	0	9	V
	High voltage of input		18	24	28	V
	Sink current of input	Input 1 (24V)		3.8		mA
	Pulse width of input	High voltage or low voltage	10			mS
	Isolation strength of input		2500			V
DO（D0-D7）	Break over Current	Output is 0,shout circuit,	0.1			mA
	Break over voltage	Output is 0,shout circuit, Ic=0.1mA			0.3	V
	Leakage Current	Output is 1, open circuit		2		uA
	Bias Voltage	Output is 1, open circuit			50	V
	Pulse width of output	High voltage or low voltage	50			uS
	Isolation strength of output		2500			V
AO（C0-C3）	Frequency of PWM	Output is set to 0x0000, the duty ratio is 50%		732		Hz
	Resolution of PWM			16		bit
	Output range of PWM	Power voltage is 24V,no load	0		24	V
	Load Current of PWM	Power voltage is 24V, pure resistor load	0	1	2	A
RS485	Baud Rate	N81，is set via RS232	2.4	115.2	691.2	Kbps
	Load capacity of BUS				64	
RS232	Baud Rare			115.2		Kbps
Environment Parameter	Operating Temperature		-40	25	85	℃
	Storage Temperature		-55	25	85	℃
	Operating Humidity	25℃	10%		90%	RH
	ESD	HBS. Contact the device enclosure or air to discharge.	8			KV

5 Data Communication

5.1 RS232 Interface

Serial connection properties:

115200bps，N81 (1 starting bit, 8 Data bits, 1 stop bit, No parity bit）

Data frame

Address	0x00	0x02	0x03	0x04	0x05
Def.	0x5AA5	Length	Command	0x00	DATA_Pack
Spec.	Frame head	Data length	Cmd		Data_pack
E.g.	0x5AA5	0x04	0x82	0x00	0x08 0x01

Instructions:

➢ 0x80: Configure properties of RS485 interface

TX: 5A A5 07 80 00 ADR485 BODE_485 ACK_ADR_START ACK_ADR_END

RX: None

E.g:5A A5 07 80 00 0001 07 08 21

ADR485：RS485 address, 0x0001-0xFFFE. 0x0001 is factory default value;

BODE_485：Baud Rate for RS485, 0x00-0x0F. Default value is 0x07. Please refer to the chart below.

Bode_485	0x00	0x01	0x02	0x03	0x04	0x05	0x06	0x07
Baud Rate	2400	2400	4800	9600	19200	38400	57600	115200
Bode_485	0x08	0x09	0x0A	0x0B	0x0C	0x0D	0x0E	0x0F
Baud Rate	28800	76800	62500	125000	250000	230400	345600	691200

ACK_ADR_START: Start address of the register for auto reply by RS485. Value is 0x00-0x3F

ACK_ADR_END: Final address of the register for auto reply by RS485. Value is 0x00-0x3F

➢ 0x81: Read the properties of RS485 interface

TX: 5A A5 03 81 00 05

RX: 5A A5 07 81 00 ADR485 BODE_485 ACK_ADR_START ACK_ADR_END

➢ 0x82: Read from memory

TX: 5A A5 04 82 00 ADR(0x00-0x3F) RD_LEN

RX: 5A A5 LEN 82 00 ADR DATA

ADR: Start address (Word) of variable memory to be read in DCT_100.

RD_LEN: The length of the info to be read.

Note: 0x82 command will **CLEAR** the contents from memory after reading it.

➢ 0x83: Write in memory

TX: 5A A5 LEN 83 00 ADR(0x1D-0x3F) WR_LEN DATA

RX: None

ADR: Start address (Word) of variable memory to be changed in DCT_100.

WR_LEN: The length of the info to be written.

DATA: The contents to be written.

➢ 0x8E: A/D re-calibration

TX: 5A A5 05 8E 55 AA 5A A5

RX: None

Note: Please send this command **AFTER** input 2.500V standard signal in CH0 channel. The device is calibrated during manufacture.

5.2 RS485 Interface

Serial Connection properties

Baud Rate can be set from 2400bps – 691.2Kbps via RS232. Transmit in N81 mode: 1 starting bit, 8 data bits, 1 stop bit, no parity bit)

Data frame

Addr.	0x00	0x02	0x03	0x04	0x05
Def.	0x5AA5	Length	Command	DATA_Pack	CRC16
Spec	Frame head	Data length	Cmd	Data	ECC
E.g.	0x5AA5	0x03	0x8F		0xFEE4

CRC16 is the CRC sum in ANSI, X16+X15+X2+1 for instructions and data.

Instructions

➢ 0x83: Write contents in memory via RS485

TX: 5AA5 LEN 83 ADR_DGUS LEN_DATA DATA CRC，

RX: None

E.g.5AA5 10 83 005D 05 FF FF FF FF FF FF FF FF 00 00 25AE

ADR_DGUS: Starting address of DGUS data variable memory which is mapped from DCT_100 memory, every DCT_100 will be assigned 64 words (128KB) according to the RS485 address.

ADR_DGUS=ADR485*64+DCT_100 starting address

LEN_DATA: Length of the contents to be written in Word

DATA: data to be written.

➢ 0x8F: Signal for reading request in RS485

TX: 5AA5 03 8F FE E4

RX: 5AA5 LEN 82 ADR_DGUS DATA CRC

To avoid data collision, all devices on RS485 will answer 0x8F command by Timing, the range of acknowledged data will be decided by ACK_ADR_START and ACK_ADR_END set by 0x80 command via RS232.

6 8051Re-development platform

DCT_100 provided Re-development platform for 8051 user, provide approximately 32MIPS of processing power for special or customizing requirement.

- Code: 0x2000-0xEFFF, 52KB, the starting 4 bytes must be "DWIN" in the .BIN file.

    ORG   1FFCH

    DB   "DWIN"

    ……（User's code starts from 2000, and data stored before 2000 can't be accessed by MOVC command.）

- Internal memory: 28-2F（8 Byte, bit addressing），50-7F（48 Byte）
- External memory (XRAM):0x500-0xFFF (2816 Bytes), addressing by MOVX command
- Hardware configurations variables: Stored in 0x00-0x7F in External memory
- Timer T0: 16bit timer, 48MHz
- Except T0, no hardware can't be accessed directly for user code, only can be accessed by Hardware configuration variables in memory, otherwise the device will malfunctioning.
- User code may not control of turn-off IRQ.

To load user program for MCS51 (.bin file, within 2 seconds after power-on)

Step1：Send "5A A5 05 8D 55 AA 5A A5"repeatedly in 100ms

Step2：DCT_100 Power-on

Step3：DCT_100 answer "Please Tx File！"

Step4: Send the program in .bin format

Step5：DCT_100 answer "*******END********", downloading is finished.

Example for re-develop 8051

```
                ORG        1FFCH
                DB "DWIN"
    START:    MOV        DPTR,#0044H        ；Use T0 as timer, output 1Hz off/on signal at D0, D0 LED will blink.
              MOVX      A,@DPTR
              JNZ        START                ; Check time on Timer (500ms)
              INC        DPL
              MOVX      A,@DPTR
              JNZ        START
              MOV        A,#LOW(500)        ; Reset 500ms timer
              MOVX      @DPTR,A
              DEC        DPL
              MOV        A,#HIGH(500)
              MOVX      @DPTR,A
              MOV        DPTR,#0042H
              MOVX      A,@DPTR
              XRL        A,#01H                ;Inverse value in D0
              MOVX      @DPTR,A
              LJMP        START
```
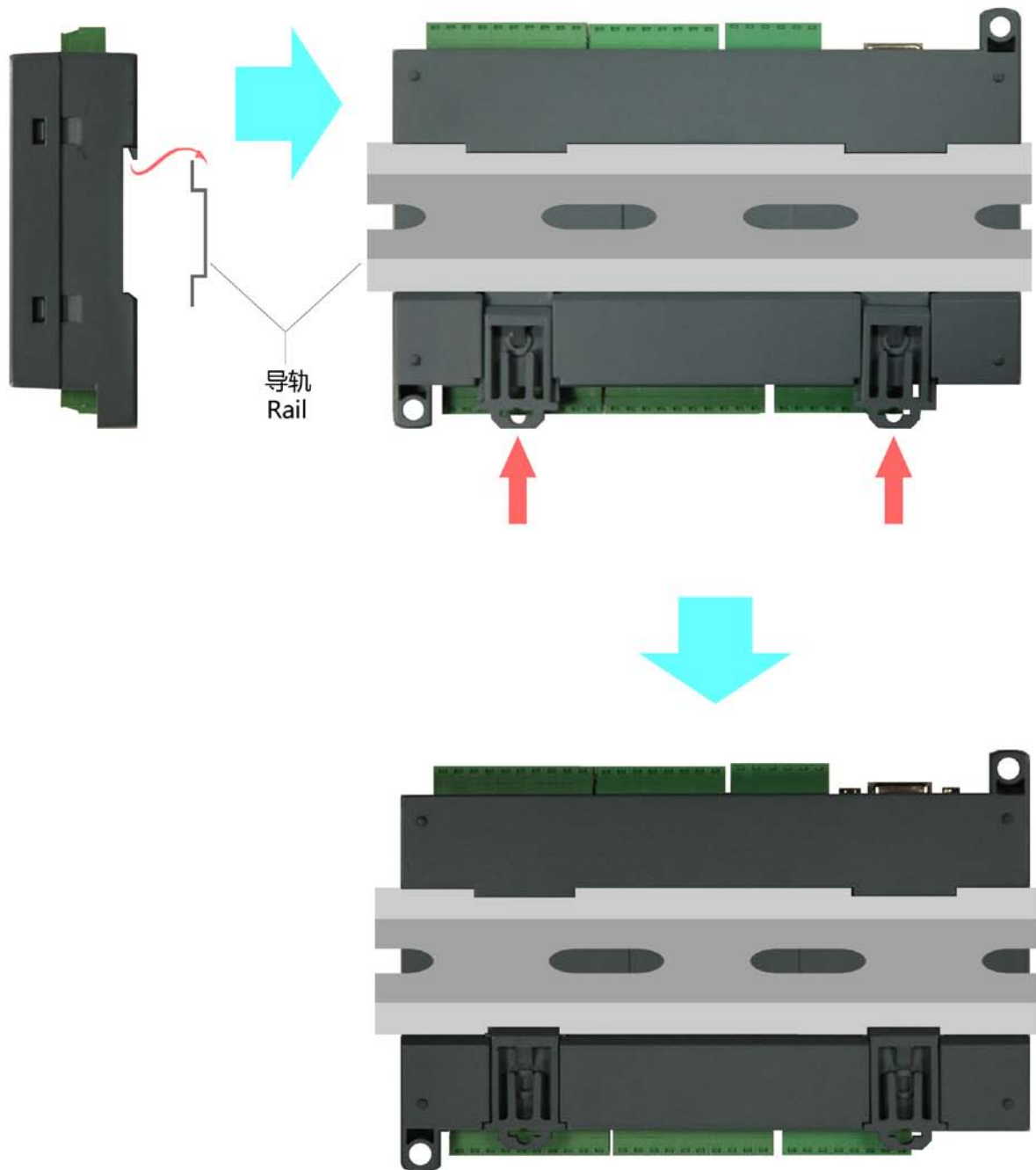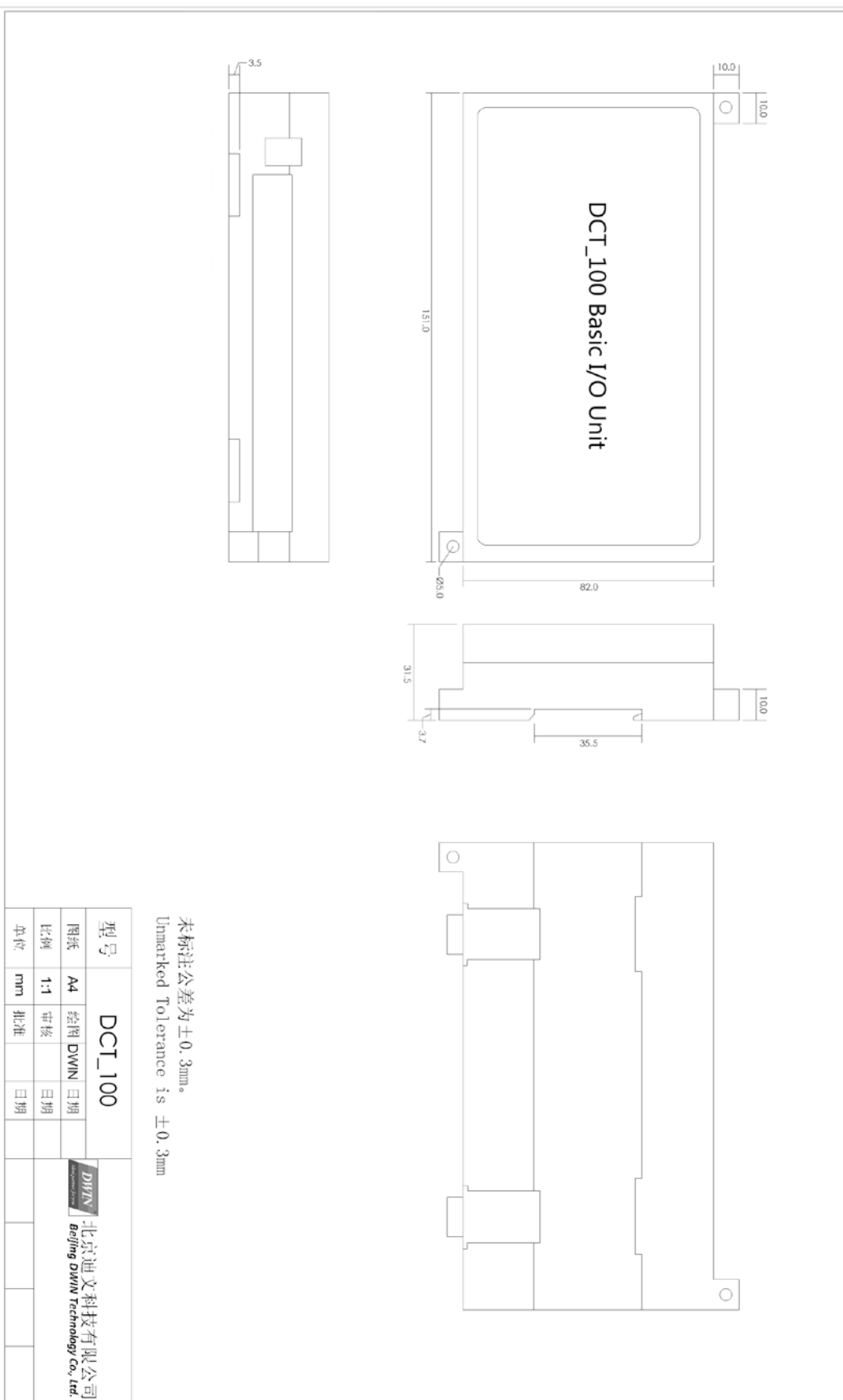
7 Installation:

DCT_100 use rails to install as the diagram below:

导轨
Rail

8 Dimensions

9 History of Revising

Date	Contents	Version
2012.09.13	Initial released	V1.0
2012.12.13	Add picture with enclosure, installation and dimensions	V1.0

12

If you have any doubts, suggestions, or want the latest update for our industrial automation products, please contact us:

info@ampdisplay.com
Thank you and your support will motivate us for further improvements!