# 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)

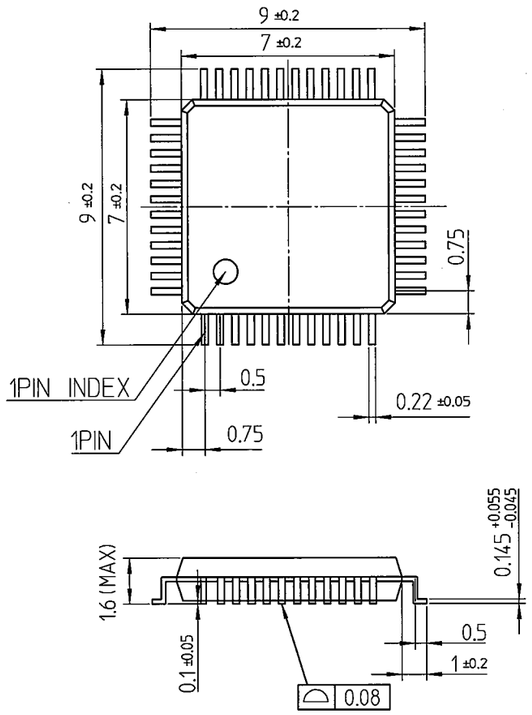
(2) A/D converter resolution : 10 bits

(3) Interface : RS232C & USB 2.0 Full speed

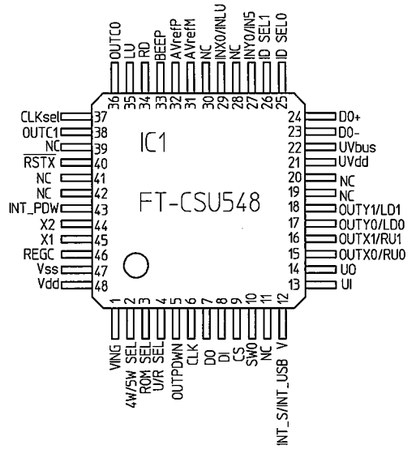
(4) Others

- *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 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.

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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 |
| 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<br>OUTX0/RU0、OUTX1/RU1<br>OUTPDWN,OUTC1,U0,CS,DI,CLK<br>BEEP,OUTC0 | Vcc=5.0V±5%<br>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<br>OUTX0/RU0、OUTX1/RU1<br>OUTPDWN,OUTC1,U0,CS,DI,CLK<br>BEEP,OUTC0 | Vcc=5.0V±5%<br>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%<br>Iol1=15.0mA | | | 2.0 | V |
| | | | Vcc=5.0V±5%<br>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)<br>INX0/INLU,INY0/IN5,ID SEL0,ID SEL1<br>INT_S/INT_USB V,UI<br>4W/5W SEL,ROM SEL,U/R SEL<br>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)<br>INX0/INLU,INY0/IN5,ID SEL0,ID SEL1<br>INT_S/INT_USB V,UI<br>4W/5W SEL,ROM SEL,U/R SEL<br>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 |

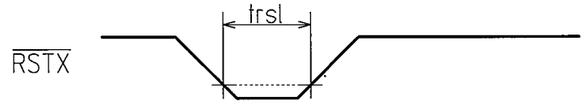
MODEL No. FT-CSU548(FTCSU548)

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)

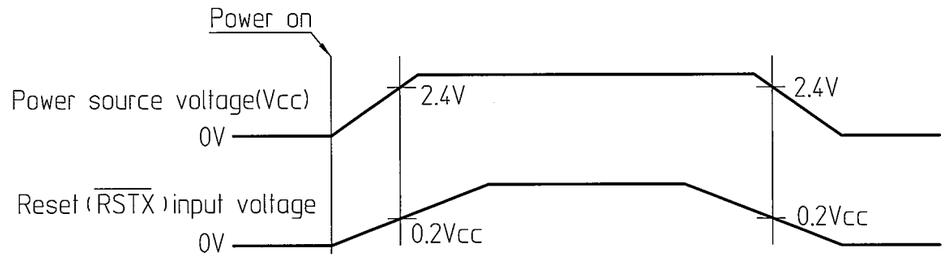
| ITEM | SYMBOL | CONDITION | LIMITS | | UNIT |
|---|---|---|---|---|---|
| | | | Min. | Max. | |
| $\overline{RSTX}$ LOW pulse width | trsl | - | 10 | - | μs |




(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.

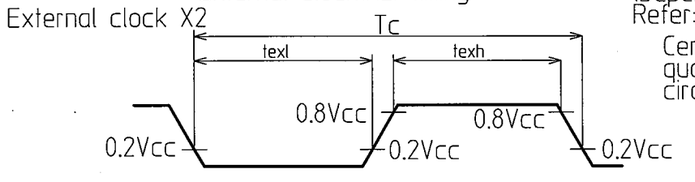



(3) External clock timing

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

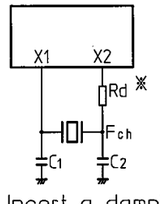
| ITEM | SYMBOL | NAME | LIMITS | | UNIT |
|---|---|---|---|---|---|
| | | | Min. | Max. | |
| External clock input "H" & "L" pulse width | texh<br>texl | X2 | 30 | | ns |
| External clock input cycle time | tc | X2 | 62.34 | | ns |

・External clock(X2) timing

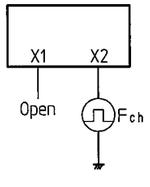



・Clock input circuit
(Depending on the type of clock, setting is necessary. Refer:"See page 5, column 6")

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) | | | | |
|---|---|---|---|---|---|
| NKK SWITCHES CO., LTD. | | | | | |
| 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<br>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.<br>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.<br>Direct : After receiving a command, it shifts to the low power mode immediately.<br>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<br>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 |

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# 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<br>Parity bit: None<br>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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| | | |
|---|---|---|
| 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 |
| DRAWN BY: S. Kurihara | Apr.14 '17 | Over 30 up to 50 ±0.8; Over 50 ±1.2 |

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| 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<br>02h : Calibration data mode |
| Data output mode | 01h | 01h : Stream mode<br>02h : Point mode |
| Sampling rate | 03h | 1st byte<br>0xh:x is the return value of lower order sampling rate value (z3~z0).<br>2nd byte<br>0xh:x is the return value of higher order sampling rate value (z7~z4). |
| Time-out function | 05h | 1st byte return value<br>0xh:x is the lower order time-out value (z3-z0).<br>2nd byte return value<br>0xh:x is the higher order time-out value (z9-z4). |
| Duplicate coordinate processing function | 06h | 00h : Duplicate coordinate processing function disenable<br>01h : Duplicate coordinate processing function enable |
| Low power function | 07h | 00h : Direct<br>01h : Auto mode |
| Lock function | 08h | 00h : lock condition<br>01h : lock clear |
| Pen up code function | 0Ah | 00h : 4 bytes<br>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<br>Z0 : 0-4 wire Z1 : 0-Without E2PROM<br>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.



| | | | |
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| MODEL No. | FT-CSU548(FTCSU548) | | |
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| 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 |

# 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)<br>Descriptor and vendor commands<br>EP1:4 byte (Interrupt transfers)<br>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 |



| | | | |
|---|---|---|---|
| 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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## (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<br>02h : Calibration data mode |
| Data output mode | 01h | 01h : Stream mode<br>02h : Point mode |
| Sampling rate | 03h | Value of sampling rate |
| Duplicate coordinate processing function | 06h | 00h : Duplicate coordinate processing function disenable<br>01h : Duplicate coordinate processing function enable |
| Lock function | 08h | 00h : lock condition<br>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<br>Z0 : 0-4 wire Z1 : 0-Without E2PROM<br>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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| | | | |
|---|---|---|---|
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| 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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## 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.

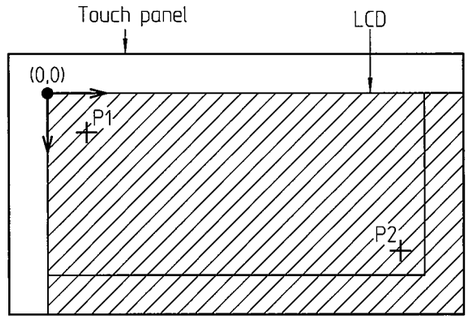
## 12.ABOUT THE INTERVAL TIME

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)



| | | | |
|---|---|---|---|
| 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 |
| 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)

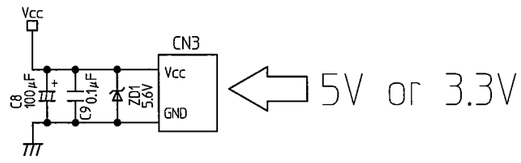
NKK SWITCHES CO., LTD.

1E-FT-CSU548_11(器外形名)

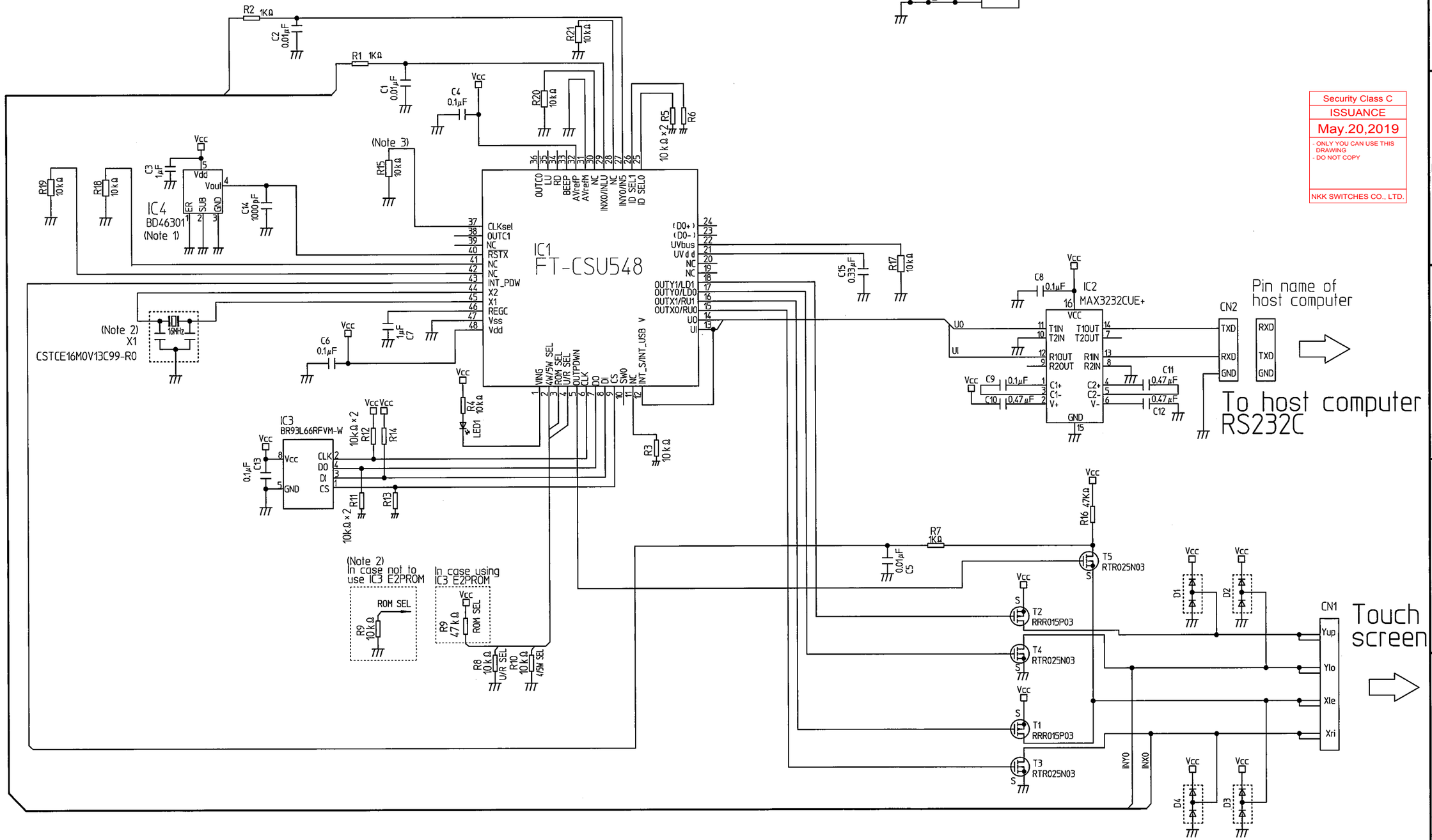
# 14. RECOMMENDED CIRCUITS

## (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"

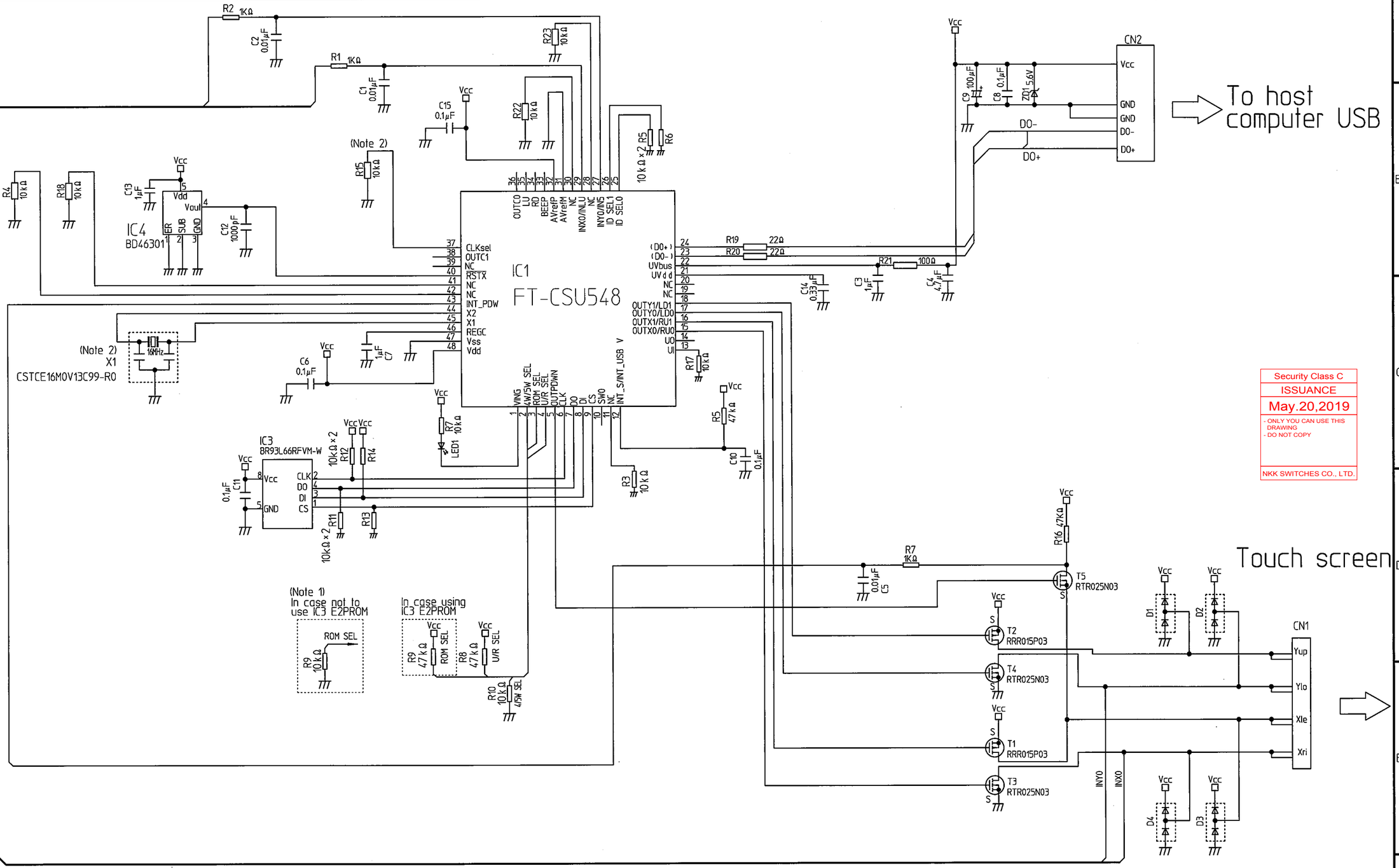
| | | | |
|---|---|---|---|
| MODEL No. | FT-CSU548(FTCSU548) | APPROVED BY: H. Kurashima | May.9 '17 |
| | NKK SWITCHES CO., LTD. | CHECKED BY: M. Tamura | Apr.27 '17 |
| | | CHECKED BY: H. Kadowaki | Apr.18 '17 |
| | | DRAWN BY: S. Kurihara | Apr.14 '17 |

SCALE :
DIMENSIONS IN mm

| 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 |

# (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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| | | |
|---|---|---|
| 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

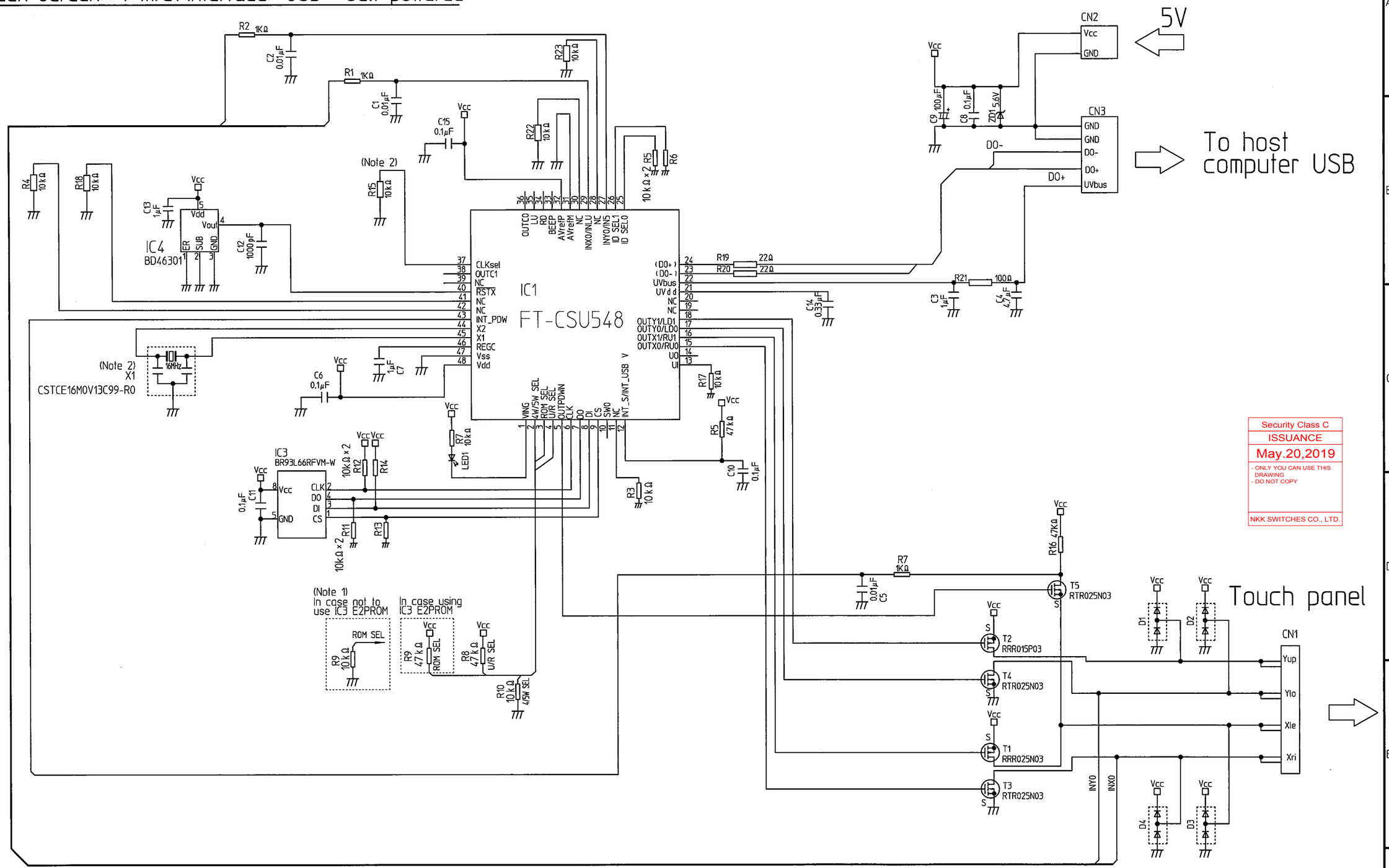
1E-FT-CSU548_13(遊外形名)

様式 No.6435

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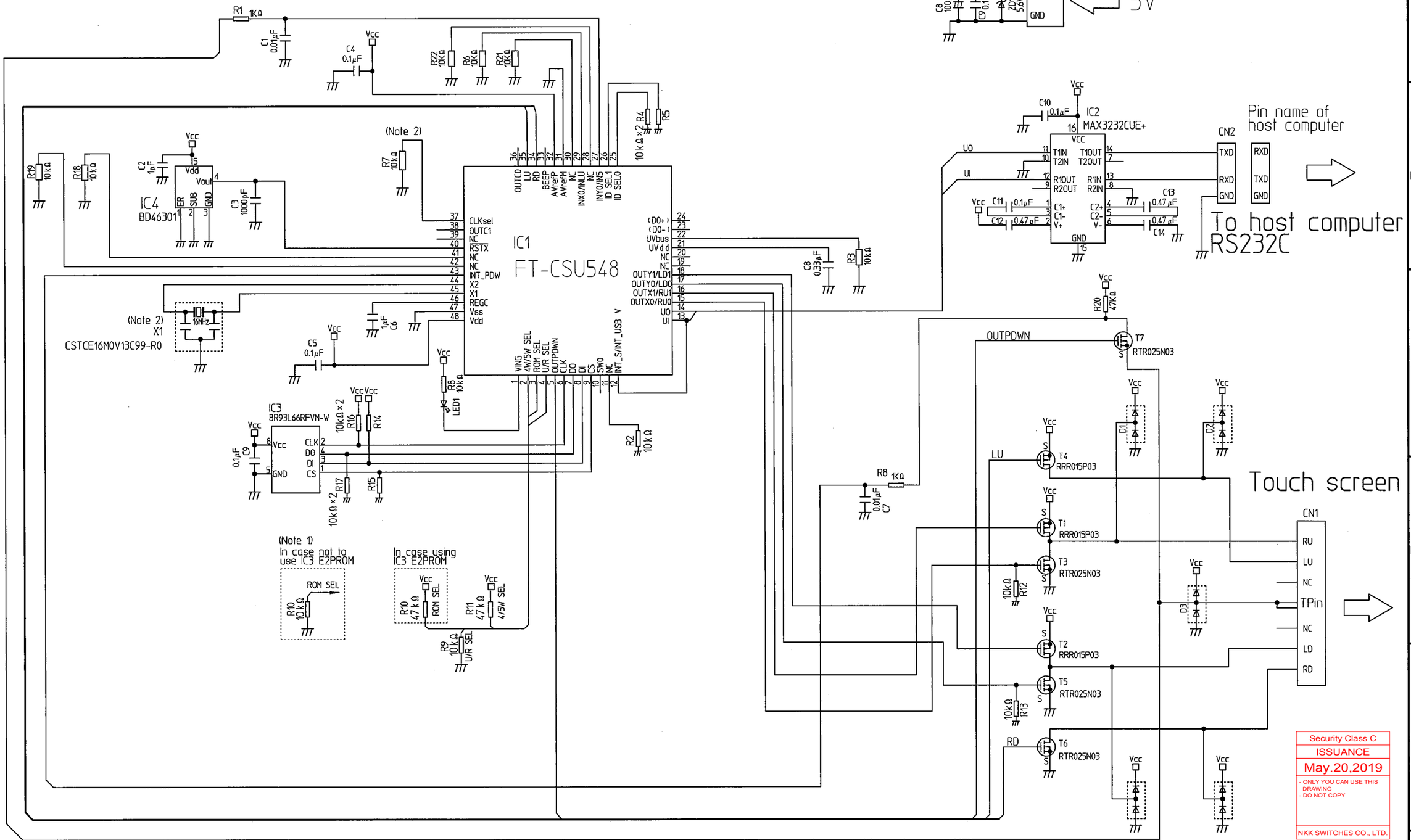
# (4) Touch screen: 5 wire, Interface: RS232C

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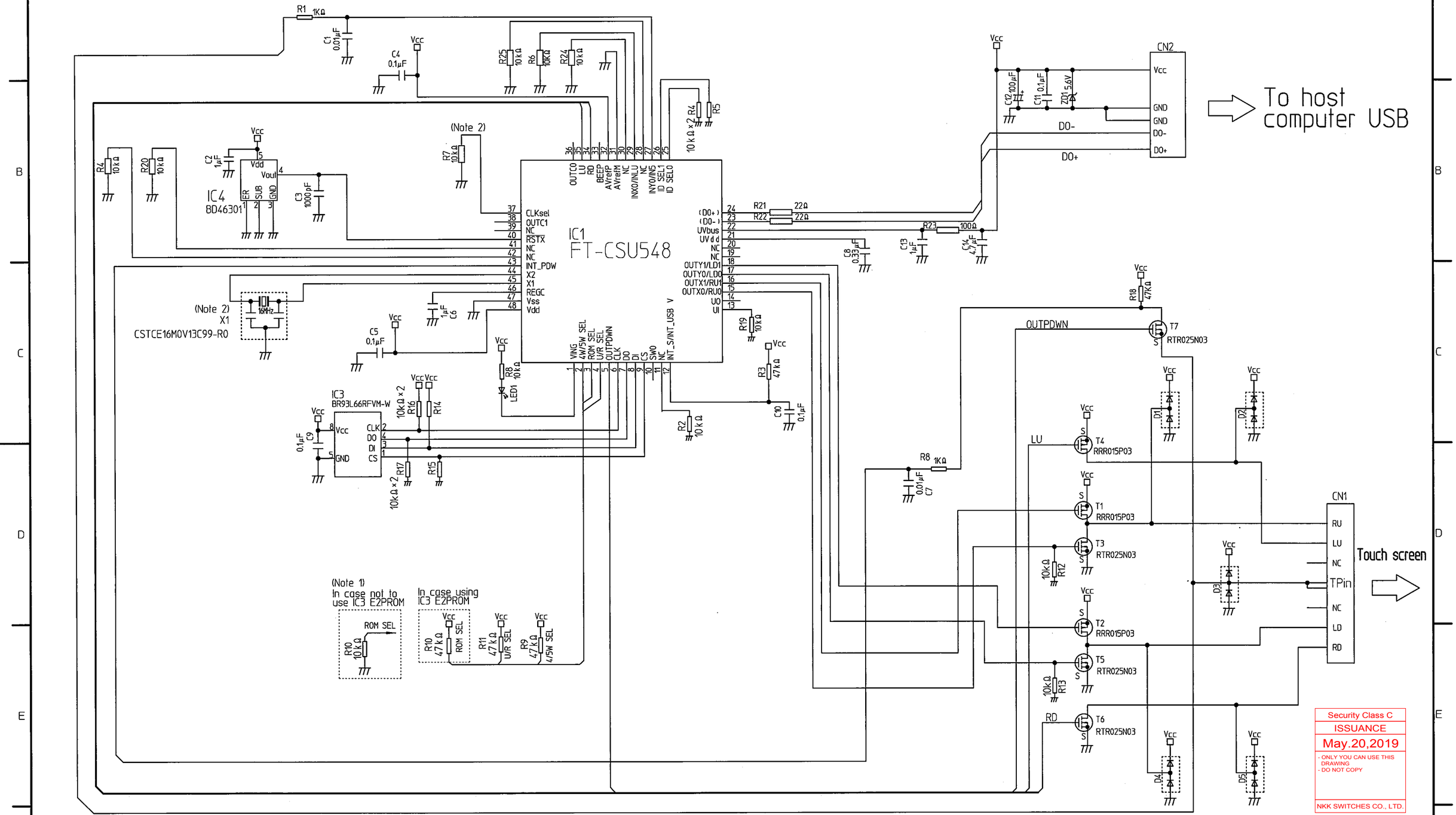
| | | |
|---|---|---|
| APPROVED BY: H. Kurashima | May.9 '17 | SCALE : |
| CHECKED BY: M. Tamura | Apr.27 '17 | DIMENSIONS IN mm |
| CHECKED BY: H. Kadowaki | Apr.18 '17 | Unless otherwise specified tolerances |
| DRAWN BY: S. Kurihara | Apr.14 '17 | Dimensions range / Tolerances: Up to 6 ±0.3; Over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

MODEL No. FT-CSU548(FTCSU548)

NKK SWITCHES CO., LTD.

# (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.

No. 190545

1E-FT-CSU548_16(超外形名)

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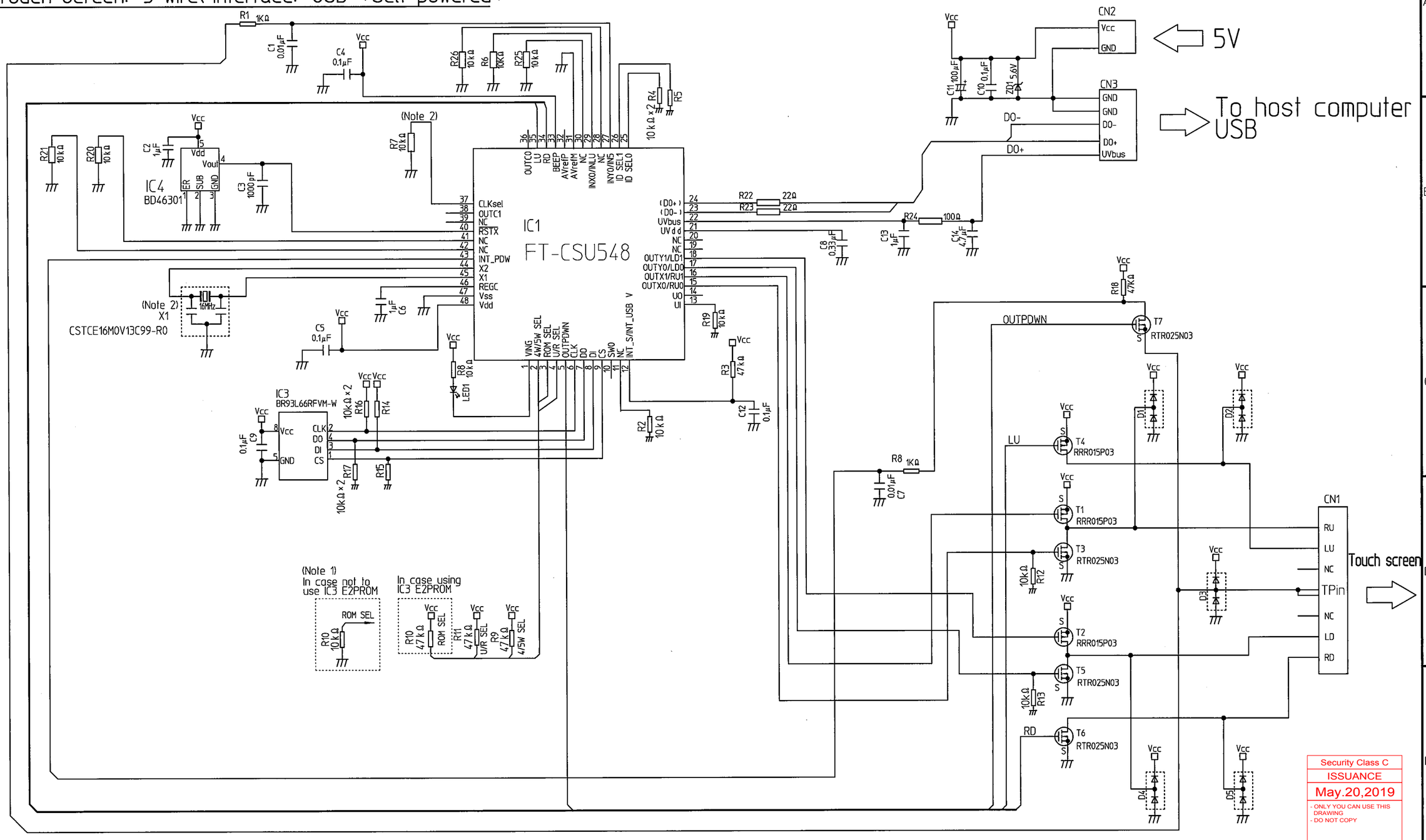
NKK SWITCHES CO., LTD.

様式 No.6435

# (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"

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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 |

MODEL No. FT-CSU548(FTCSU548)

NKK SWITCHES CO., LTD.

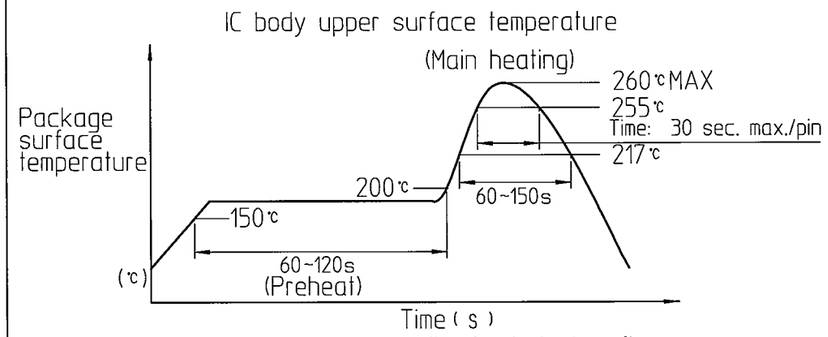
No. 190545

1E-FT-CSU548_17(海外形名)

様式 No.6435

# 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<br>・Peak humidity time (-5℃) : 255℃ Time: 30 sec. max./pin<br>・Solder melting point or higher (time of over 217 ℃) : 60~150s<br>・Preheat area time (150~200℃) : 60~120s<br>  <br><br><Temperature profile for hot air reflow><br>Note<br>・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)<br>・Time: 3 sec. max./pin<br>・Number of mounting: 1 time |

15-3. Full solder dipping

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



| | | | | |
|---|---|---|---|---|
| MODEL No. | FT-CSU548(FTCSU548) | APPROVED BY: H. Kurashima | May.9 '17 | SCALE : |
| NKK | 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<br>Dimensions range / Tolerances<br>Up to 6 ±0.3<br>Over 6 up to 30 ±0.5<br>Over 30 up to 50 ±0.8<br>Over 50 ±1.2 |
| | | DRAWN BY: S. Kurihara | Apr.14 '17 | |

# 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.



| | | | |
|---|---|---|---|
| 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 |

MODEL No. FT-CSU548(FTCSU548)

NKK SWITCHES CO., LTD.