1.PRODUCT OUTLINE

1-1 OUTLINE : NKK controller chip performs position detection on which the touch screen was touched by using NKK 4 & 5 wires analog touch screen and has the function to transmit the position coordinates to host computer.

1-2 FEATURES :

(1) Power source voltage : 5.0VDC & 3.3VDC (3.3VDC only available for RS232C & 4 wire touch screen)

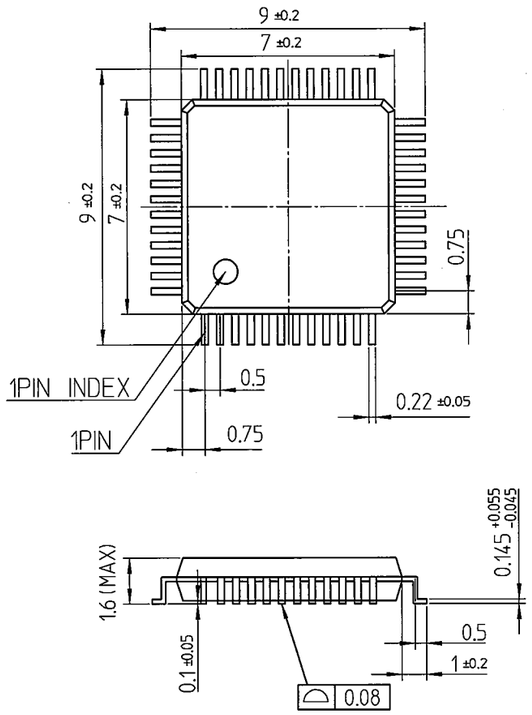
(2) A/D converter resolution : 10 bits

(3) Interface : RS232C & USB 2.0 Full speed

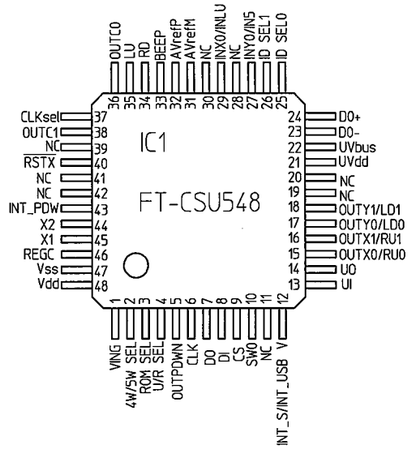
(4) Others

- *Package: LQFP 48 pins
- *High accuracy
- *Efficiency improvement of host CPU operation.
- *Noise filter (Prevent bounce, malfunction prevention by noise)
- *Duplicate coordinate processing function
- *Available to modify the functions by commands from host computer.
- *Low power function (only available for RS232)

2. OUTER DIMENSION



3. PIN ASSIGNMENT



4. PIN DESCRIPTION

PIN NO.	NAME	IN/OUT	FUNCTION
1	VING	OUT	Power indicator
2	4W/5W SEL	IN	Select touch screen type, 4/5 wire (See page 5, column 6)
3	ROM SEL	IN	Select with/ without EEPROM (See page 5, column 6)
4	U/R SEL	IN	Select interface, USB/RS232C (See page 5, column 6)
5	OUTPDWN	OUT	FET controll pin for detect pen down
6	CLK	OUT	Connect to EEPROM clock
7	DO	IN	Connect to EEPROM data output
8	DI	OUT	Connect to EEPROM data input
9	CS	OUT	Connect to EEPROM chip select
10	SW0	IN	(Note 1),(Note 2)
11	NC	IN	Connect to Vss by 10kΩ
12	INT_S/INT_USB V	IN	232C : Interrupt input USB : Vcc detect
13	UI	IN	Serial data receive input (CMOS level)
14	UO	OUT	Serial data transmit output (CMOS level)
15	OUTX0/RU0	OUT	FET controll pin-0 for 4 wire-X, 5 wire-RU
16	OUTX1/RU1	OUT	FET controll pin-1 for 4 wire-X, 5 wire-RU
17	OUTY0/LD0	OUT	FET controll pin-0 for 4 wire-Y, 5 wire-LD
18	OUTY1/LD1	OUT	FET controll pin-1 for 4 wire-Y, 5 wire-LD
19	NC		
20	NC		

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MODEL No.	FT-CSU548(FTCSU548)		
NKK	NKK SWITCHES CO., LTD.		

APPROVED BY: H. Kurashima	May.9 '17	SCALE 5 : 1	
CHECKED BY: M. Tamura	Apr.27 '17	DIMENSIONS IN mm	
CHECKED BY: H. Kadowaki	Apr.18 '17	Unless otherwise specified tolerances	
DRAWN BY: S. Kurihara	Apr.14 '17	Dimensions range	Tolerances
		Up to 6	±0.3
		Over 6 up to 30	±0.5
		Over 30 up to 50	±0.8
		Over 50	±1.2

PIN NO.	NAME	IN/OUT	FUNCTION
21	UVdd	IN	Connected to Vss via a capacitor 0.33μF
22	UVbus	IN	RS232C:Connect to Vss by 10kΩ
23	D0-	IN/OUT	USB upstream I/O
24	D0+	IN/OUT	USB upstream I/O
25	ID SEL0	IN	Connect to Vss by 10kΩ
26	ID SEL1	IN	Connect to Vss by 10kΩ
27	INY0/IN5	IN	A/D converter input (4 wire-Y、5wire-TPin)
28	NC	IN	Connect to Vss by 10kΩ
29	INX0/INLU	IN	A/D converter input (4 wire-X,5wire-LU)
30	NC	IN	Connect to Vss by 10kΩ
31	AVrefM	IN	Reference voltage input pin for A/D converter (-).
32	AVrefP	IN	Reference voltage input pin for A/D converter (+).
33	BEEP	OUT	Beep output
34	RD	OUT	FET controll pin for 5 wire-RD
35	LU	OUT	FET controll pin for 5 wire-LU
36	OUTC0	OUT	External output-0
37	CLKsel	IN	Clock selection (See page 5, column 6)
38	OUTC1	OUT	External output-1
39	NC	OUT	
40	$\overline{\text{RSTX}}$	IN	Reset input for active "L"
41	NC	IN	Connect to Vss by 10kΩ
42	NC	IN	Connect to Vss by 10kΩ
43	INT_PDW	IN	Pen-down interrupt input
44	X2	IN	Clock input
45	X1	IN	Clock output
46	REGC	IN	Connected to Vss via a capacitor
47	Vss		GND potential of all terminals
48	Vdd		Power source to 3.3VDC/5VDC

Note 1: The pin connected to pull-up resistor inside the controller chip.
Note 2: Open

5. ELECTRICAL CHARACTERISTICS

5-1. Absolute maximum ratings(Ta=25℃)

ITEM	SYMBOL	NAME		RATINGS	UNIT
Power source voltage	Vcc	Vdd		-0.5~6.5	V
UVdd pin input voltage	Viuvdd	UVdd		-0.3~Vcc +0.3 (Note3)	V
Input voltage	V_{I1}	NC(No.11,28,30,41,42),INX0/INLU,INY0/IN5, ID SEL0,ID SEL1,INT_S/INT_USB V,UI,SW0, D0,CIKsel,X1,X2,INT_PDW,RSTX		-0.3~Vcc +0.3 (Note3)	V
	V_{I2}	D0+、D0-、UVbus 4/5W SEL,ROM SEL,U/R SEL,		-0.3~+6.5	V
Output voltage	V_{O1}	RD,LU,OUTY0/LD0,OUTY1/LD1, OUTX0/RU0,OUTX1/RU1, OUTPDWN,OUTC1,U0,VING, CS,DI,CLKOUTC0,BEEP		-0.3~Vcc +0.3 (Note3)	V
	V_{O2}	D0+、D0-		-0.3~6.5	V
REGC UVdd pin input voltage	Viregc	REGC		-0.3~+2.8 and -0.3~Vcc+0.3 (Note4)	V
Operating temperature	Ta			-20~85	℃
Storage temperature	Tstg			-40~125	℃
"H" input voltage	Ioh1	1 pin	LU,RD,OUTY0/LD0,OUTY1/LD1 OUTX0/RU0、OUTX1/RU1 OUTPDWN,OUTC1,U0,CS,DI,CLK BEEP,OUTC0	-40	mA
		Total -170mA	LU,RD,OUTC1,BEEP,OUTC0	-70	mA
			OUTY0/LD0,OUTY1/LD1 OUTX0/RU0,OUTX1/RU1,U0 OUTPDWN,CS,DI,CLK	-100	mA
"L" input voltage	Iol1	1 pin	LU,RD,OUTY0/LD0、OUTY1/LD1 OUTX0/RU0、OUTX1/RU1 OUTPDWN,OUTC1,U0,CS,DI,CLK VING,BEEP,OUTC0	40	mA
		Total -170mA	LU,RD,OUTC1,BEEP,OUTC0	70	mA
			OUTY0/LD0,OUTY1/LD1 OUTX0/RU0,OUTX1/RU1,U0 OUTPDWN,VING,CS,DI,CLK	100	mA
Analog Input voltage	Vai	AVrefP,AVrefM,INX0/INLU,INY0/IN5		-0.3~Vcc+0.3 (Note3) and-0.3~AVrefP+0.3	V

Note 3: 6.5 V or less
Note 4: REGC Connect the REGC pin to Vss via a capacitor (0.47 to 1 μF).
This regulates the absolute maximum rating of the REGC pin.

MODEL No.	FT-CSU548(FTCSU548)		
NKK SWITCHES CO., LTD.			
APPROVED BY: H. Kurashima	May.9 '17	SCALE :	
CHECKED BY: M. Tamura	Apr.27 '17	DIMENSIONS IN mm	
CHECKED BY: H. Kadowaki	Apr.18 '17	Unless otherwise specified Tolerances	
DRAWN BY: S. Kurihara	Apr.14 '17	Dimensions range	Tolerances
		Up to 6	±0.3
		Over 6 up to 30	±0.5
		Over 30 up to 50	±0.8
		Over 50	±1.2

PRODUCT SPECIFICATIONS 3/19

5-2.Recommended operating conditions (Vcc=3.3/5.0V,±5.0% Vss=0V, Communicate by RS232C : Ta=-20~85℃, Communicate by USB : Ta=0~70℃, unless otherwise noted)

※ RS232C, 4 wires analog touch screen only.

ITEM	SYMBOL	NAME	TEST CONDITION	LIMITS Min.	LIMITS Typ.	LIMITS Max.	UNIT
Power source voltage	Vcc	Vdd	Vcc=5.0V	4.75	5.0	5.25	V
			Vcc=3.3V ※	3.135	3.3	3.465	
Operating temperature	-	-	RS232C	-20	-	85	℃
	-	-	USB	0	-	70	℃
Analog reference voltage	Vref	AVrefM		-	0	-	V
		AVrefP		-	Vcc	-	
Power source voltage	Vss	Vss		-	0	-	V
"H" input voltage	Vih1	INT_S/INT_USB V,UI,SW0,DO CIKsel		0.8Vcc		Vcc	V
	Vih2	INX0/INLU,INY0/INS,ID SEL0,ID SEL1		0.7Vcc		Vcc	V
	Vih3	4W/5W SEL,ROM SEL,U/R SEL		0.7Vcc		6.0	V
	Vih4	X1,X2,INT_PDW,$\overline{RSTX}$		0.8Vcc		Vcc	V
"L" input voltage	Vil1	INT_S/INT_USB V,UI,SW0,DO CIKsel		0		0.2Vcc	V
	Vil2	INX0/INLU,INY0/INS,ID SEL0,ID SEL1		0		0.3Vcc	V
	Vil3	4W/5W SEL,ROM SEL,U/R SEL		0		0.3Vcc	V
	Vil4	X1,X2,INT_PDW,$\overline{RSTX}$		0		0.2Vcc	V

ITEM	SYMBOL	NAME	TEST CONDITIONS	LIMITS Min.	LIMITS Typ.	LIMITS Max.	UNIT
"H" output current (Note 1)	Ioh1	LU,RD,OUTY0/LD0, OUTY1/LD1 OUTX0/RU0, OUTX1/RU1 OUTPDWN,OUTC1,U0,CS,DI,CLK BEEP,OUTC0 1 pin				-3.0 (Note 3)	mA
		LU,RD,OUTC1,BEEP,OUTC0 (Duty≤70%) Total (Note 4)	Vcc=5.0V±5%			-30.0	mA
			Vcc=3.3V±5%			-10.0	mA
		OUTY0/LD0,OUTY1/LD1 OUTX0/RU0,OUTX1/RU1,U0 OUTPDWN,CS,DI,CLK (Duty≤70%) Total (Note 4)	Vcc=5.0V±5%			-30.0	mA
			Vcc=3.3V±5%			-19.0	mA
		All pin total (Duty≤70%) (Note 4)				-60.0	mA
"L" output current (Note 2)	Iol1	LU,RD,OUTY0/LD0, OUTY1/LD1 OUTX0/RU0, OUTX1/RU1 OUTPDWN,OUTC1,U0,CS,DI,CLK BEEP,OUTC0 1 pin				8.5 (Note 3)	mA
		VING 1 pin				15.0 (Note 3)	mA
		LU,RD,OUTC1,BEEP,OUTC0 (Duty≤70%) Total (Note 4)	Vcc=5.0V±5%			40.0	mA
			Vcc=3.3V±5%			15.0	mA
		OUTY0/LD0, OUTY1/LD1 OUTX0/RU0, OUTX1/RU1 OUTPDWN,U0,VING,CS,DI,CLK (Duty≤70%) Total (Note 4)	Vcc=5.0V±5%			40.0	mA
			Vcc=3.3V±5%			35.0	mA
		All pin total (Duty≤70%) (Note 4)				80.0	mA
Clock frequency	f	X1		15.960	16	16.040	MHz

Note 1. It is a current value that guarantees the operation of the device even if it flows from the Vcc terminal to the output terminal.

Note 2. It is a current value that guarantees the operation of the device even if current flows to the output terminal.

Note 3. but, please do not exceed the total current value.

Note 4. but, the current flowing in one terminal does not change depending on duty Also, current exceeding the absolute maximum rating can not be passed.

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APPROVED BY: H. Kurashima	May.9 '17	SCALE :
CHECKED BY: M. Tamura	Apr.27 '17	DIMENSIONS IN mm
CHECKED BY: H. Kadowaki	Apr.18 '17	Unless otherwise specified tolerances: Dimensions range / Tolerances; Up to 6: ±0.3; Over 6 up to 30: ±0.5; Over 30 up to 50: ±0.8; Over 50: ±1.2
DRAWN BY: S. Kurihara	Apr.14 '17	

MODEL No. FT-CSU548(FTCSU548)

NKK SWITCHES CO., LTD.

5-3. DC standard

(Vcc=3.3/5.0V, ±5.0%, Vss=0V, Communicate by RS232C : Ta=-20~85℃,
Communicate by USB : Ta=0~70℃, unless otherwise noted)

ITEM	SYMBOL	NAME	TEST CONDITIONS	LIMITS Min.	LIMITS Typ.	LIMITS Max.	UNIT
"H" output voltage	Voh1	LU,RD,OUTY0/LD0、OUTY1/LD1 OUTX0/RU0、OUTX1/RU1 OUTPDWN,OUTC1,U0,CS,DI,CLK BEEP,OUTC0	Vcc=5.0V±5% Ioh1=-3.0mA	Vcc-0.7			V
			Ioh1=-2.0mA	Vcc-0.6			V
			Ioh1=-1.5mA	Vcc-0.5			V
"L" output voltage	Vol1	LU,RD,OUTY0/LD0、OUTY1/LD1 OUTX0/RU0、OUTX1/RU1 OUTPDWN,OUTC1,U0,CS,DI,CLK BEEP,OUTC0	Vcc=5.0V±5% Iol1=8.5mA			0.7	V
			Iol1=3.0mA			0.6	V
			Iol1=1.5mA			0.4	V
			Iol=0.6mA			0.4	V
	Vol2	VING	Vcc=5.0V±5% Iol1=15.0mA			2.0	V
			Vcc=5.0V±5% Iol1=5.0mA			0.4	V
			Iol1=3.0mA			0.4	V
			Iol1=2.0mA			0.4	V

ITEM	SYMBOL	NAME	TEST CONDITIONS		LIMITS Min.	LIMITS Typ.	LIMITS Max.	UNIT
"H" input leakage current	Iih1	AVrefM,AVrefP,NC(No.11,28,30) INX0/INLU,INY0/IN5,ID SEL0,ID SEL1 INT_S/INT_USB V,UI 4W/5W SEL,ROM SEL,U/R SEL SW0,,DO,CLKsel,INT_PDW,RSTX	Vi=Vcc				1	μA
	Iih2	X1,X2,NC(41,42)	Vi=Vcc	External clock			1	μA
				Resonator connection			10	μA
"L" input leakage current	Iil1	AVrefM,AVrefP,(No.11,28,30) INX0/INLU,INY0/IN5,ID SEL0,ID SEL1 INT_S/INT_USB V,UI 4W/5W SEL,ROM SEL,U/R SEL SW0,,DO,CLKsel,INT_PDW,RSTX	Vi=Vss				-1	μA
	Iil2	X1,X2,NC(41,42)	Vi=Vss	External clock			-1	μA
				Resonator connection			-10	μA
RAM hold voltage (Note 1)	V_{DDDR}	Vdd			1.44		5.25	V
Power source current (Note 2) (Note 3)	I_{DD1}	Vdd	Calibration data mode			6.5		mA
			Stop mode			241		μA

(Note 1) Data is not retained when reset is applied

(Note 2) It is the total current flowing to V_{DD}.
Includes input leakage current when it is fixed to input terminal V_{SS}.
but, the current flowing during A / D converter, LVD circuit, I / O port, internal pull-up / pull-down resistor, data flash rewrite is not included.

(Note 3) USB internal power supply

APPROVED BY: H. Kurashima	May.9 '17	SCALE :
CHECKED BY: M. Tamura	Apr.27 '17	DIMENSIONS IN mm
CHECKED BY: H. Kadowaki	Apr.18 '17	Unless otherwise specified tolerances
DRAWN BY: S. Kurihara	Apr.14 '17	Dimensions range / Tolerances
		Up to 6 / ±0.3
		Over 6 up to 30 / ±0.5
		Over 30 up to 50 / ±0.8
		Over 50 / ±1.2

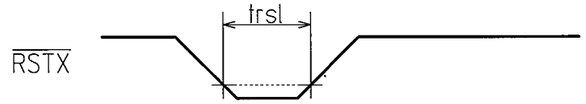
MODEL No. FT-CSU548(FTCSU548)

NKK SWITCHES CO., LTD.

5-4. AC standard

(1) Reset timing (Vcc=3.3/5.0V,±5.0% Vss=0V, Communicate by RS232C : Ta=-20~85℃, Communicate by USB : Ta=0~70℃, unless otherwise noted)

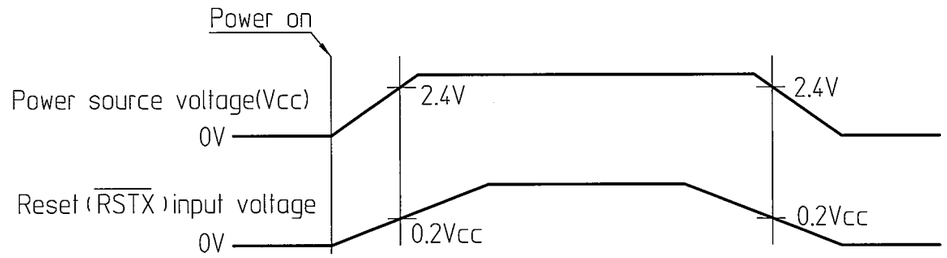
ITEM	SYMBOL	CONDITION	LIMITS		UNIT
			Min.	Max.	
$\overline{RSTX}$ LOW pulse width	trsl	-	10	-	μs



(2) Power on reset

① If Vcc is 2.4 V when Vcc rises, check that the reset input voltage ($\overline{RSTX}$) is less than 0.2 V.

② If Vcc is 2.4 V or less when Vcc drops, please make sure the reset input voltage ($\overline{RSTX}$) is less than 0.2 V. When starting operation again please cancel reset after power supply voltage Vcc becomes 2.4 V or more.

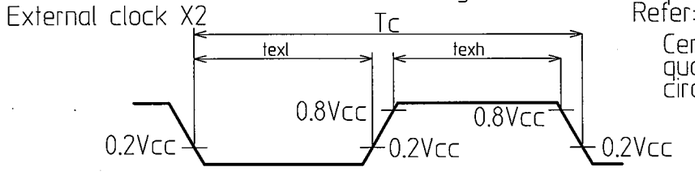


(3) External clock timing

(Vcc=3.3/5.0V,±5.0% Vss=0V, Communicate by RS232C : Ta=-20~85℃, Communicate by USB : Ta=0~70℃, unless otherwise noted)

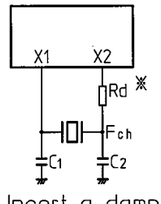
ITEM	SYMBOL	NAME	LIMITS		UNIT
			Min.	Max.	
External clock input "H" & "L" pulse width	texh texl	X2	30		ns
External clock input cycle time	tc	X2	62.34		ns

・External clock(X2) timing

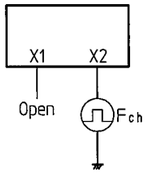


・Clock input circuit
(Depending on the type of clock, setting is necessary. Refer:"See page 5, column 6")

Ceramic resonator or quarts-crystal oscillator circuit



External clock input circuit



※ Insert a damping resistor if required. The resistance will vary depending on the oscillator and the oscillation drive capacity setting.Use the value recommended by the manufacturer of the oscillator.

5-5.A/D converter characteristics

(Vcc=3.3V±5%/5.0V±5%, Vss=0V, Communicate by RS232C : Ta=-20~85℃, Communicate by USB : Ta=0~70℃, unless otherwise noted)

ITEM	SYMBOL	TEST CONDITIONS	LIMITS			UNIT
			Min.	Typ.	Max.	
Resolution	Res		-	-	10	bit
Total error	AINL	10bit Resolution AVrefp=Vcc	-	1.2	±3.5	LSB
Conversion time	tconv	10bit Resolution Vsel	2.125	-	39	μs
Zero scale error	EZS	10bit Resolution AVrefp=Vcc	-	-	±0.25	%FSR
Full scale error	EFS	10bit Resolution AVrefp=Vcc	-	-	±0.25	%FSR
Integral linearity error	ILE	10bit Resolution AVrefp=Vcc	-	-	±2.5	LSB
Differential linearity error	DLE	10bit Resolution AVrefp=Vcc	-	-	±1.5	LSB
Analog input voltage	Vain	INY0/INL5,INX0/INLU	0	-	Vcc	V

6. SETTING FOR INPUT PIN

(1) Select touch panel type, 4 wire/5 wire

Pin No.	2
Name	4/5W SEL
Touch panel type	Setting
4 wire	L
5 wire	H

(2) Select EEPROM, with/without

Pin No.	3
Name	ROM SEL
E2PROM	Setting
Without	L
With	H

(3) Select interface type, RS232C/USB

Pin No.	4
Name	U/R SEL
Interface	Setting
RS232C	L
USB	H

(4) Select clock type

Pin No.	37
Name	CLKsel
Clock type	Setting
Crystal (ceramic) oscillator	L
External clock	H

※Changing the setting of each terminal should be done when the power is turned off.

MODEL No.	FT-CSU548(FTCSU548)		
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APPROVED BY: H. Kurashima	May.9 '17	SCALE	:
CHECKED BY: M. Tamura	Apr.27 '17	DIMENSIONS IN mm	
		Unless otherwise specified Tolerances	
CHECKED BY: H. Kadowaki	Apr.18 '17	Dimensions range	Tolerances
		Up to 6	±0.3
DRAWN BY: S. Kurihara	Apr.14 '17	Over 6 up to 30	±0.5
		Over 30 up to 50	±0.8
		Over 50	±1.2

7. FUNCTION EXPLANATION

Note: Valid interface (R: Only RS232C is available, U: Only USB is available, R/U: Both RS232 & USB are available)

FUNCTION	CONTENTS	NOTE	EXPLANATION
Interface	Serial and USB communication	R/U	The asynchronous serial and USB
Sampling rate	Set to the optional value	R/U	Calibration data mode Max. 130 p/s Source data mode Max. 190 p/s
Coordinates data format	4 bytes binary	R/U	See page 11 "Format of the coordinates data"
Coordinates mode	Source data mode	R/U	A/D converted data is sent to the host CPU.
	Calibration data mode	R/U	Calibrated data is sent to the host CPU.
Data output mode	Point mode	R/U	Outputs the coordinates value of the first pen down only.
	Stream mode	R/U	Outputs a coordinates value continuously while the pen remains down.
Duplicate coordinate processing function	Stop to send Duplicate coordinates	R/U	Compares the coordinates value transferred in the previous operation with the current coordinate data and if the coordinate values are the same, the controller does not send the current coordinate data. (Only valid in stream mode)
Time-out function	Sets the time-out time	R	If the required data was not received within the preset time-out time, the controller sends error code "F3h" to the host CPU.

Note: Valid interface (R: Only RS232C is available, U: Only USB is available, R/U: Both RS232 & USB are available)

FUNCTION	CONTENTS	NOTE	EXPLANATION
Calibration	Calibration	R/U	Calibrate the touch panel coordinates to the LCD coordinates.
Low power function	Stop mode	R	Stop mode : stops oscillation. The way of wake up : Pen down, reset, stop cancellation command
	Way of switching to each mode	R	The command which switches to each low power mode has the following two ways. Direct : After receiving a command, it shifts to the low power mode immediately. Auto : After the last coordinate input, if there is no input for a preset time, the controller switches to the low power mode.
	Transition times	R	Transition from normal mode to low power mode : about 5μs Transition from stop mode to normal mode : about 50ms+ 5μs
Status function	Controller setting state confirmation	R/U	Chip sends the setting state of the controller to the host CPU.
Interface test function	Tests the interface	R	Tests whether the communication between the chip and the host CPU, normally using by the optional data.
Pen up code function	1 byte	R	Send 1 byte pen up code when pen up.
	4 bytes	R/U	Send 4 bytes pen up code when pen up.
Lock function	Starts and clears the lock function	R/U	If a lock command is issued, after transmitting the coordinate data currently being transmitted, the controller halts transmission. The lock state is cleared by sending a lock clear command.
Reset	Software reset	R	Reset by the command
	Hardware reset	R/U	Reset by the $\overline{\text{RSTX}}$ pin.
	Power on reset	R/U	Reset when turning on the power supply
	Watchdog reset	R/U	When the software of controller is out of controll, the reset function works automatically.
A/D converter	Resolution	R/U	10bit
Host CPU data output function	Output the data from host CPU	R/U	Output the level from chips pin no. 16 & 17, which the data has sent from host CPU.
Power source indicator	Power source	R/U	Blink LED on and off while the controller chip is active.
Beep	Beep	R/U	Output "H" level signal while settled time when detected pen down.

APPROVED BY: H. Kurashima	May.9 '17	SCALE	:
CHECKED BY: M. Tamura	Apr.27 '17	DIMENSIONS IN mm	
CHECKED BY: H. Kadowaki	Apr.18 '17	Unless otherwise specified Tolerances	
DRAWN BY: S. Kurihara	Apr.14 '17	Dimensions range	Tolerances
		Up to 6	±0.3
		Over 6 up to 30	±0.5
		Over 30 up to 50	±0.8
		Over 50	±1.2

MODEL No. FT-CSU548(FTCSU548)

NKK SWITCHES CO., LTD.

8. RS232C COMMUNICATE SPECIFICATION AND COMMANDS

8-1. RS232C Communicate specification

ITEM	CONTENTS
Boud rate (unchangeable)	9600(bps)
Communication protocol (unchangeable)	Data length: 8 bit Parity bit: None Stop bit: 1 bit

8-2. Commands for using RS232C communication

Function	Command	Command value	Number of the bytes	Description
Sampling rate	Setting of sampling rate	91h	3	Default setting: 80(p/s)

Sends an optional value 10 to maximum (p/s) according to the following format.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	Bit0
1	0	0	1	0	0	0	1
0	0	0	0	z3	z2	z1	z0
0	0	0	0	z7	z6	z5	z4

z0 to z7 : The binary number of sampling rate (z). (z7 is the high-order bit)

There is a maximum sampling rate of each mode as follows :

Calibration data mode - 130 (p/s)
Source data mode - 190 (p/s)

Note : Becareful not to settle more than the maximum sampling rate. The coordinate data may becomes abnormal.

Function	Command	Command value	Number of the bytes	Description
Coordinates mode	Source data mode	80h	1	Default setting: Calibration data mode
	Calibration data mode	81h	1	
Data output mode	Point mode	A0h	1	Default setting: Stream mode
	Stream mode	A1h	1	
Duplicate coordinate processing function	Enable	84h	1	Default setting: Enable
	Disenable	85h	1	
Time-out function	Time-out value (z)	88h	3	Default setting: 100

According to the following format, it sets time-out value (z).

bit7	bit6	bit5	bit4	bit3	bit2	bit1	Bit0
1	0	0	0	1	0	0	0
0	0	0	0	z3	z2	z1	z0
0	0	z9	z8	z7	z6	z5	z4

z0~z9 : The binary number of time-out value (z). (z9 is the high-order bit)

It calculates time-out time by the following formula and it sets a time-out value.

Time-out time (ms)=4 × time-out value

The minimum of time-out value z≥1

Function	Command	Command value	Number of the bytes	Description
Calculate Calibration ratio	Calibration ratio	83h	17	

According to the following format, controller calculate and sets a calibration ratio.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	Bit0	
1	0	0	0	0	0	1	1	← command
0	0	0	0	x3	x2	x1	x0	The 1st LCD reference point
0	0	x9	x8	x7	x6	x5	x4	x0~x9 : The binary number of the horizontal axis coordinates x of the 1st reference point
0	0	0	0	y3	y2	y1	y0	y0~y9 : The binary number of the vertical axis coordinates y of the 1st reference point
0	0	y9	y8	y7	y6	y5	y4	(x9, y9 are the high-order bit).
0	0	0	0	X3	X2	X1	X0	The 2nd LCD reference point
0	0	X9	X8	X7	X6	X5	X4	X0~X9 : The binary number of the horizontal axis coordinates X of the 2st reference point
0	0	0	0	Y3	Y2	Y1	Y0	Y0~Y9 : The binary number of the vertical axis coordinates Y of the 2st reference point
0	0	Y9	Y8	Y7	Y6	Y5	Y4	(x9, y9 are the high-order bit).
0	0	0	0	Ax3	Ax2	Ax1	Ax0	The A/D value of the 1st reference point
0	0	Ax9	Ax8	Ax7	Ax6	Ax5	Ax4	Ax0~Ax9 : The binary number of the A/D value which horizontal axis coordinates x of the 1st reference point
0	0	0	0	Ay3	Ay2	Ay1	Ay0	Ay0~Ay9 : The binary number of the A/D value which vertical axis coordinates y of the 1st reference point
0	0	Ay9	Ay8	Ay7	Ay6	Ay5	Ay4	(x9, y9 are the high-order bit).
0	0	0	0	AX3	AX2	AX1	AX0	The A/D value of the 2nd reference point
0	0	AX9	AX8	AX7	AX6	AX5	AX4	AX0~AX9 : The binary number of the A/D value which horizontal axis coordinates X of the 2nd reference point
0	0	0	0	AY3	AY2	AY1	AY0	AY0~AY9 : The binary number of the A/D value which vertical axis coordinates Y of the 2nd reference point
0	0	AY9	AY8	AY7	AY6	AY5	AY4	(x9, y9 are the high-order bit).

*The absolute value of margin between the A/D value (AX,AY) of the 2nd reference point and the A/D value (Ax,Ay) of the 1st reference point are as follows.

|AX-Ax|>100, |AY-Ay|>100

* More than 50 msec interval is required between the last calibrtaion command (17 bytes) and next command.

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CHECKED BY: H. Kadowaki	Apr.18 '17	Unless otherwise specified tolerances: Dimensions range / Tolerances; Up to 6 ±0.3; Over 6 up to 30 ±0.5
DRAWN BY: S. Kurihara	Apr.14 '17	Over 30 up to 50 ±0.8; Over 50 ±1.2

MODEL No. FT-CSU548(FT-CSU548)

NKK SWITCHES CO., LTD.

PRODUCT SPECIFICATIONS 8/19

Function	Command	Command value	Number of the bytes	Description
Low power function	Auto stop	B1h	2	The codes and the wait time at auto mode
	Direct stop	B3h	1	
	Auto clear	B4h	1	
	Stop clear	E2h	1	

Codes	00h	01h	02h	03h
Wait time (second)	01	10	30	60

The way of wake up from the direct stop mode: Pen down, reset(only without E2PROM), "Stop clear"command reception
The way of wake up from the auto stop mode: Pen down, reset, "Stop clear" command reception

When canceling an auto stop mode, first send the "Stop clear" command (E2h), second send an "Auto clear" command (B4h). Take an interval time (more than 50msec) between first and second commands.
When returning from the stop mode, be sure to use stop clear command (E2h).
(When sending a command except the stop clear command (E2h), operation doesn't guaranteed.)
Do not send the "Auto stop" nor "Direct stop" commands while pendown the touch panel.

Interface test function	Interface	C4h	2	After the reception of 2 bytes data which 1 byte of interface diagnosis command (C4h) and 1 byte of optional data from the host CPU, the controller sends back 1 byte of received optional data to the host CPU.
Pen up code function	4 bytes	E3h	1	
	1 byte	E4h	1	Set the bytes of pen up code. 4 bytes or 1 byte
Lock function	Lock condition	E0h	1	Default setting : Lock clear
	Lock clear	E1h	1	
Reset	Reset	C0h	1	Software reset
Host CPU data output function	Host CPU data	A2h	2	Default setting : Pin no. 36 & 38 are "L" level

Set "0" to the bit "z0" or "z1" to output "L" level and set "1" for the "H" level.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
1	0	1	0	0	0	1	0
0	0	0	0	0	0	z1	z0

Bit	Pin No.
z0	36
z1	38

The controller chip starts from default setting after reboot, no matter with or without E2PROM.

Clear E2PROM data	Clear E2PROM	C5h	1	Clear the all stored E2PROM data
Beep time setting	Beep time	86h	2	Default setting : 0 msec

Set the beep time from 100 to 300 msec by 50 msec step.
Pin no. 19 output the "H" level while the settled time when pen down the touch panel.

Codes	00h	01h	02h	03h	04h	05h
"H" level time (msec)	0	100	150	200	250	300

Function	Command	Command value	Number of the bytes	Description
Status function	Status	C3h	2	

Mode	Code	Return value
Coordinates mode	00h	01h : Source data mode 02h : Calibration data mode
Data output mode	01h	01h : Stream mode 02h : Point mode
Sampling rate	03h	1st byte 0xh:x is the return value of lower order sampling rate value (z3~z0). 2nd byte 0xh:x is the return value of higher order sampling rate value (z7~z4).
Time-out function	05h	1st byte return value 0xh:x is the lower order time-out value (z3-z0). 2nd byte return value 0xh:x is the higher order time-out value (z9-z4).
Duplicate coordinate processing function	06h	00h : Duplicate coordinate processing function disenable 01h : Duplicate coordinate processing function enable
Low power function	07h	00h : Direct 01h : Auto mode
Lock function	08h	00h : lock condition 01h : lock clear
Pen up code function	0Ah	00h : 4 bytes 01h : 1 byte
Host CPU data output function	0Bh	0xh : x=Data from host CPU
With/without E2PROM 4/5 wire touch panel	0Dh	0xh : x=0,0,Z1,Z0 Z0 : 0-4 wire Z1 : 0-Without E2PROM 1-5 wire 1- With E2PROM

8-3. Error codes for RS232C communication

- F1 : When receiving an undefined command (the command undefined by this specification), the controller sends "F1h" to the host CPU.
- F2 : When receiving data which isn't defined by the command composed by plural bytes, the controller sends "F2h" to the host CPU.
- F3 : When the continuing data can not be received in the command after the time-out time passed, the controller sends "F3h" to the host CPU.
- F4 : When receiving a new command while receiving a plural composed command, the controller sends "F4h" to the host CPU.

Notice : Error code "F2" doesn't correspond to all plural composed commands.

MODEL No.	FT-CSU548(FTCSU548)		
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CHECKED BY: H. Kadowaki	Apr.18 '17	Unless otherwise specified Tolerances	
DRAWN BY: S. Kurihara	Apr.14 '17	Dimensions range	Tolerances
		Up to 6	±0.3
		Over 6 up to 30	±0.5
		Over 30 up to 50	±0.8
		Over 50	±1.2

9. USB SPECIFICATION AND COMMANDS

9-1. USB Specification

ITEM	CONTENTS
USB Specification	USB 2.0 Full Speed
Power source	BUS-powered/Self-powered
Device class	Vendor specific
Endpoint	EP0:8 byte (Control transfers) Descriptor and vendor commands EP1:4 byte (Interrupt transfers) Coordinate data
Frame interval	1 msec
Vendor ID	16C3h
Product ID	FC10h

9-2. Commands for using USB

(1). Sampling rate

(a) Default setting: 80(p/s)

(b) Sends an optional value 10 to maximum (p/s) according to the following format.

bmRequestType	bRequest	wValue	wIndex	wLength	Data
01000000B (40h)	91h	Sampling rate value (Note)	0	0	None

Note : Becareful not to settle more than the maximum sampling rate.
The coordinate data may becomes abnormal.
There is a maximum sampling rate of each mode as follows :
Calibration data mode - 130 (p/s)
Source data mode - 190 (p/s)

(2). Coordinates mode

(a) Default setting: Calibration data mode

(b) Source data mode

bmRequestType	bRequest	wValue	wIndex	wLength	Data
01000000B (40h)	80h	0	0	0	None

(c) Calibration data mode

bmRequestType	bRequest	wValue	wIndex	wLength	Data
01000000B (40h)	81h	0	0	0	None

(3). Data output mode

(a) Default setting: Stream mode

(b) Point mode

bmRequestType	bRequest	wValue	wIndex	wLength	Data
01000000B (40h)	A0h	0	0	0	None

(c) Stream mode

bmRequestType	bRequest	wValue	wIndex	wLength	Data
01000000B (40h)	A1h	0	0	0	None

(4). Duplicate coordinate processing function

(a) Default setting: Enable duplicate coordinate processung

(b) Enable duplicate coordinate processing

bmRequestType	bRequest	wValue	wIndex	wLength	Data
01000000B (40h)	84h	0	0	0	None

(c) Disenable duplicate coordinate processing

bmRequestType	bRequest	wValue	wIndex	wLength	Data
01000000B (40h)	85h	0	0	0	None

(5). Lock function

(a) Lock condition

bmRequestType	bRequest	wValue	wIndex	wLength	Data
01000000B (40h)	E0h	0	0	0	None

(b) Lock clear

bmRequestType	bRequest	wValue	wIndex	wLength	Data
01000000B (40h)	E1h	0	0	0	None

(6). Host CPU data output function

(a) Default setting : Pin no. 36 & 38 are "L" level

(b) Host CPU data output

bmRequestType	bRequest	wValue	wIndex	wLength	Data
01000000B (40h)	A2h	See below	0	0	None

Set "0" to the bit "z0" or "z1" to output "L" level and set "1" for the "H" level.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0	0	0	0	0	0	z1	z0

Bit	Pin No.
z0	36
z1	38

The controller chip starts from default setting after reboot, no matter with or without E2PROM.

(7). Status function

bmRequestType	bRequest	wValue	wIndex	wLength	Data
11000000B (C0h)	C3h	See below	0	01h	None

Mode	wValue	Return value
Coordinates calculation method	00h	01h : Source data mode 02h : Calibration data mode
Data output mode	01h	01h : Stream mode 02h : Point mode
Sampling rate	03h	Value of sampling rate
Duplicate coordinate processing function	06h	00h : Duplicate coordinate processing function disenable 01h : Duplicate coordinate processing function enable
Lock function	08h	00h : lock condition 01h : lock clear
Host CPU data output function	0Bh	0xh : x=Data from host CPU
With/without E2PROM 4/5 wire touch panel	0Dh	0xh : x=0,0,Z1,Z0 Z0 : 0-4 wire Z1 : 0-Without E2PROM 1-5 wire 1- With E2PROM

(8). Clear E2PROM data

bmRequestType	bRequest	wValue	wIndex	wLength	Data
01000000B (40h)	C5h	0	0	0	None

(9). Beep time setting

(a) Default setting : 0 msec

(b)

bmRequestType	bRequest	wValue	wIndex	wLength	Data
01000000B (40h)	86h	See below	0	0	None

Set the beep time from 100 to 300 msec by 50 msec step.
Pin no. 33 output the "H" level while the settled time when pen down the touch panel.

wValue	00h	01h	02h	03h	04h	05h
"H" level time (msec)	0	100	150	200	250	300

(10). Calculate Calibration ratio

bmRequestType	bRequest	wValue	wIndex	wLength	Data
01000000B (40h)	83h	2h	0	000Fh	Data format as follows

According to the following format, controller calculate and sets a calibration ratio.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	Bit0
0	0	0	0	x3	x2	x1	x0
0	0	x9	x8	x7	x6	x5	x4
0	0	0	0	y3	y2	y1	y0
0	0	y9	y8	y7	y6	y5	y4
0	0	0	0	X3	X2	X1	X0
0	0	X9	X8	X7	X6	X5	X4
0	0	0	0	Y3	Y2	Y1	Y0
0	0	Y9	Y8	Y7	Y6	Y5	Y4
0	0	0	0	Ax3	Ax2	Ax1	Ax0
0	0	Ax9	Ax8	Ax7	Ax6	Ax5	Ax4
0	0	0	0	Ay3	Ay2	Ay1	Ay0
0	0	Ay9	Ay8	Ay7	Ay6	Ay5	Ay4
0	0	0	0	AX3	AX2	AX1	AX0
0	0	AX9	AX8	AX7	AX6	AX5	AX4
0	0	0	0	AY3	AY2	AY1	AY0
0	0	AY9	AY8	AY7	AY6	AY5	AY4

The 1st LCD reference point
x0~x9 : The binary number of the horizontal axis coordinates x of the 1st reference point
y0~y9 : The binary number of the vertical axis coordinates y of the 1st reference point
(x9, y9 are the high-order bit).

The 2nd LCD reference point
X0~X9 : The binary number of the horizontal axis coordinates X of the 2st reference point
Y0~Y9 : The binary number of the vertical axis coordinates Y of the 2st reference point
(x9, y9 are the high-order bit).

The A/D value of the 1st reference point
Ax0~Ax9 : The binary number of the A/D value which horizontal axis coordinates x of the 1st reference point
Ay0~Ay9 : The binary number of the A/D value which vertical axis coordinates y of the 1st reference point
(x9, y9 are the high-order bit).

The A/D value of the 2nd reference point
AX0~AX9 : The binary number of the A/D value which horizontal axis coordinates X of the 2nd reference point
AY0~AY9 : The binary number of the A/D value which vertical axis coordinates Y of the 2nd reference point
(x9, y9 are the high-order bit).

*The absolute value of margin between the A/D value (AX,AY) of the 2nd reference point and the A/D value (Ax,Ay) of the 1st reference point are as follows.
$|AX-Ax|>100$, $|AY-Ay|>100$

* More than 50 msec interval is required between the last calibrtaion command (16 bytes) and next command.

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CHECKED BY: H. Kadowaki	Apr.18 '17	Unless otherwise specified Tolerances
DRAWN BY: S. Kurihara	Apr.14 '17	Dimensions range / Tolerances: Up to 6 ±0.3; Over 6 up to 30 ±0.5; Over 30 up to 50 ±0.8; Over 50 ±1.2

MODEL No. FT-CSU548(FTCSU548)

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10.FORMAT OF THE COORDINATE DATA (4-BYTE)

bit	7	6	5	4	3	2	1	0	
	ph	0	0	P	X3	X2	X1	X0	1st byte
	0	0	X9	X8	X7	X6	X5	X4	2nd byte
	0	1	1	SW0	Y3	Y2	Y1	Y0	3rd byte
	0	0	Y9	Y8	Y7	Y6	Y5	Y4	4th byte

ph : Phase bit , always set to 1.
P : Pen status (pen down=1, pen up=0)
"0" : Always set to 0.
X0 to X9 : The binary number of horizontal axis coordinates value (X).
(X9 is the high-order bit)
Y0 to Y9 : The binary number of vertical axis coordinates value (Y).
(Y9 is the high-order bit)

According to the pen up code setting, it outputs pen up code data.

(a)Pen up code setting: 1 byte (Only RS232C communication)
It outputs "80h" as the pen up code data.
(b)Pen up code setting: 4 bytes (RS232C and USB)
The pen up data would be as follows
ph (phase bit): 1
p (pen status): 0
coordinate data (X0-X9,Y0-Y9): All "0"

Notice: During and after reset, the controller chip sometimes send invalid data (ex. 00h, FFh, F0h, etc.). Please ignore these data by host CPU.

11.NOTICE TO USE E2PROM

(1) When using the E2PROM, the updated commands (except "Host CPU data output function") are stored to E2PROM and after reboot the chip will start from the updated status. In order to clear the data of E2PROM please follows the steps below.

(a) Send E2PROM clear command (C5h)
(b) Reset the controller chip

(2) There is the limitation for number of data rewrite times to E2PROM. Please avoid to send the commands often from host CPU.

(3) If EEPROM is not used, IC settings are initialized after reset.

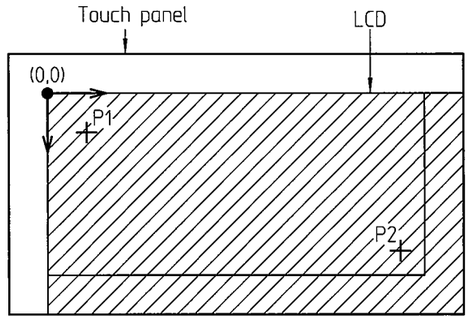
12.ABOUT THE INTERVAL TIME

When wake up from stop mode or resetting controller (hardware reset, software reset, power on reset, watch dog reset), the stable time of controller must be taken. The interval time must be more than 50 (ms).

13.HOW TO SET CALIBRATION RATIO TO CONTROLLER

(a) Set the controller to the source data mode (80h)
(b) Display the 1st reference point P1 to the LCD.
(c) Touch the 1st reference point P1 with the stylus.
(d) Save the source data mode of the 1st set point to the host.
(e) Display the 2nd reference point P2 to the LCD.
(f) Touch the 2nd reference point P2 with the stylus.
(g) Host computer receive the A/D value of each 1st reference point P1 and 2nd reference point P2.
(h) Send a calibration ratio command code (83h).
(i) Send the LCD coordinates value of each 1st (P1) and 2nd (P2) reference point (8 bytes).
P1→P2
(j) Send the A/D value of each 1st (P1) and 2nd (P2) reference point (8 bytes).
P1→P2
(k) Switch the controller to the calibration data mode. (81h)

Calculate calibration command



P1 : The 1st reference point as first pen down
P2 : The 2nd reference point as 2nd pen down
The area where data is output (The calibration data mode)

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CHECKED BY: H. Kadowaki	Apr.18 '17	Dimensions range	Tolerances
DRAWN BY: S. Kurihara	Apr.14 '17	Up to 6	±0.3
		Over 6 up to 30	±0.5
		Over 30 up to 50	±0.8
		Over 50	±1.2

MODEL No. FT-CSU548(FTCSU548)

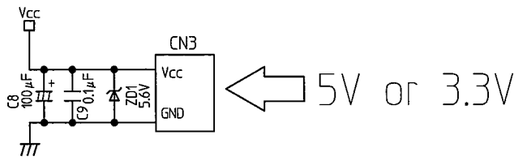
NKK SWITCHES CO., LTD.

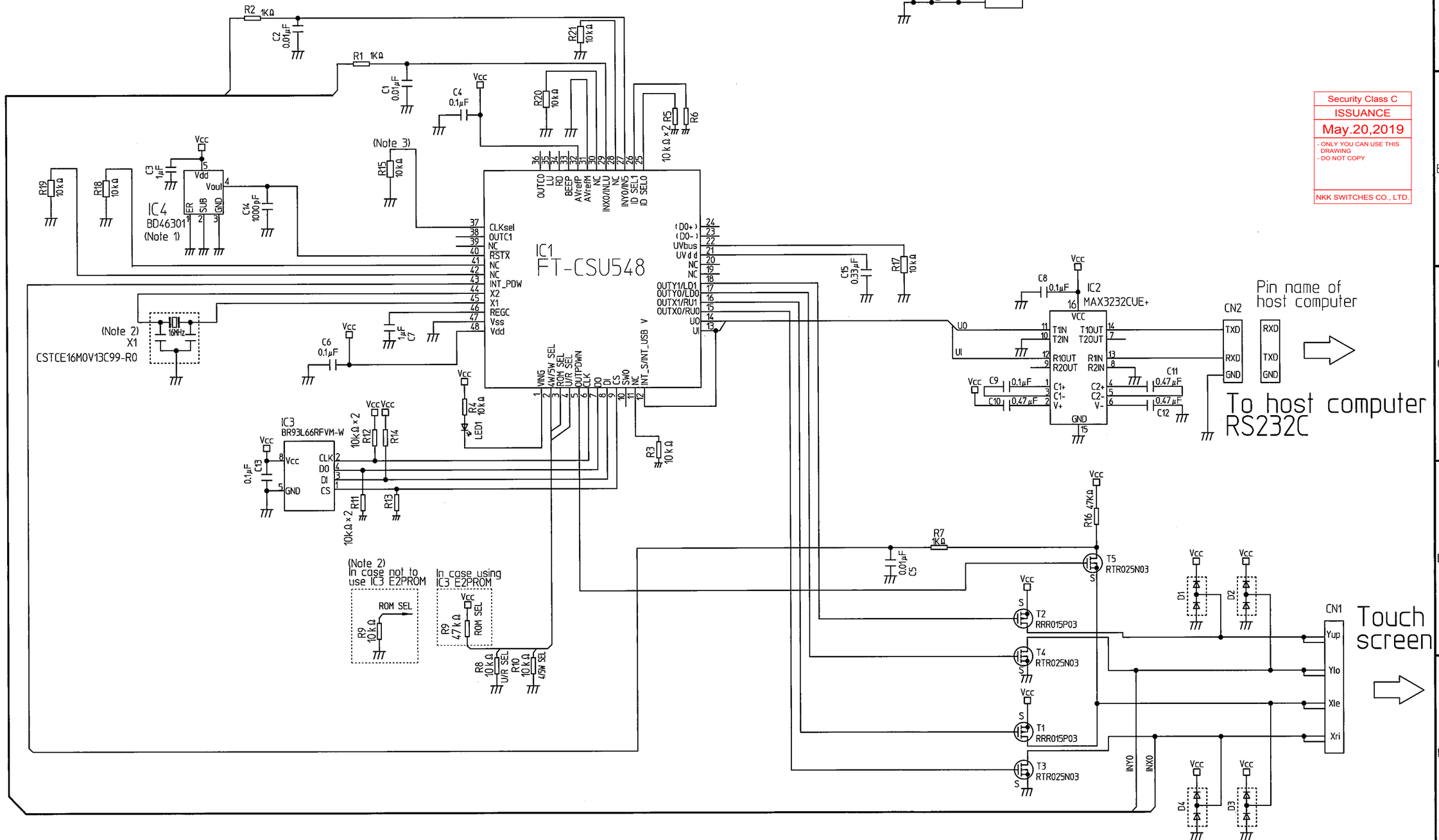
1E-FT-CSU548_11(器外形名)

14. RECOMMENDED CIRCUITS

(1) Touch screen: 4 wire, Interface: RS232C

Power source Vcc: 5V or 3.3V
Clock frequency: 16MHz
Clock: ceramic oscillator





Note 1. To use for Vcc=3.3V: BD46251 must be use for IC4 (reset IC)
Note 2. In case not to use IC3 E2PROM: Delete IC3, R12, R13, R14. Pull down R9 to GND
Note 3. In case of using external clock, it is necessary to change the setting by "See page 5, column 6"

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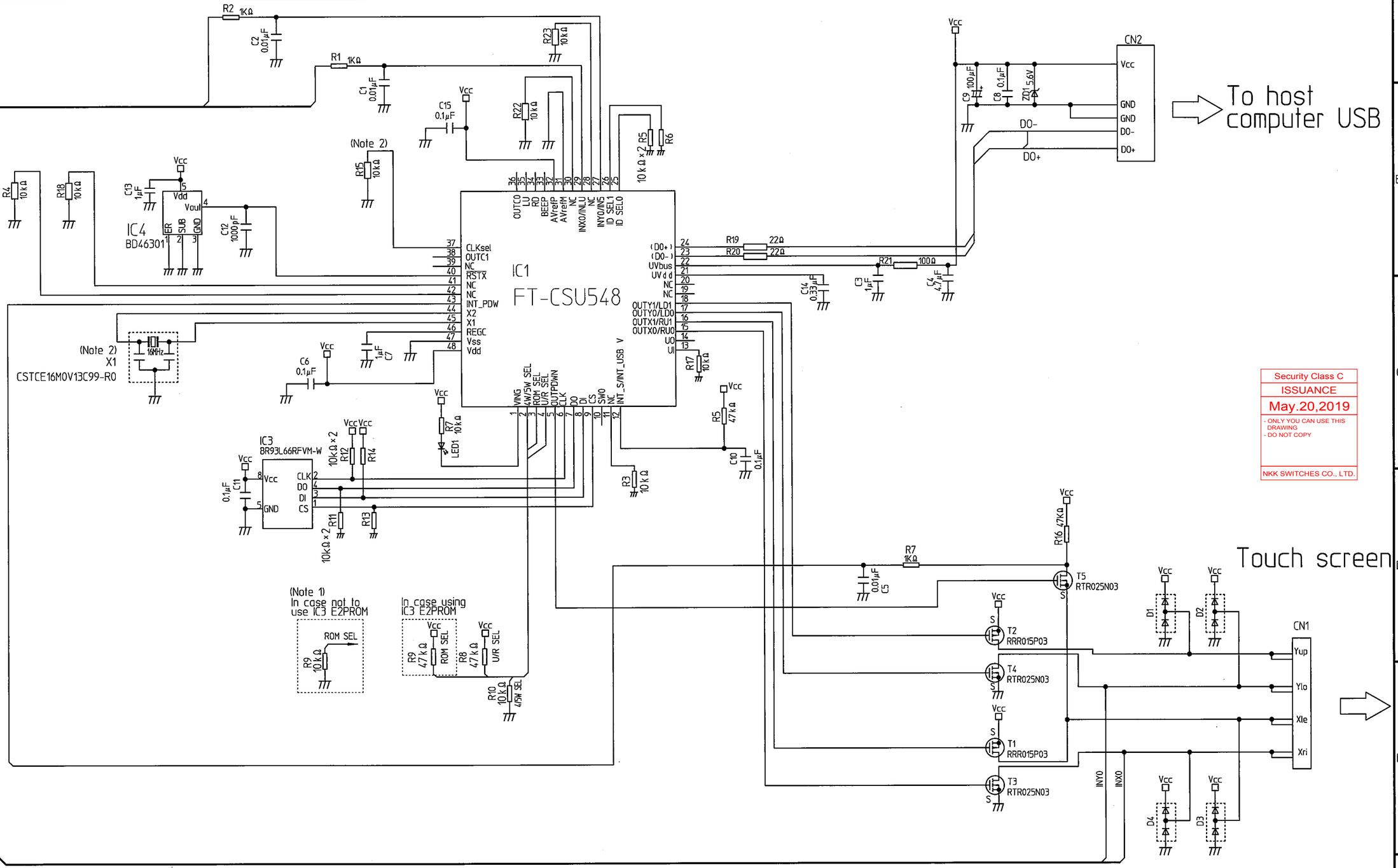
DRAWN BY: S. Kurihara	Apr.14 '17	Dimensions range	Tolerances
		Up to 6	±0.3
		Over 6 up to 30	±0.5
		Over 30 up to 50	±0.8
		Over 50	±1.2

MODEL No. FT-CSU548(FTCSU548)
NKK SWITCHES CO., LTD.
No. 190545
1E-FT-CSU548_12(海外形名)

(2) Touch screen: 4 wire, Interface: USB (Bus-powered)

Power source Vcc: 5V or 3.3V
Clock frequency: 16MHz
Clock: ceramic oscillator



Note 1. In case not to use IC3 E2PROM: Delete IC3、R12、R13、R14. Pull down R9 to GND.
Note 2. In case of using external clock, it is necessary to change the setting by "See page 5, column 6"

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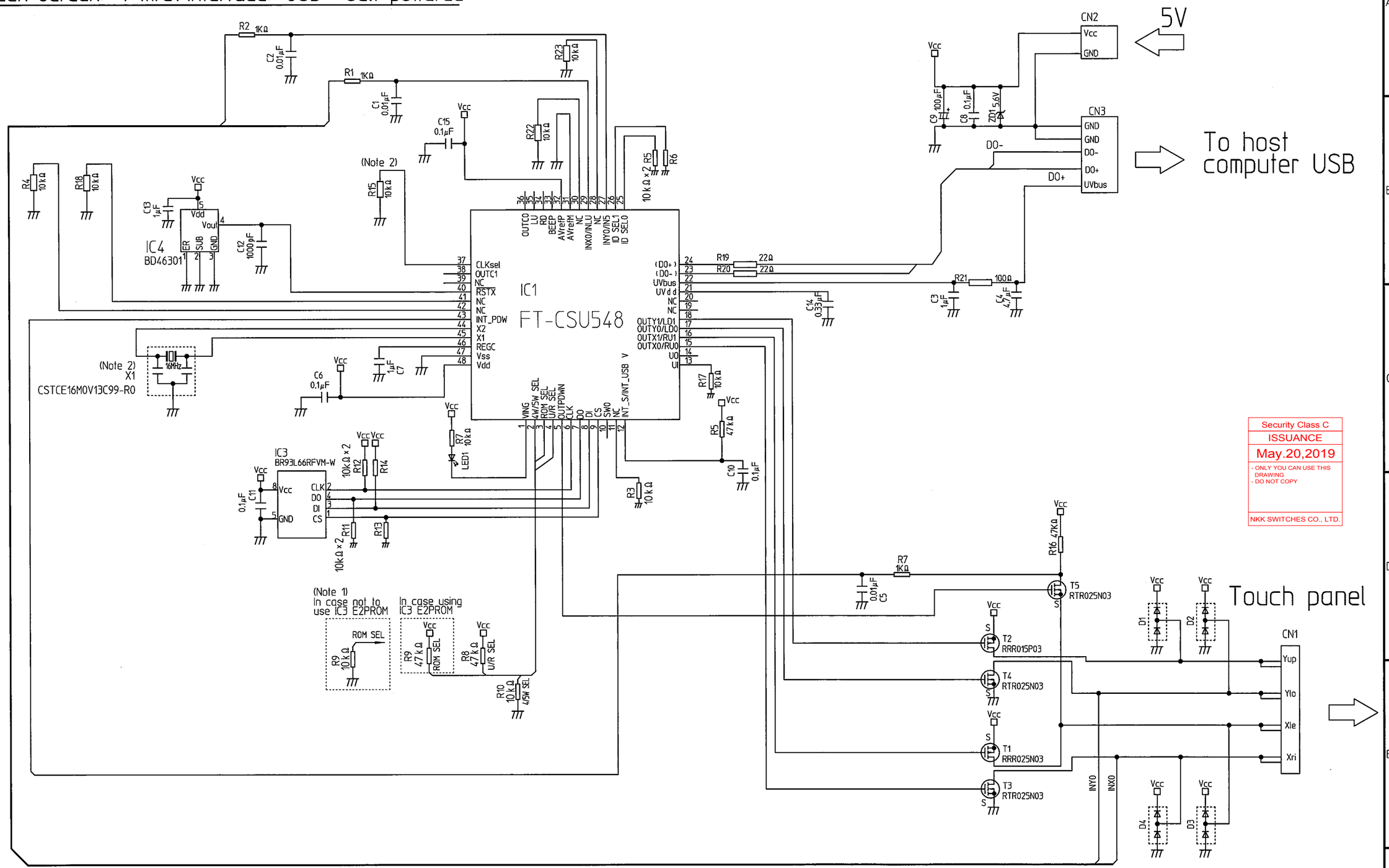
CHECKED BY: H. Kadowaki	Apr.18 '17	Unless otherwise specified Tolerances	
DRAWN BY: S. Kurihara	Apr.14 '17	Dimensions range	Tolerances
		Up to 6	±0.3
		Over 6 up to 30	±0.5
		Over 30 up to 50	±0.8
		Over 50	±1.2

MODEL No. FT-CSU548(FTCSU548)

NKK SWITCHES CO., LTD.

(3) Touch screen: 4 wire, Interface: USB (Self-powered)

Power source Vcc: Vcc=5V (Self-powered)
Clock frequency: 16MHz
Clock: ceramic oscillator



Note 1. In case not to use IC3 E2PROM: Delete IC3, R12, R13, R14. Pull down R9 to GND.
Note 2. In case of using external clock, it is necessary to change the setting by "See page 5, column 6"

APPROVED BY: H. Kurashima	May.9 '17	SCALE :	
CHECKED BY: M. Tamura	Apr.27 '17	DIMENSIONS IN mm	
CHECKED BY: H. Kadowaki	Apr.18 '17	Unless otherwise specified Tolerances	
DRAWN BY: S. Kurihara	Apr.14 '17	Dimensions range	Tolerances
		Up to 6	±0.3
		Over 6 up to 30	±0.5
		Over 30 up to 50	±0.8
		Over 50	±1.2

MODEL No. FT-CSU548(FTCSU548)

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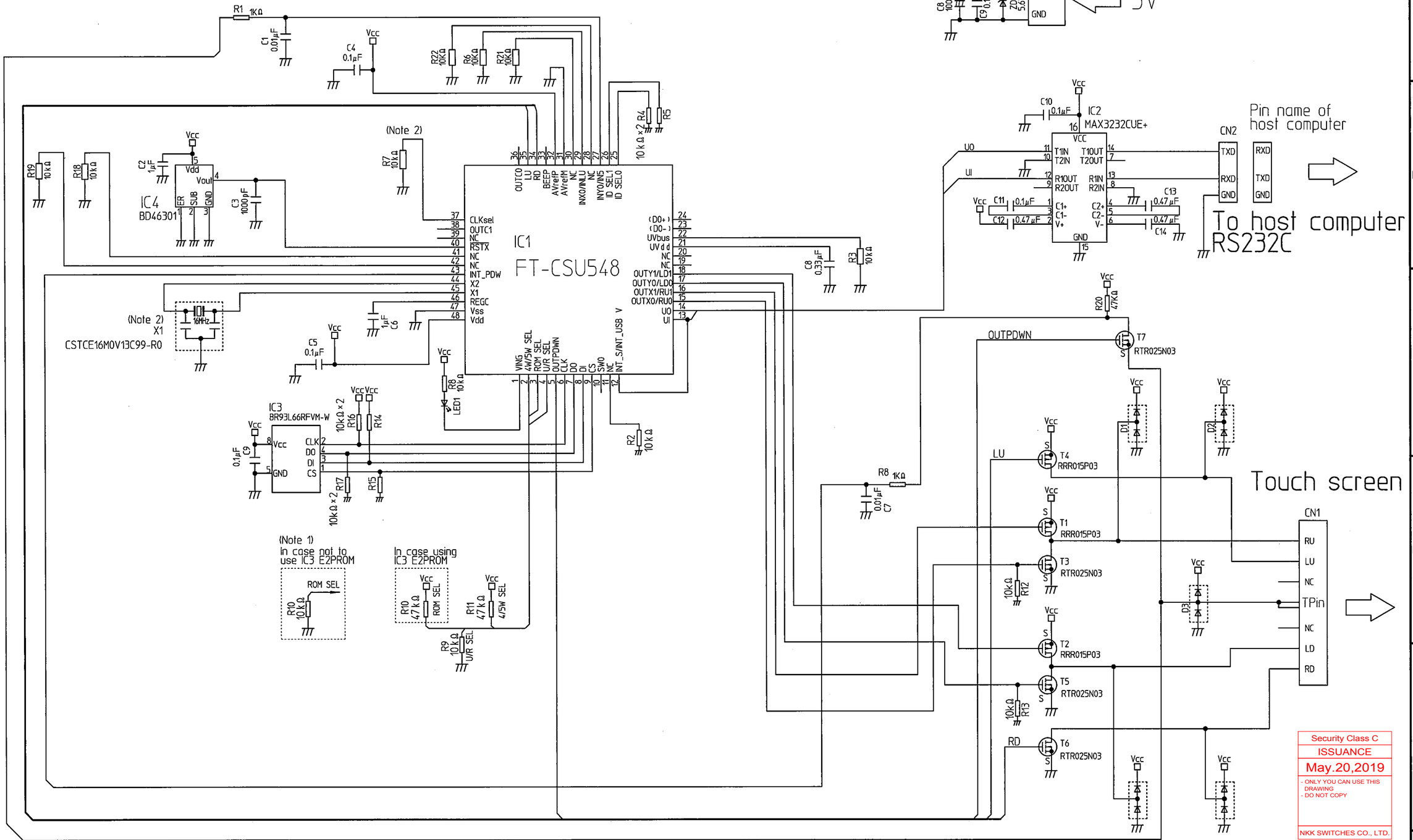
(4) Touch screen: 5 wire, Interface: RS232C

Power source Vcc: 5V
Clock frequency: 16MHz
Clock: ceramic oscillator



Note 1. In case not to use IC3 E2PROM: Delete IC3、R14、R15、R16. Pull down R10 to GND.
Note 2. In case of using external clock, it is necessary to change the setting by "See page 5, column 6"

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APPROVED BY: H. Kurashima	May.9 '17	SCALE :
CHECKED BY: M. Tamura	Apr.27 '17	DIMENSIONS IN mm
CHECKED BY: H. Kadowaki	Apr.18 '17	Unless otherwise specified tolerances
DRAWN BY: S. Kurihara	Apr.14 '17	Dimensions range / Tolerances: Up to 6 ±0.3; Over 6 up to 30 ±0.5; Over 30 up to 50 ±0.8; Over 50 ±1.2

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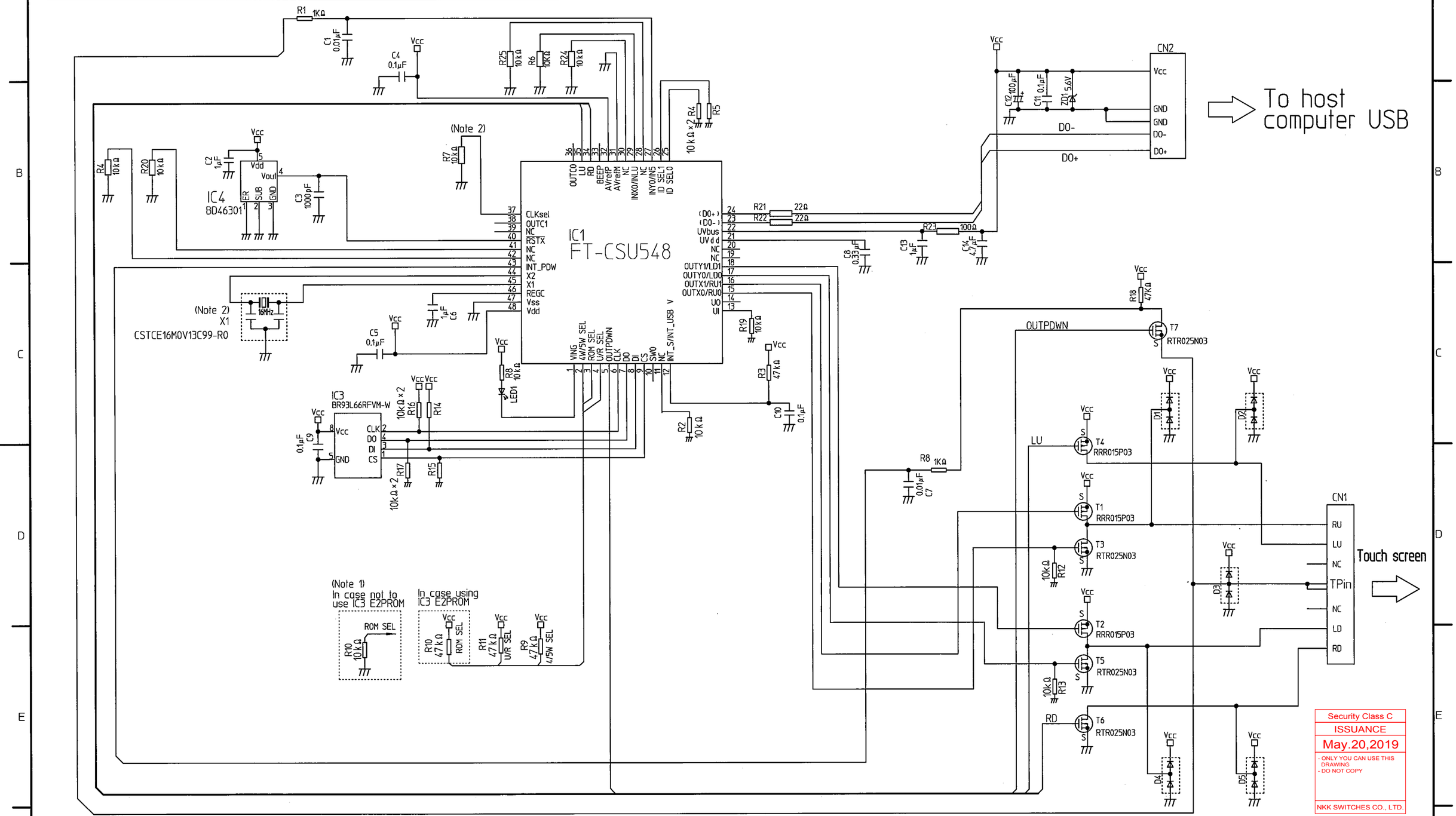
(5) Touch screen: 5 wire, Interface: USB (BUS-powered)

Power source Vcc: Bus-powered
Clock frequency: 16MHz
Clock: ceramic oscillator



Note 1. In case not to use IC3 E2PROM: Delete IC3, R14, R15, R16. Pull down R10 to GND.
Note 2. In case of using external clock, it is necessary to change the setting by
"See page 5, column 6"

APPROVED BY: H. Kurashima	May.9 '17	SCALE :	
CHECKED BY: M. Tamura	Apr.27 '17	DIMENSIONS IN mm	
CHECKED BY: H. Kadowaki	Apr.18 '17	Unless otherwise specified Tolerances	
DRAWN BY: S. Kurihara	Apr.14 '17	Dimensions range	Tolerances
		Up to 6	±0.3
		Over 6 up to 30	±0.5
		Over 30 up to 50	±0.8
		Over 50	±1.2

MODEL No. FT-CSU548(FTCSU548)

NKK SWITCHES CO., LTD.

1E-FT-CSU548_16(超外形名)

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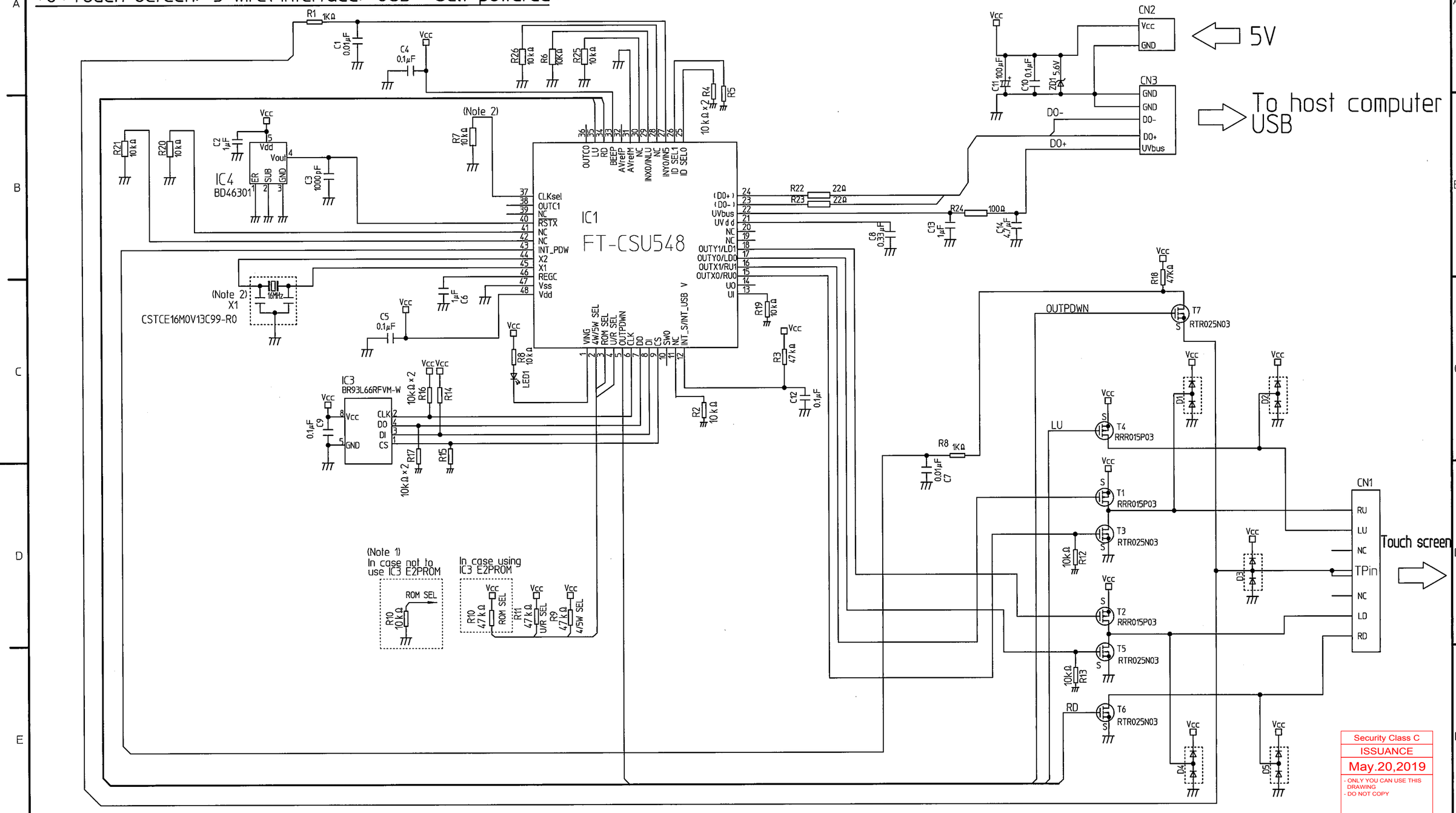
(6) Touch screen: 5 wire, Interface: USB (Self-powered)

Power source Vcc: Vcc=5V (Self-powered)
Clock frequency: 16MHz
Clock: ceramic oscillator



Note 1. In case not to use IC3 E2PROM: Delete IC3, R14, R15, R16. Pull down R10 to GND.
Note 2. In case of using external clock, it is necessary to change the setting by "See page 5, column 6"

APPROVED BY: H. Kurashima	May.9 '17	SCALE :	
CHECKED BY: M. Tamura	Apr.27 '17	DIMENSIONS IN mm	
CHECKED BY: H. Kadowaki	Apr.18 '17	Unless otherwise specified tolerances	
DRAWN BY: S. Kurihara	Apr.14 '17	Dimensions range	Tolerances
		Up to 6	±0.3
		Over 6 up to 30	±0.5
		Over 30 up to 50	±0.8
		Over 50	±1.2

MODEL No. FT-CSU548(FTCSU548)

NKK SWITCHES CO., LTD.

No. 190545

1E-FT-CSU548_17(海外形名)

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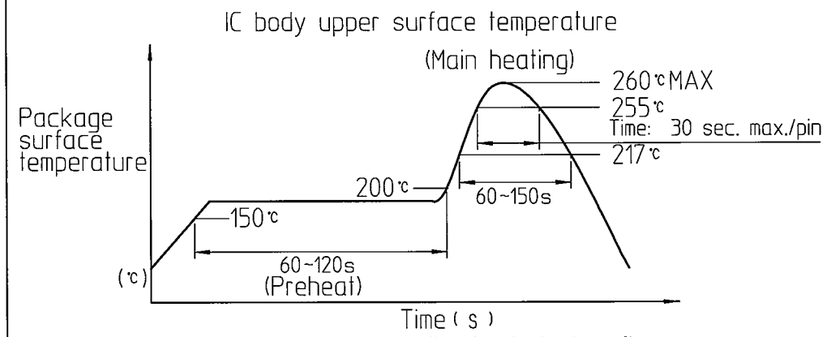
15. RECOMMENDED MOUNTING CONDITIONS

15-1. Temperature profile for hot air reflow/infrared reflow sceme

ITEM	CONTENTS
Acceptable mouting conditions	2 or less
Storage conditions	5~30℃, 70%RH or less
Hot air reflow/ Infrared reflow	・Peak temperature (260℃) : 260℃MAX ・Peak humidity time (-5℃) : 255℃ Time: 30 sec. max./pin ・Solder melting point or higher (time of over 217 ℃) : 60~150s ・Preheat area time (150~200℃) : 60~120s  <Temperature profile for hot air reflow> Note ・The solder melting temperature varies with the substrate and paste material used.For the experimental temperature profile, please use the optimum temperature under the presentation conditions

15-2. Manual soldering (partial heating method)

ITEM	CONTENTS
Storage conditions	5~30℃, 70%RH or less
Mounting conditions	・Maximum temperature(350℃ or less) ・Time: 3 sec. max./pin ・Number of mounting: 1 time

15-3. Full solder dipping

Note that the use of full solder dipping should be avoided.

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	NKK SWITCHES CO., LTD.	CHECKED BY: M. Tamura	Apr.27 '17	DIMENSIONS IN mm
		CHECKED BY: H. Kadowaki	Apr.18 '17	Unless otherwise specified Tolerances
		DRAWN BY: S. Kurihara	Apr.14 '17	Dimensions range / Tolerances: Up to 6 ±0.3; Over 6 up to 30 ±0.5; Over 30 up to 50 ±0.8; Over 50 ±1.2

16. NOTES ON USE

16-1. Precautions for product design

(1). Absolute maximum ratings

Controller chips can be permanently damaged by application of stress (voltage, current, temperature, etc.) in excess of certain established limits, called absolute maximum ratings. Do not exceed these ratings.

(2). Recommennded operating conditions

Always use controller chips within the recommended operating conditions. Operation outside these ranges may adversely affect reliability and could result in device failure.

(3). Handling of unused input pins

Unconnected input pins can adversely affect stability of operation. Such pins should be connected through an appropriate resistance to a power supply or ground. (see 4. Pin descriptions)

(4). Handling of unused outputu pins (NC pins)

Unused output pins must be keep open. (see 4 Pin descriptions)

(5). Latch-up

The occurrence of latch-up not only causes loss of reliability in the controller chips but can cause injury or damage from high heat, smoke or flame. To prevent this from happening, do the following

(a) Be sure that the voltage applied to pins do not exceed the absolute maximum ratings.
This should include attention to abnormal noise, surge levels,etc.

(b) Be sure that abnormal current flows do not occur during the power-on sequence.

(6). Fluctuating voltage of power source

Steeply gradient voltage of power souce may causes the program failure. The recommendation of power source Vcc ripple is lower than 5 % (50 to 60Hz).

(7). Notice on use by external clock

Also in case of using external clock the stable time must be taken after wake up from stop mode or resetting controller (hardware reset, software reset, power on reset, watch dog reset).

(8). Fail-safe design

The controller chips have inherently a certain rate of failure. You must protect against injury, damage or loss from such failures by incorporating safety design measures into your facility and equipment such as redundancy, fire protection, and prevention of over-current levels and other abnormal operating conditions.

(9). Notes on circuits

To design circuit of controller chip, the length of wire from chip to touch panel must be as short as possible. As the wire from chip to touch panel is analog line, keep away the electrical parts and wires that may causes electrical noise. These noise may causes failure movement of touch screen.

(10). Precautions related to usage of devices

This controller chip is intend for use in standard application (computers, office automation, other office equipment, industrial, communications, and measurement equipment, personal or household devices, etc.) This controller chip is NOT intend to use in special applications where failure or abnormal operation may directly affect human lives or cause physical injury or property damage or where extremely high levels of reliability are demanded, such as aerospace systems, atomic energy controls, sea floor repeaters, vehicle operating controls, medical devices for life support, etc.

(11). To use ceramic resonator or quarts-crystal oscillator for clock

It is recommendded to have the matching investigation by ceramic resonator or quarts-crystal oscillator manufacturer with your devices.

16-2. Storage

(1). Avoid exposure to rapid temperature changes, which cause moisture to condense inside the product. Store the controller chips in location where temperature changes are slight.

(2). Controller chips should be sealed in their aluminum laminate bags for storage.

(3). Use dry box for storage. Controller chips must store in condition humidity 45~75%RH, temerature 25~35℃.

(4). Do not store the products where they will exposed to corrosive gases or in dusty locations.

(5). Note that if controller chips are stored for an extended period of time, the solderability of the lead pins may decline, rust may form, or the electrical characteristics may deteriorate.

16-3. Static electricity

On the occasion of the handling of controller chips, be careful enough to static electricity and take the measures against a ground of a worker and a work place.

16-4. Precautions for use environment

(1). Humidity

Prolonged use in high humudity can lead to leakage in chips as well as printed circuit boards. If high humidity levels are anticipated, consider anti-humidity processing.

(2). Discaharge of static electricity

When high-voltage charges exists close to controller chips, discharges can cause abnormal operation. In such cases, use anti-static measures or processing to prevent discharges.

(3). Corrosive gases, dust,or oil

Exposure to corrosive gases or contact with dust or oil may lead to chemical reactions that will adversely affect the controller chip. If you use chips in such conditions, consider ways to prevent such exposure or to protect the devices.

(4). Others

It may cause failure movement by the ambient environment of the system used (temperature, humidity, secular distortion, surrounding circuit, wiring, and noise, etc.). Please examine an enough evaluation and the prevention measure by the system when you use controller chips.

16-5. Precautions for package mounting

(1). The controller chip is simply dried packaged. To prevent the chips body crack, please bake in condition below before mounting.

125℃ 24Hr

(2). After soldering, clean away any flux residue.

(3). Do not touch or brush the printed surface until the cleaning fluid dries.

(4). In case if diffecaulty to controll temperature or time when soldering, consider to use the low temperature melting solder.

(5). There is partially causing the temperature rise when the controller chip is left in the high temperature for a long time to soldering by the infrared rays reflow method, soldering time should be as short as possible.

(6). To remove controller chips from printed wire board should done short time as possible.

(7). There is a possibility of damage if stress is applied to the terminals. Please use with caution.

16-6. Ultrasonic cleaning

(1). The package must not resonate.

(2). The package and printd circuit board must not come into direct contact with the vibrationsource.

16-7. Others

(1). The controller chip becomes the outside for a guarantee of operation, in use by the combination with touch screen not manufactured by NKK.

(2). It cannot assume all the responsibilities to the damage that occurs by having used this controller chip.

(3). This controller chip may change the contents without a preliminary announcement for improvement.

(4). The circuits shown page 12 to 17 are for reference. Please have the enough investigation to use controller chip.

(5). Using the combination with USB device driver provided from NKK, in case not working just after installation the driver or plug-and-play to connect the controller chip, please keep the host computer and controller chip is connected by USB cable and reboot the host computer.

(6). Please do not send the commands except shown in this product specification. Sending the commands not shown in this specification may cause failure movement.

(7). Even once calibration was generated, the gap may occured between touch position and cursor position by change in ambient environment such as secular distortion, temperature change, extraction and insertion of touch screen tail to the connector, etc. In this case, calibrate again to accurate the touch and cursor position.

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