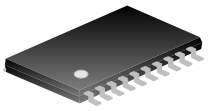
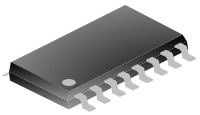
# LOW VOTLAGE LOW POWER I/O TYPE MCU WITH BUILT-IN HIGH PRECISION OSCILLATOR AND E²PROM

## DESCRIPTION

SC51P2320 is a 3V I/O type 8-bit low power MCU. It bases on powerful SC51 CPU core and embeds 20K-byte OTP, 768-byte RAM and 1K-byte $E^2$PROM. It integrates comparator, voltage detector, carrier modulation and demodulation module and three configurable timers, which is very suitable for self-learning remote control. It supports three kinds of low power modes and peripheral clock gating, which is very suitable for battery-powered systems.



TSSOP-20-225-0.65



SOP-16-225-1.27

## APPLICATION

- Self-learning remote control
- Universal remote control

## FEATURES

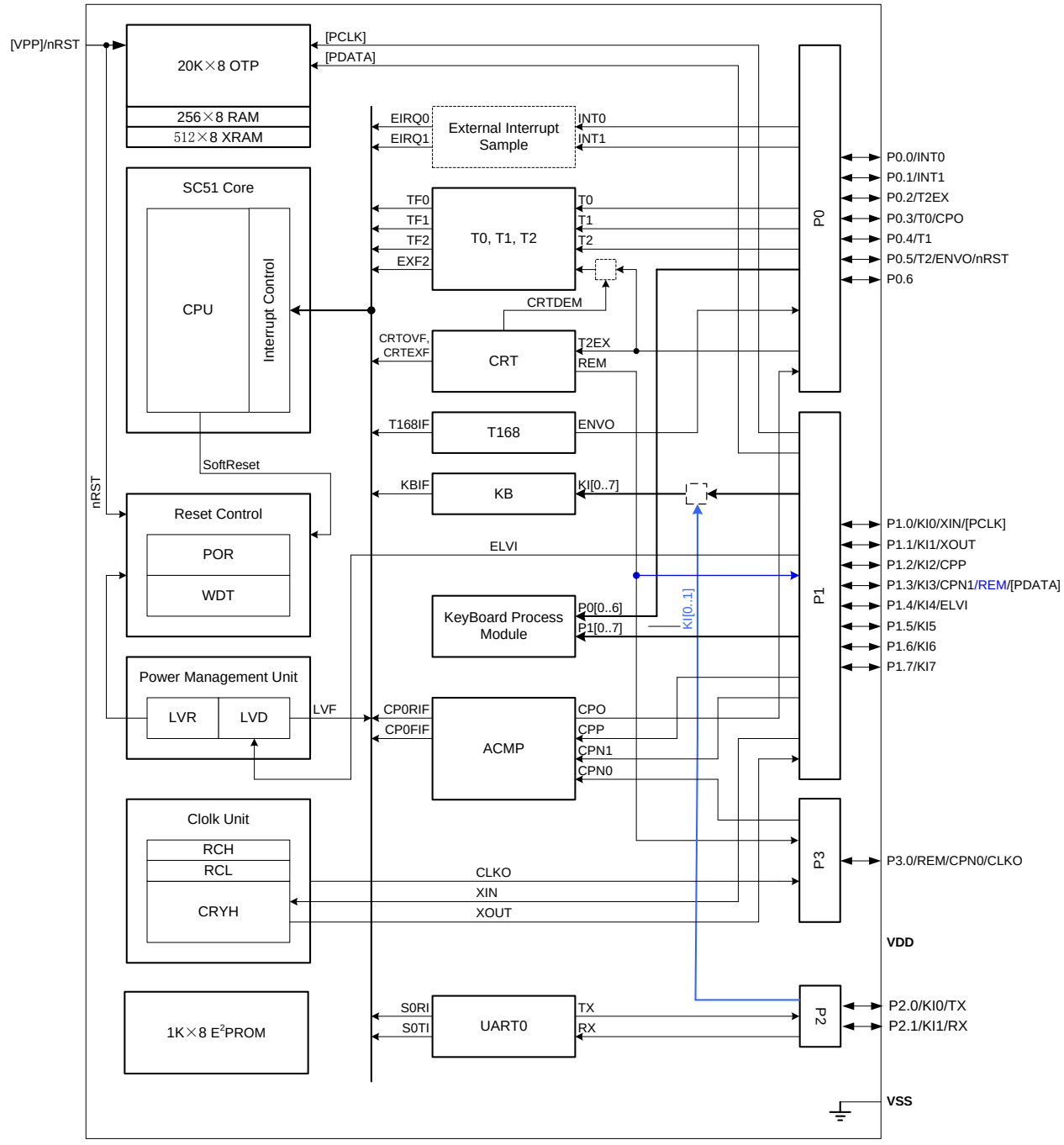
- 8 bit SC51 CPU
  - Compatible with MCS51 instructions, dual DPTR; support software reset instruction.
  - Improved instruction structure, the execution time of 90% instructions is two to four clock cycles.
  - Programmable system clock pre-divider: 1/2/8/64.
- On-Chip Memory
  - 20K-byte OTP, data retention time > 10 years.
  - 256-byte RAM, 512-byte XRAM.
  - 1K-byte $E^2$PROM.
    - Data retention time > 10 years@85°, 20000 cycles.
    - Endurance > 100,000.
- Programming
  - Support In-System-Programming (ISP), only 5-pins are needed (including VDD/VSS).
  - Support Parallel Programming (CPP) Interface.
  - Support Multi-Time-Programming (MTP):4K×5 / 8K×2 / 20K×1.
  - Support OTP page encryption, page size: 4K.
- Integrated power monitor circuits
  - Built-In Power-On-Reset (POR).
  - Built-In Low-Voltage-Reset (LVR) with 2 levels selectable: 1.7V and 1.9V.
  - Built-In Low-Voltage-Detect (LVD) with 16 levels selectable.
- Operating Frequency Range
  - Built-In 20KHz low power Oscillator (RCL).
  - Built-In 4MHz high precision Oscillator (RCH) with±1% frequency variation @ -10~50°C, $V_{DD}$=1.8~3.6V.
  - External 1~8MHz crystal oscillator.
  - CPU maximum operating frequency: 6MHz @ $V_{DD}$=1.8~3.6V.

- Support 12 Interrupts, including
  - 2 channel external interrupt INT0, INT1 with polarity configurable.
  - Polarity Keyboard-Interrupt (KBI) wakeup interrupt on P1 port with polarity configurable.
  - Carrier Envelope generator interrupt.
  - Carrier Timer interrupt.
  - T0/T1/T2 interrupts.
  - LVD interrupt.
  - ACMP rising edge and falling edge interrupt.
  - UART transmission interrupt.
- I/O
  - Support up to 18 I/O Ports.
  - Built-in high current open-drain output transistor, $I_{OL}$=180mA or 250mA @ $V_{OL}$=0.3V, $V_{DD}$=3V.
- Peripherals
  - Standard 8051 T0/ T 1.
  - 16-bit T2.
  - Carrier Timer for carrier modulation and demodulation (CRT).
  - Internal Carrier envelope generator (T168).
  - One Analog Comparator (ACMP).
  - Keyboard interrupt controller (KBI).
  - Built-In Watchdog-Timer (WDT).
  - Universal Asynchronous Receiver/ Transmitter
- Support three low power operation Modes
  - IDLE Mode.
  - STOP Mode.
  - Low Voltage Stop Mode.
- Package Type
  - SOP-16-225-1.27.
  - TSSOP-20-225-0.65

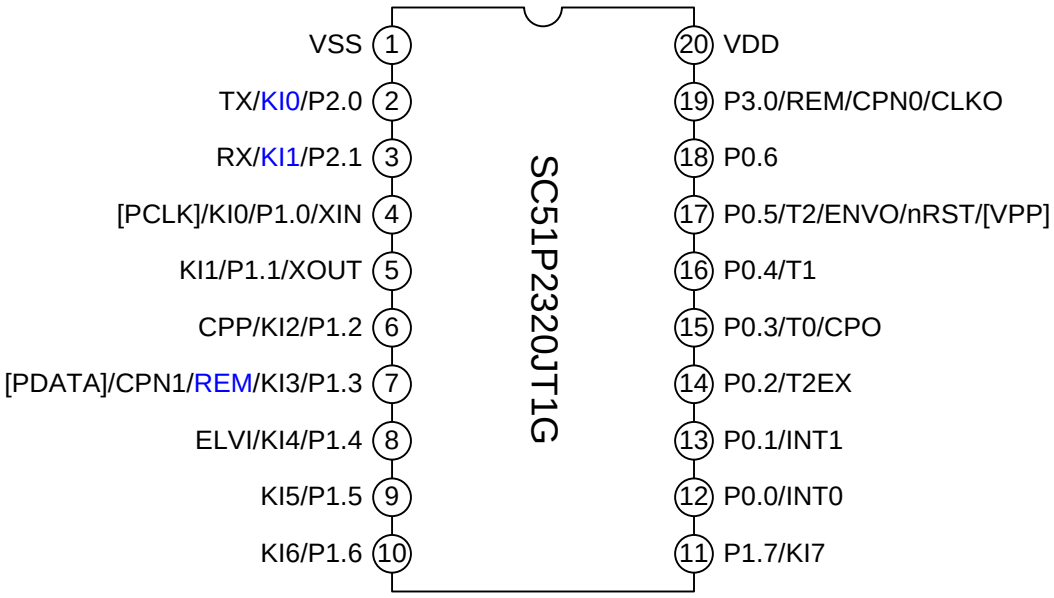
## ORDERING INFORMATION

| Part No. | Package | Marking | Material | Packing |
|---|---|---|---|---|
| SC51P2320SC1G | SOP-16-225-1.27 | SC51P2320SC1G | Halogen free | tube |
| SC51P2320SC1GTR | | SC51P2320SC1G | Halogen free | Tape & Reel |
| SC51P2320JT1G | TSSOP-20-225-0.65 | 2320JT1G | Halogen free | tube |
| SC51P2320JT1GTR | | 2320JT1G | Halogen free | Tape & Reel |

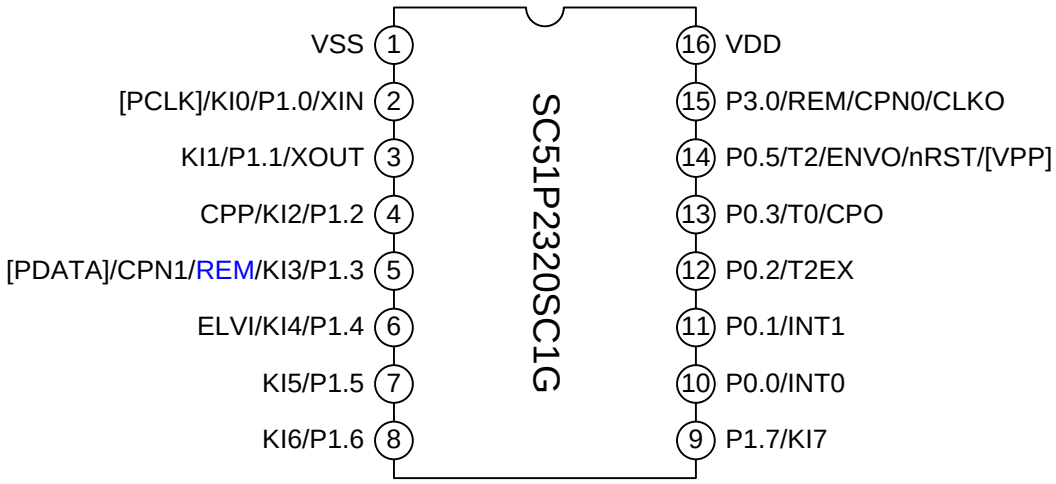
## BLOCK DIAGRAM



## PIN CONFIGURATION




**Note1:** the pins marked in blue can be remapped by software
**Note2:** the pins enclosed by square brackets is used for programming




**Note1:** the pins marked in blue can be remapped by software

**Note2:** the pins enclosed by square brackets is used for programming

## PIN DESCRIPTION

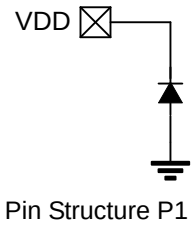
| Pin Name | Pin number | | Pin Type | Pin Structure | Function description |
|---|---|---|---|---|---|
| | -JT1 | -SC1 | | | |
| **Power supply** | | | | | |
| VDD | 20 | 16 | P | P1 | Power supply |
| VSS | 1 | 1 | P | P0 | Ground |
| **In-System-Programming (ISP)** | | | | | |

| Pin Name | Pin number | | Pin Type | Pin Structure | Function description |
|---|---|---|---|---|---|
| | -JT1 | -SC1 | | | |
| [VPP] | 17 | 14 | P | A | OTP Programming high voltage input |
| [PCLK] | 4 | 2 | I | B | OTP Programming clock Input |
| [PDATA] | 7 | 5 | I/O | B | OTP Programming data |
| **System** | | | | | |
| XIN | 4 | 2 | I | B& | External Crystal input |
| XOUT | 5 | 3 | O | B& | External Crystal output |
| nRST | 17 | 14 | I | A | External reset input, active low |
| CLKO | 19 | 15 | O | C | Clock output |
| ELVI | 8 | 6 | A | B | External input for LVD detect |
| **I/O** | | | | | |
| P0.0 | 12 | 10 | I/O | B | Normal input/output I/O, bit operation available |
| P0.1 | 13 | 11 | I/O | B | |
| P0.2 | 14 | 12 | I/O | B | |
| P0.3 | 15 | 13 | I/O | B | |
| P0.4 | 16 | - | I/O | B | |
| P0.5 | 17 | 14 | I/O | A | Input/output I/O, not support push pull output |
| P0.6 | 18 | - | I/O | B | Normal input/output I/O, bit operation available |
| P1.0 | 4 | 2 | I/O | B& | |
| P1.1 | 5 | 3 | I/O | B& | |
| P1.2 | 6 | 4 | I/O | B | |
| P1.3 | 7 | 5 | I/O | B | |
| P1.4 | 8 | 6 | I/O | B | |
| P1.5 | 9 | 7 | I/O | B | |
| P1.6 | 10 | 8 | I/O | B | |
| P1.7 | 11 | 9 | I/O | B | |
| P2.0 | 2 | - | I/O | B | Normal input/output I/O, bit operation available |
| P2.1 | 3 | - | I/O | B | |
| P3.0 | 19 | 15 | I/O | C | Normal input/output I/O, bit operation available |
| **External Interrupt** | | | | | |
| INT0 | 12 | 10 | I | B | External interrupt 0 input |
| INT1 | 13 | 11 | I | B | External interrupt 1 input |
| **Keyboard Interrupt** | | | | | |
| KI0 | 4 | 2 | I | * | Keyboard interrupt wakeup input |
| KI1 | 5 | 3 | I | * | |
| KI2 | 6 | 4 | I | B | |
| KI3 | 7 | 5 | I | B | |
| KI4 | 8 | 6 | I | B | |
| KI5 | 9 | 7 | I | B | |

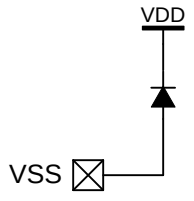
| Pin Name | Pin number | | Pin Type | Pin Structure | Function description |
|---|---|---|---|---|---|
| | -JT1 | -SC1 | | | |
| KI6 | 10 | 8 | I | B | |
| KI7 | 11 | 9 | I | B | |
| **Timer (T0,T1,T2)** | | | | | |
| T0 | 15 | 13 | I | B | T0/T1/T2 external counting clock input |
| T1 | 16 | - | I | B | |
| T2 | 17 | 14 | I | A | |
| T2EX | 14 | 12 | I | B | T2 external capture input |
| **Analog comparator (ACMP)** | | | | | |
| CPP | 6 | 4 | A | B | Analog comparator positive input |
| CPN0 | 19 | 15 | A | * | Analog comparator negative input |
| CPN1 | 7 | 5 | A | * | Analog comparator negative input |
| CPO | 15 | 13 | O | B | Analog comparator output |
| **Carrier Envelope generator (T168)** | | | | | |
| ENVO | 17 | 14 | O | A | Carrier Envelope generator output |
| **Carrier Timer (CRT)** | | | | | |
| REM | 19,7 | 15,5 | O | * | Carrier output |
| **Universal Asynchronous Receiver/Transmitte (UART)** | | | | | |
| TX | 2 | - | O | B | UART data output |
| RX | 3 | - | I | B | UART data input |

**Note：** For Pin Type: “P” denotes Power pins, “I/O” denotes normal input/output pins, “I” denotes input pins, “O” denotes output pins; For Pin Structure: “B&” denotes the pad structure is similar to “B” type pad structure, “*” denotes the pad structure is depends on remap pin position

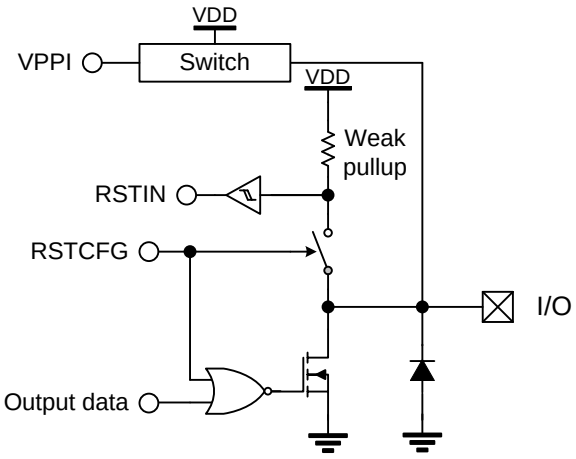
## PIN STRUCTURE



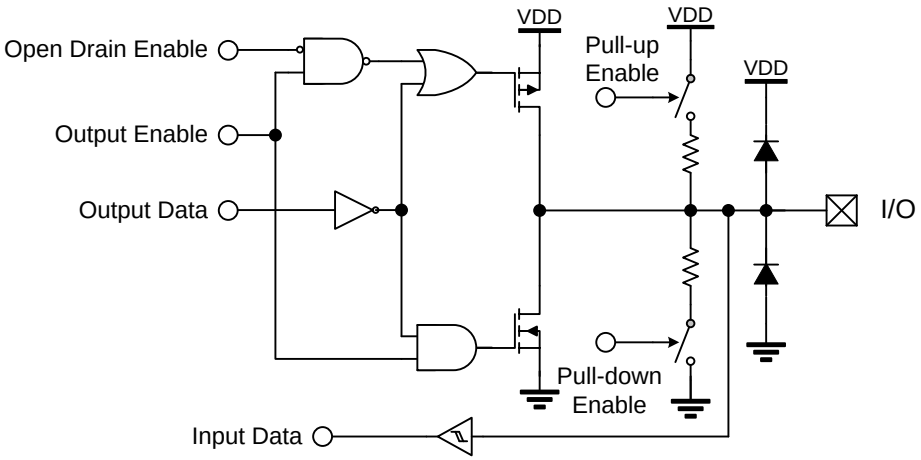

Pin Structure P1



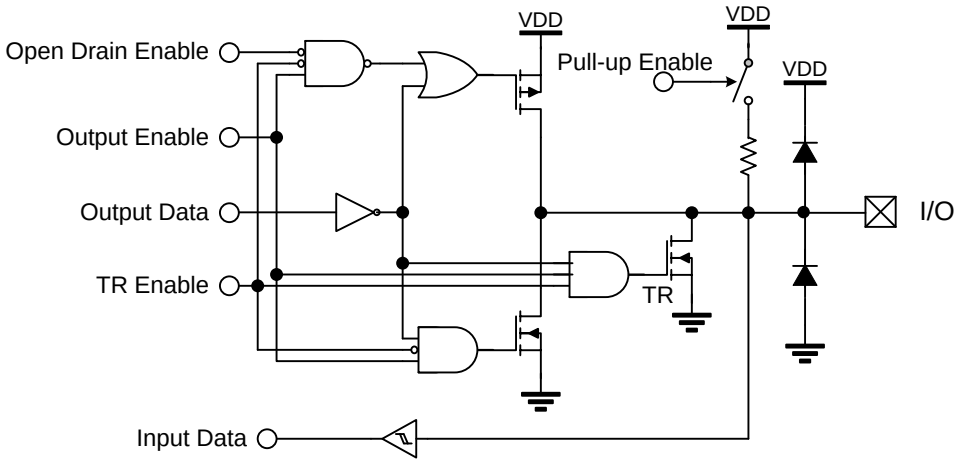

Pin Structure P0




Pin Structure A




Pin Structure B




Pin Structure C

**Note：** pull-up and pull-down won't be simultaneously enabled by internal logic.

## Absolute Maximum Ratings

| Characteristics | Symbol | Range | Unit |
|---|---|---|---|
| Supply voltage | $V_{DD}$ | -0.3 ~ +5.5 | V |
| Input voltage | $V_I$ | -0.3 ~ $V_{DD}$+0.3 | V |
| Storage temperature Range | $T_{STG}$ | -55 ~ +125 | °C |
| Operating temperature Range | $T_{OPR}$ | -40 ~ +85 | °C |

## DC ELECTRICAL CHARACTERISTICS (unless otherwise specified, $V_{DD}$=3V, $T_{AMB}$=25°C)

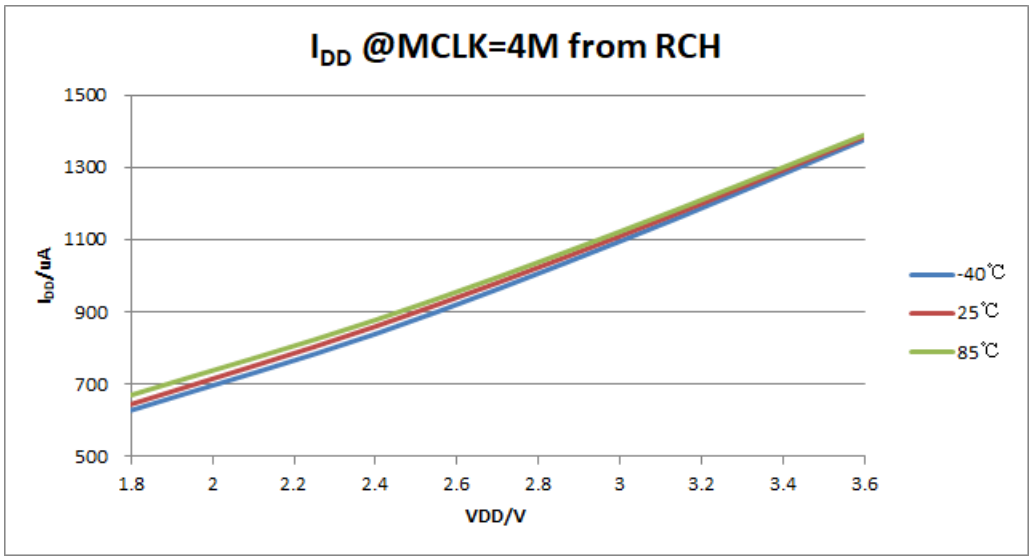
| Characteristics | Symbol | Test condition | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| Operating voltage | $V_{DD}$ | - | | 1.8 | - | 3.6 | V |
| Operating Current | $I_{DD}$ | Normal Mode | Internal RCH, $F_{MCLK}$= 4MHz | - | 1.1 | 1.5 | mA |
| | | | Internal RCH, $F_{MCLK}$= 500KHz | - | 0.4 | 0.5 | |
| | | | External 4MHz Crystal, $F_{MCLK}$= 4MHz | - | 1.5 | 2.2 | |
| | | IDLE Mode | Internal RCH, $F_{MCLK}$= 62.5KHz | - | 220 | 260 | μA |
| | | | External 4MHz Crystal, $F_{MCLK}$= 4MHz | - | 750 | 1400 | |
| | | STOP Mode | With RCL | - | 2 | 3 | μA |
| | | | Without RCL | - | 1 | 2 | |
| External Crystal | $F_{OSC}$ | - | | 1 | - | 8 | MHz |
| Internal RCH | $F_{RC}$ | $V_{DD}$=1.8~3.6V, $T_{AMB}$=-10~50°C | | 3.96 | - | 4.04 | MHz |
| | | $V_{DD}$=1.8~3.6V, $T_{AMB}$=-20~70°C | | 3.94 | - | 4.06 | |
| | | $V_{DD}$=1.8~3.6V, $T_{AMB}$=-40~85°C | | 3.90 | - | 4.10 | |
| Internal RCL | $F_{TRC}$ | $V_{DD}$=1.8~3.6V, $T_{AMB}$=-40~85°C (Typical: $V_{DD}$=3V, $T_{AMB}$=25°C) | | 6 | 20 | 40 | KHz |
| Input high voltage | $V_{IH}$ | P0.5 | | 0.7*$V_{DD}$ | - | $V_{DD}$ | |
| | | GPIO except for P0.5 | | 0.8*$V_{DD}$ | - | $V_{DD}$ | V |
| Input low voltage | $V_{IL}$ | P0.5 | | 0 | - | 0.1*$V_{DD}$ | |
| | | GPIO except for P0.5 | | 0 | - | 0.2*$V_{DD}$ | V |
| Output high current | $I_{OH}$ | $V_{OH}$=2.4V | P3.0 | - | 15 | - | mA |
| | | $V_{OH}$=2.7V | P0[0..4], P0.6/P1/P2 | - | 4 | - | |
| Output low current | $I_{OL}$ | $V_{OL}$=0.3V | P0/P1/P2/P3.0 (except P0.5) | - | 10 | - | mA |
| | | | P0.5 | - | 5 | - | |
| TR sink current | $I_{OL}$ | $V_{OL}$=0.3V | low level（TRDS=0） | - | 200 | - | mA |
| | | | high level（TRDS=1） | - | 250 | - | |
| Pull-up resistor | $R_{PU}$ | $V_{IN}$=0V | P0.5 | 100 | 150 | 200 | kΩ |
| | | | P 3.0 RPUS[2:0]=000 | 30 | 40 | 50 | |
| | | | P 3.0 RPUS[2:0]=001 | 40 | 50 | 60 | |
| | | | P 3.0 RPUS[2:0]=010 | 50 | 60 | 70 | |
| | | | P 3.0 RPUS[2:0]=011 | 60 | 70 | 80 | |
| | | | P 3.0 RPUS[2:0]=100 | 70 | 80 | 90 | |
| | | | P 3.0 RPUS[2:0]=101 | 75 | 90 | 105 | |
| | | | P 3.0 RPUS[2:0]=110 | 85 | 100 | 115 | |

| Characteristics | Symbol | Test condition | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| | | | RPUS[2:0]=111 | 95 | 110 | 125 | |
| | | | GPIO except for P0.5 and P3.0 | 100 | 145 | 200 | |
| Pull-down resistor | $R_{PD}$ | $V_{IN}=V_{DD}$ | $V_{DD}$=1.8~3.6V | 50 | 75 | 100 | kΩ |
| LVR detecting voltage | $V_{LVR}$ | LVRS=0 | | 1.65 | 1.70 | 1.78 | V |
| | | LVRS=1 | | 1.85 | 1.90 | 2.0 | |
| LVR hysteresis | VHYS（LVR） | - | | - | 20 | - | mV |
| Low voltage detect | $V_{LVD}$ | LVDS=0000 | $V_{DD}$ falling | 1.77 | 1.81 | 1.85 | V |
| | | | $V_{DD}$ rising | 1.79 | 1.88 | 1.97 | |
| | | LVDS=0001 | $V_{DD}$ falling | 1.84 | 1.90 | 1.97 | |
| | | | $V_{DD}$ rising | 1.91 | 1.99 | 2.07 | |
| | | LVDS=0010 | $V_{DD}$ falling | 1.95 | 2.01 | 2.08 | |
| | | | $V_{DD}$ rising | 2.00 | 2.09 | 2.17 | |
| | | LVDS=0011 | $V_{DD}$ falling | 2.00 | 2.10 | 2.21 | |
| | | | $V_{DD}$ rising | 2.11 | 2.19 | 2.27 | |
| | | LVDS=0100 | $V_{DD}$ falling | 2.12 | 2.21 | 2.29 | |
| | | | $V_{DD}$ rising | 2.16 | 2.29 | 2.44 | |
| | | LVDS=0101 | $V_{DD}$ falling | 2.23 | 2.30 | 2.39 | |
| | | | $V_{DD}$ rising | 2.33 | 2.40 | 2.49 | |
| | | LVDS=0110 | $V_{DD}$ falling | 2.32 | 2.40 | 2.50 | |
| | | | $V_{DD}$ rising | 2.38 | 2.50 | 2.63 | |
| | | LVDS=0111 | $V_{DD}$ falling | 2.39 | 2.50 | 2.62 | |
| | | | $V_{DD}$ rising | 2.50 | 2.60 | 2.70 | |
| | | LVDS=1000 | $V_{DD}$ falling | 2.49 | 2.60 | 2.73 | |
| | | | $V_{DD}$ rising | 2.57 | 2.70 | 2.84 | |
| | | LVDS=1001 | $V_{DD}$ falling | 2.58 | 2.70 | 2.84 | |
| | | | $V_{DD}$ rising | 2.67 | 2.80 | 2.93 | |
| | | LVDS=1010 | $V_{DD}$ falling | 2.70 | 2.80 | 2.90 | |
| | | | $V_{DD}$ rising | 2.78 | 2.90 | 3.05 | |
| | | LVDS=1011 | $V_{DD}$ falling | 2.79 | 2.90 | 3.04 | |
| | | | $V_{DD}$ rising | 2.88 | 3.00 | 3.15 | |
| | | LVDS=1100 | $V_{DD}$ falling | 2.85 | 2.99 | 3.13 | |
| | | | $V_{DD}$ rising | 2.96 | 3.10 | 3.26 | |
| | | LVDS=1101 | $V_{DD}$ falling | 2.96 | 3.08 | 3.23 | |
| | | | $V_{DD}$ rising | 3.06 | 3.20 | 3.35 | |
| | | LVDS=1110 | $V_{DD}$ falling | 3.04 | 3.17 | 3.32 | |
| | | | $V_{DD}$ rising | 3.15 | 3.29 | 3.44 | |

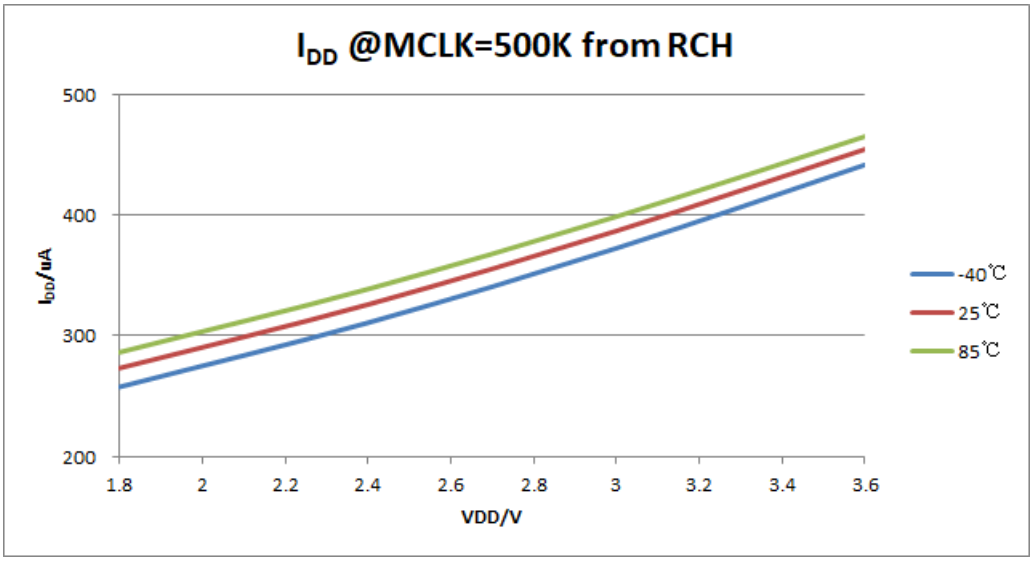
| Characteristics | Symbol | Test condition | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| | | LVDS=1111 | $V_{DD}$ falling | 3.14 | 3.27 | 3.43 | |
| | | | $V_{DD}$ rising | 3.26 | 3.39 | 3.54 | |

Note：the type vale is characteristic result, not test in production.

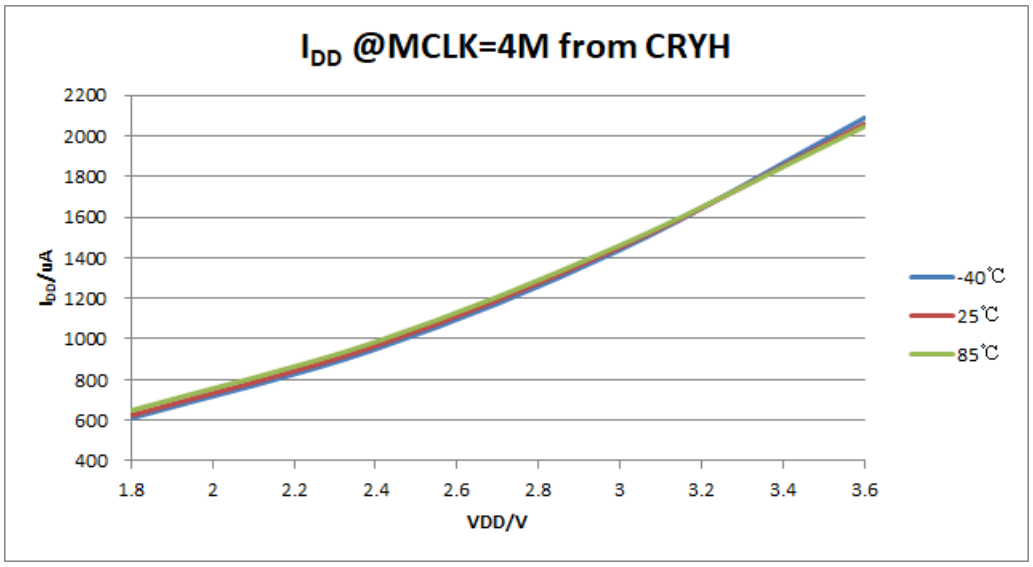
## DC and AC characteristics figure



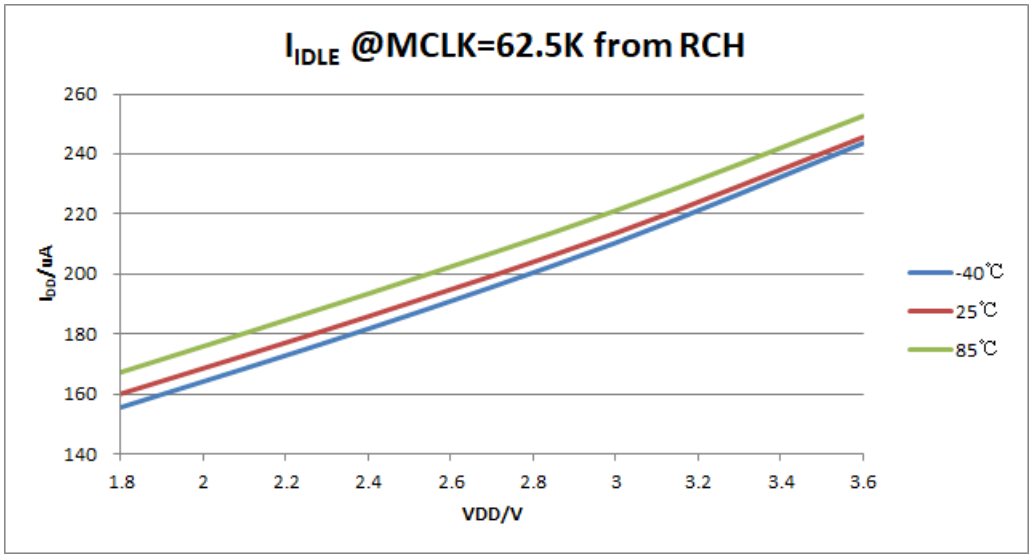

$I_{DD}$ @MCLK=4MHz, from RCH



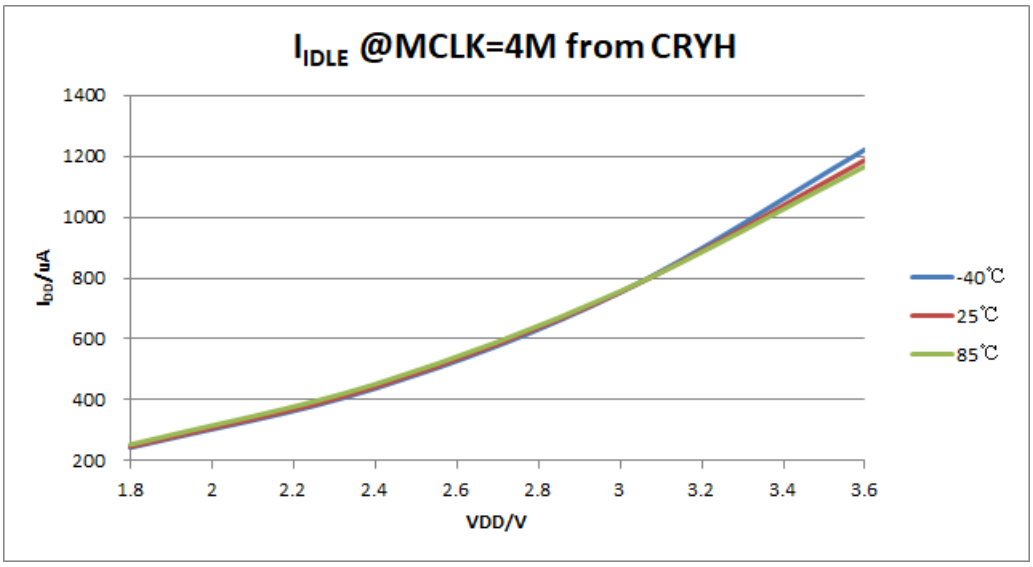

$I_{DD}$ @MCLK=500KHz, from RCH



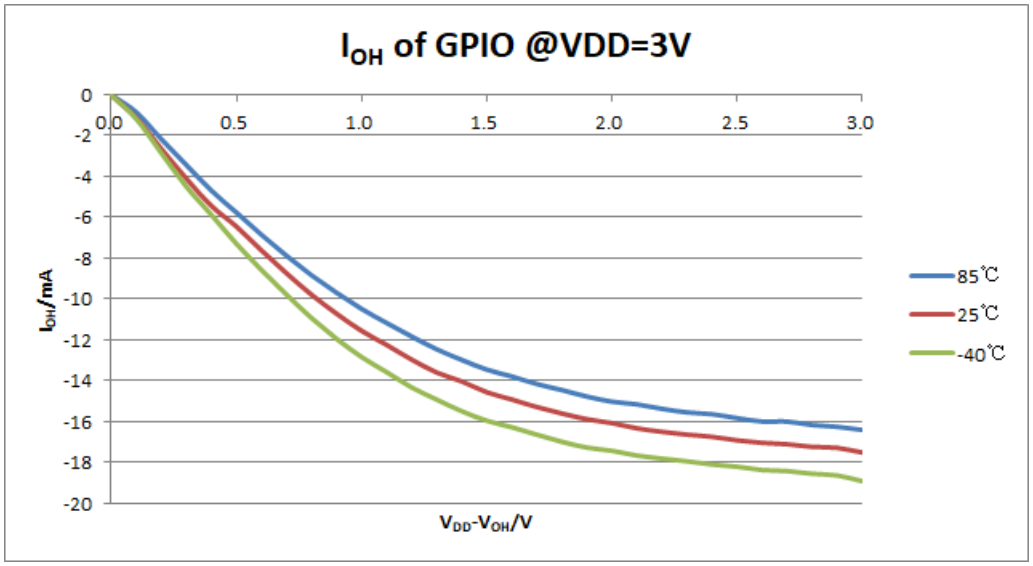

$I_{DD}$ @MCLK=4MHz, from CRYH



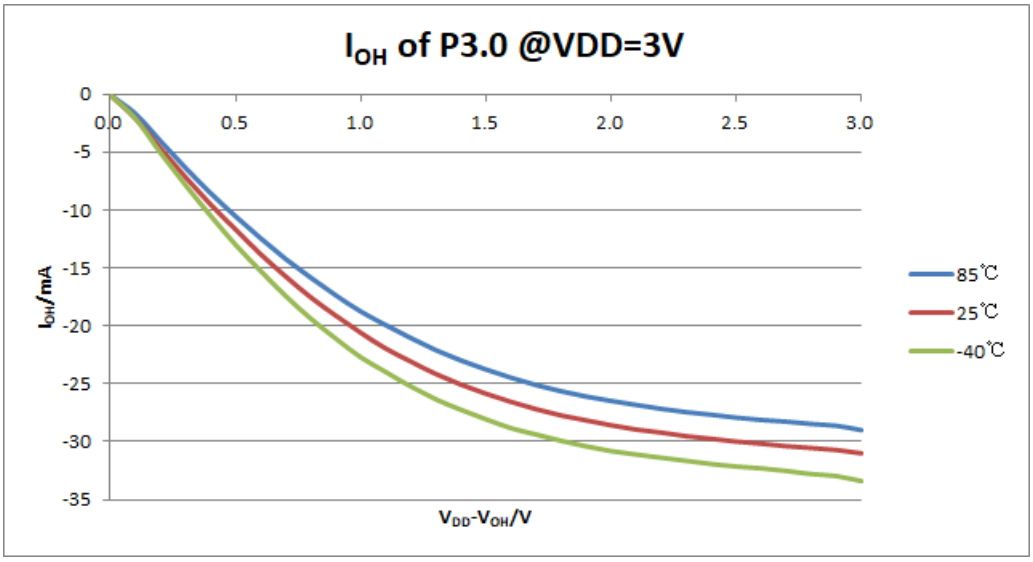

$I_{IDLE}$ @MCLK=62.5KHz, from RCH



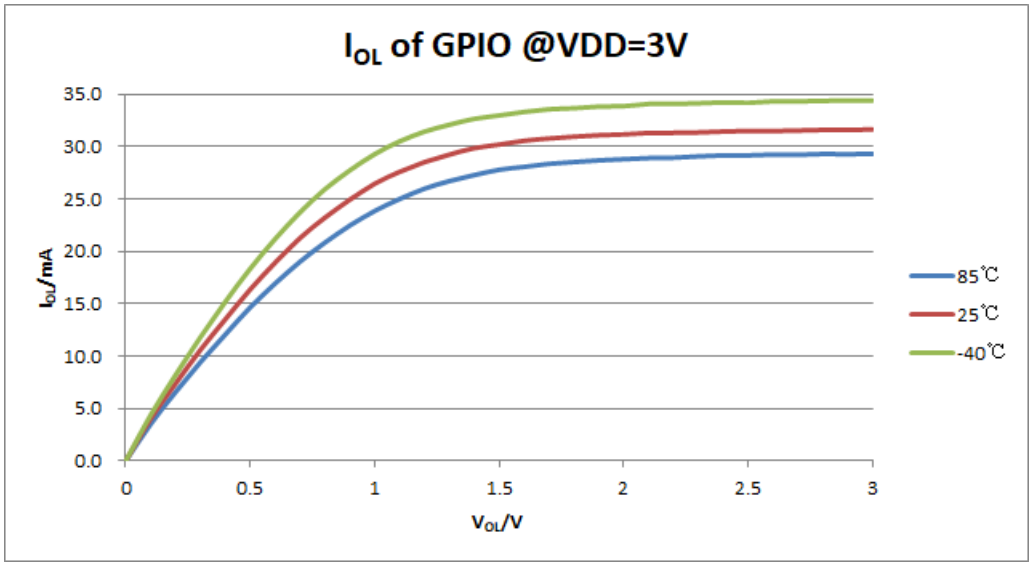

$I_{IDLE}$ @MCLK=4MHz, from CRYH



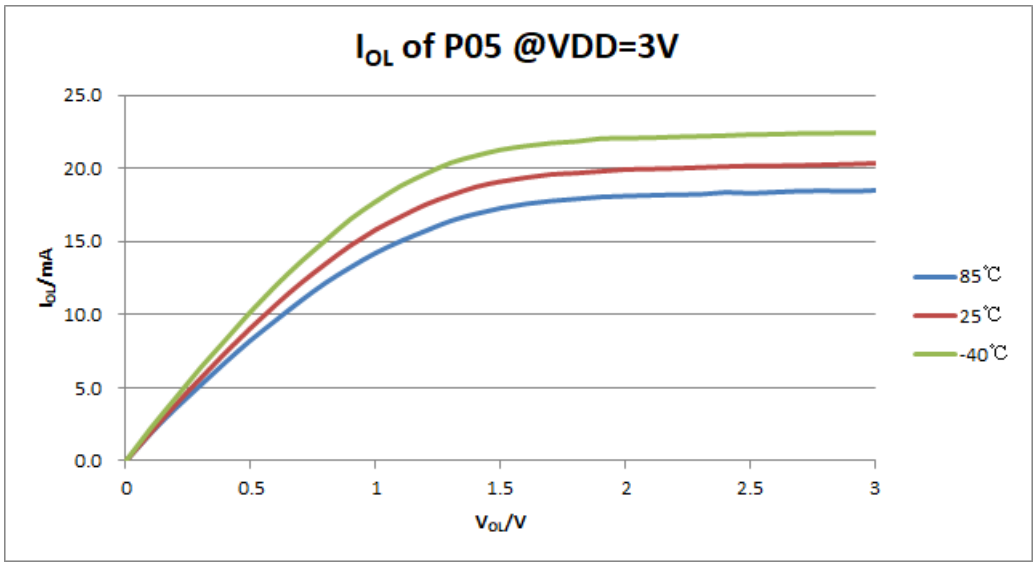

Source current of GPIO



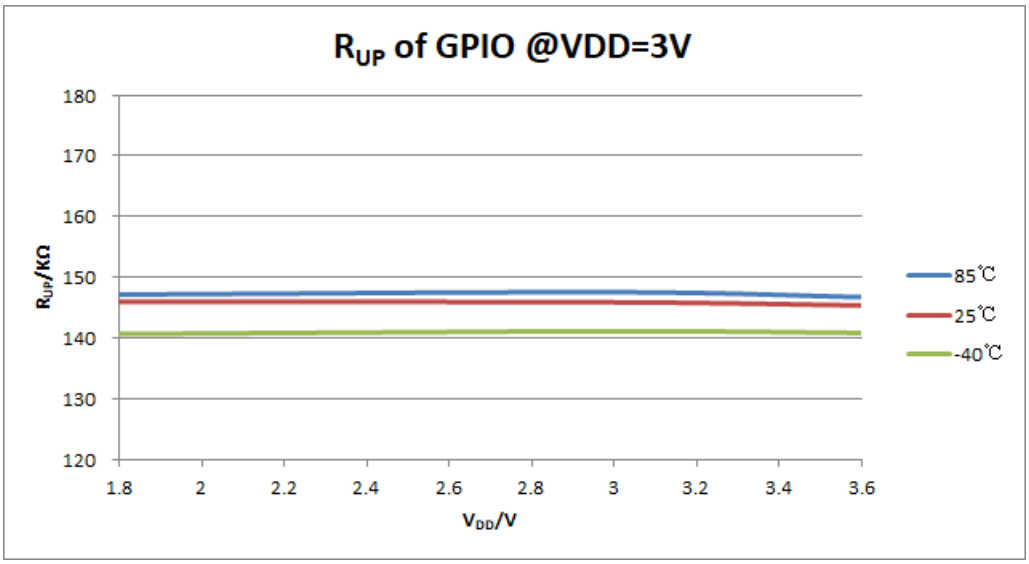

Source current of REM/P3.0



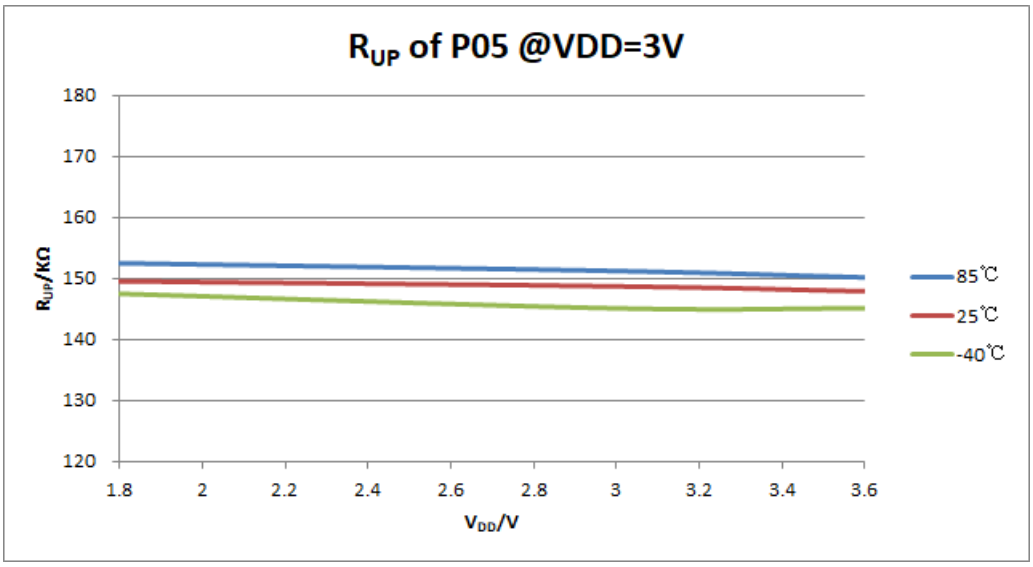

Sink current of GPIO



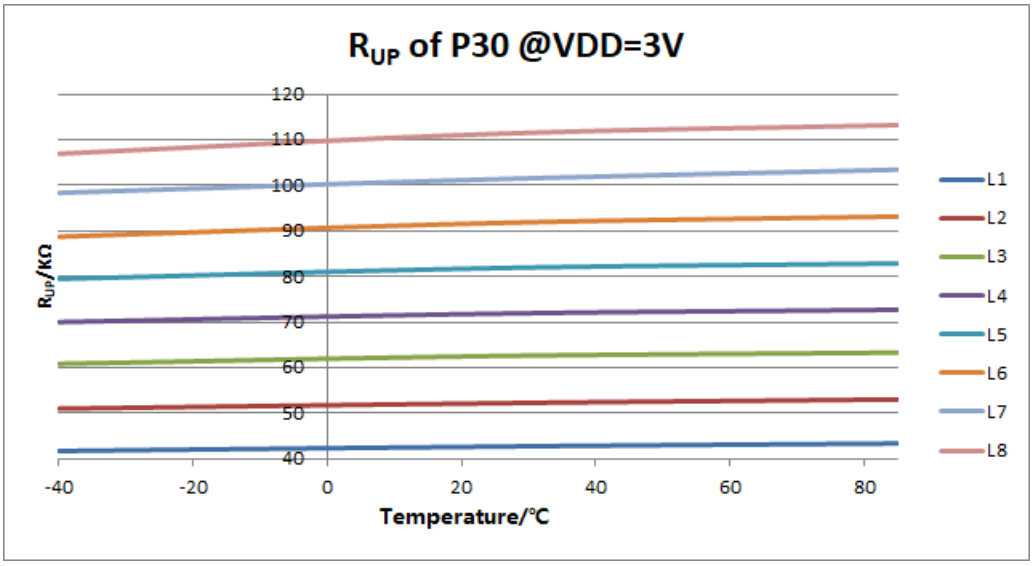

Sink current of nRST/P0.5



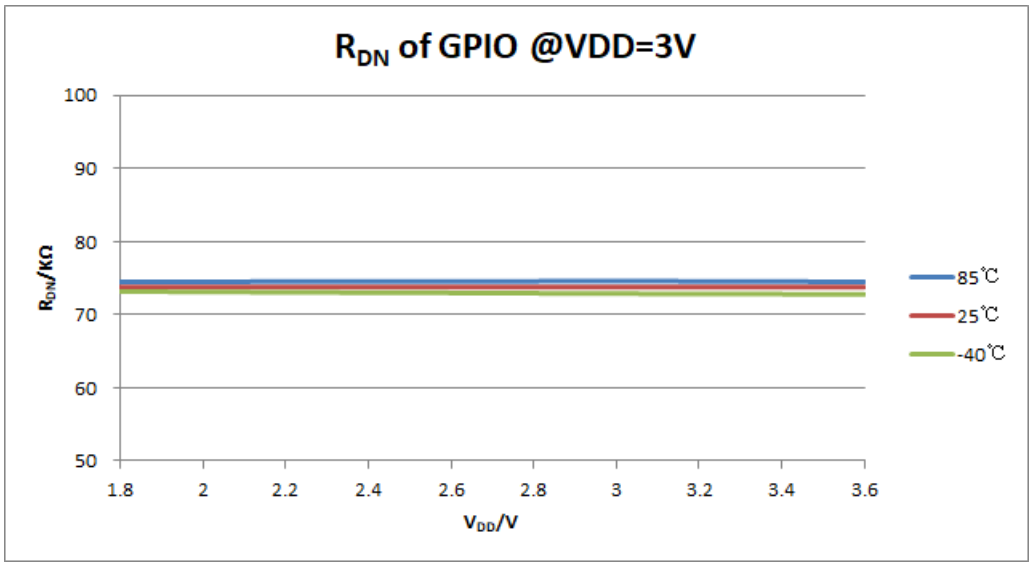

Pull-up resistor of GPIO



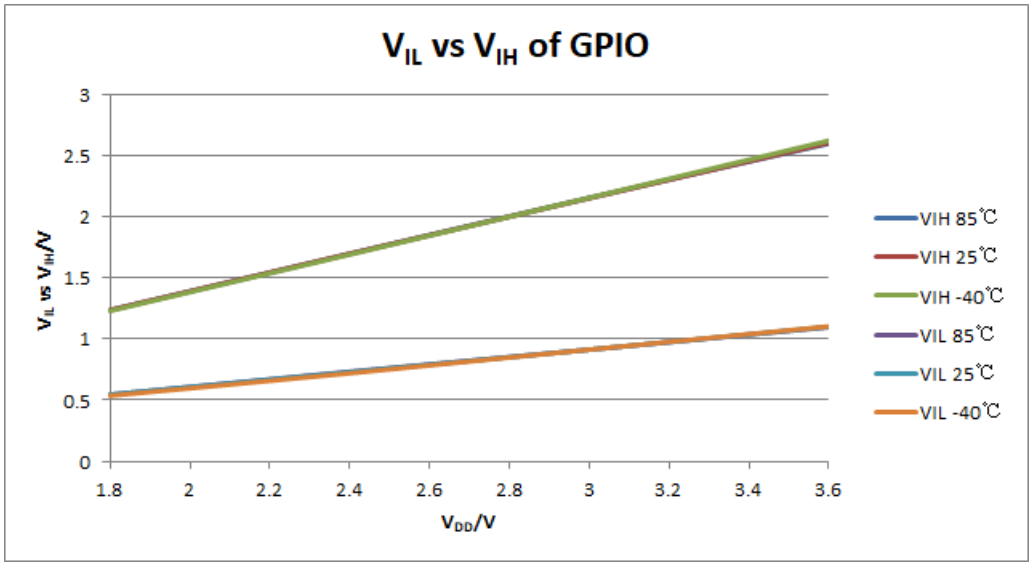

Pull-up resistor of nRST/P0.5



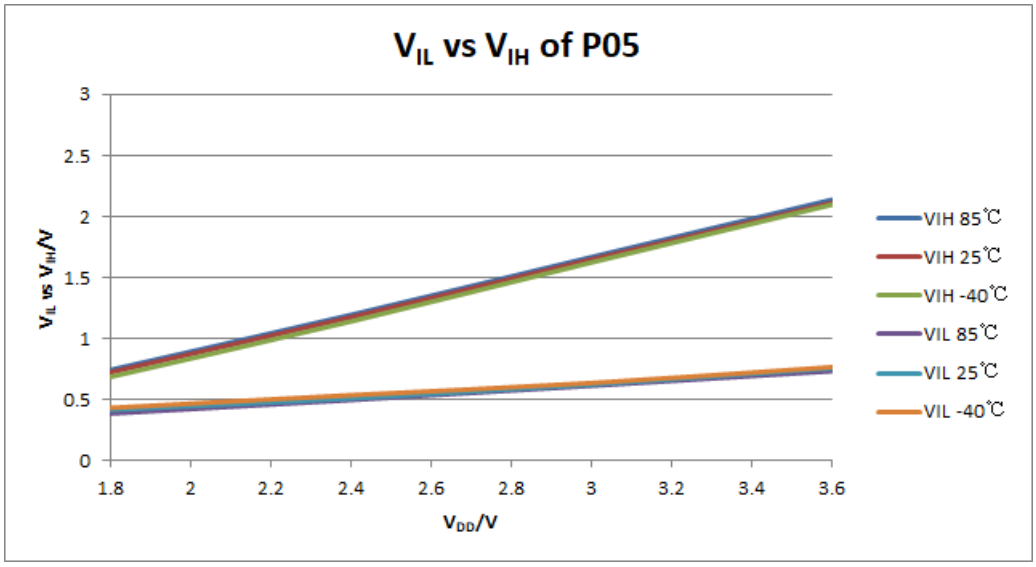

Pull-up resistor of REM/P3.0



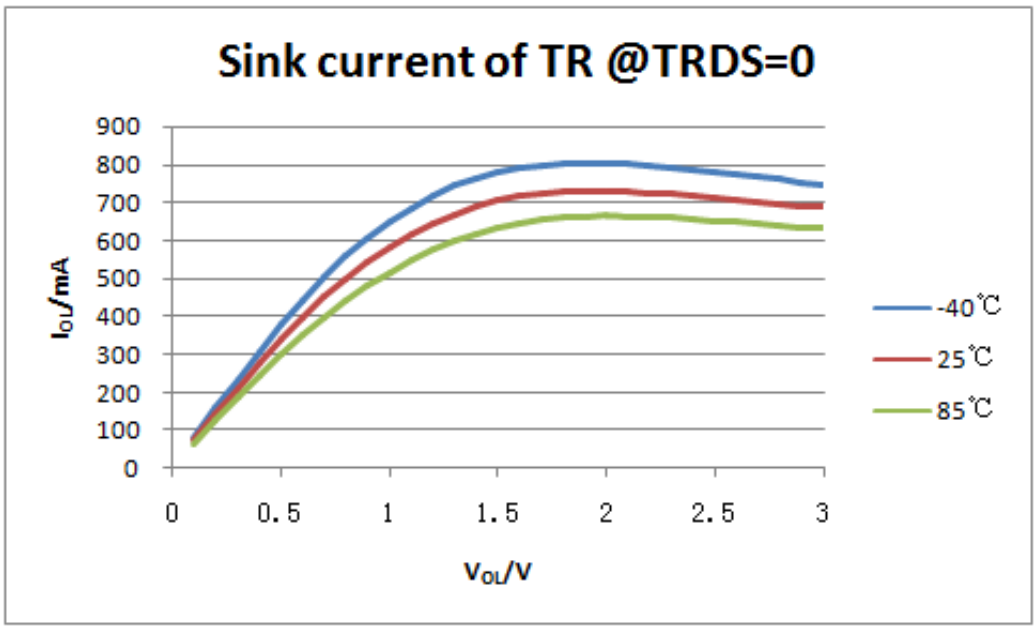

Pull-down resistor of GPIO



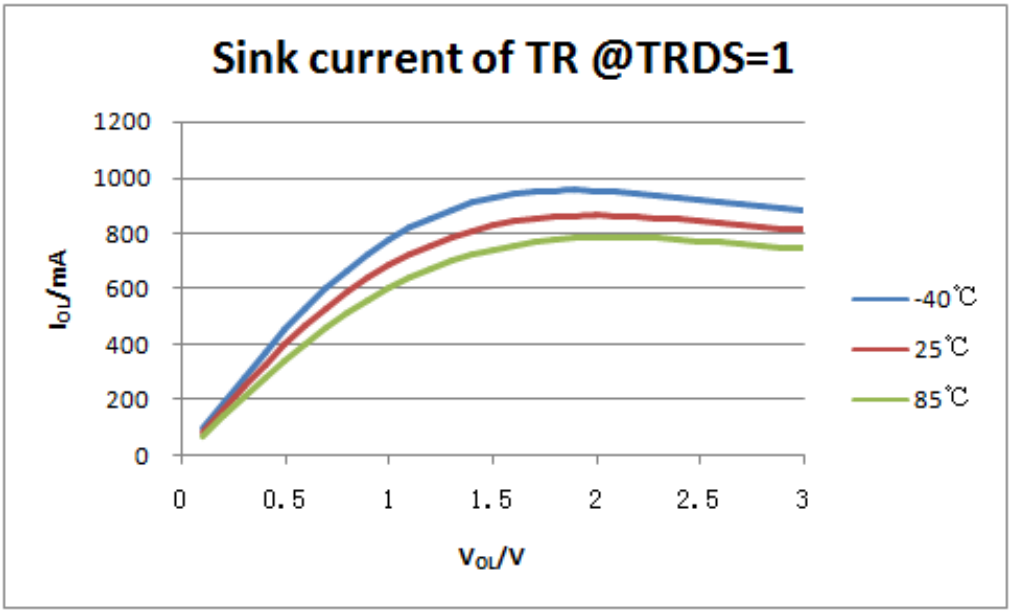

$V_{IL}$ vs $V_{IH}$ of GPIO



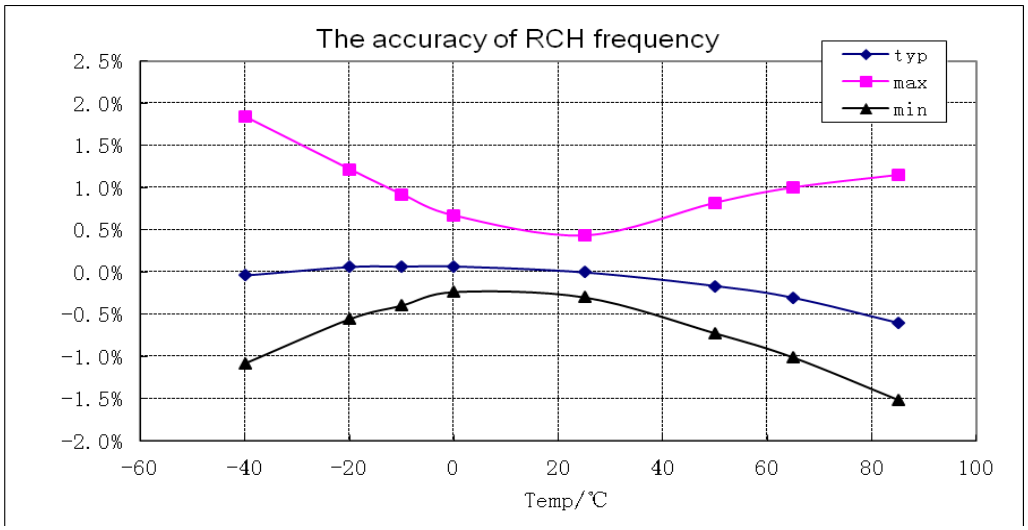

$V_{IL}$ vs $V_{IH}$ of nRST/P0.5




Sink current of TR low level



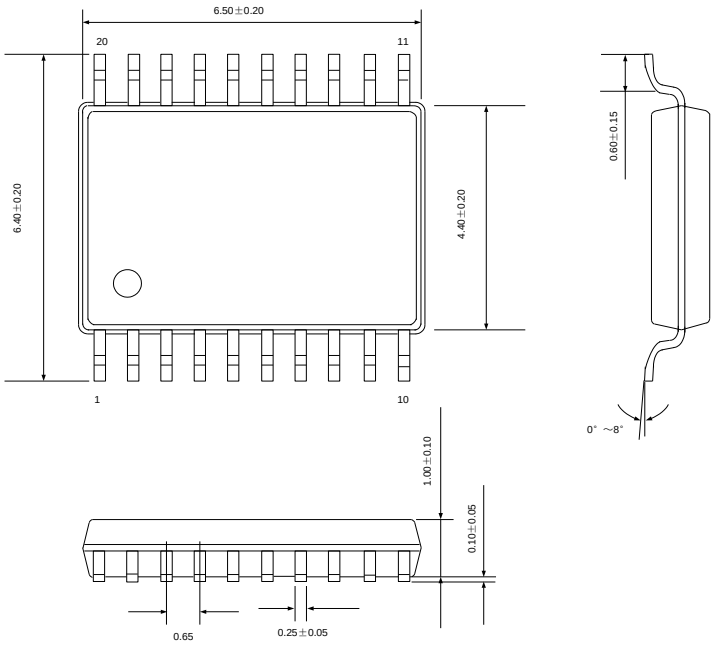

Sink current of TR high level



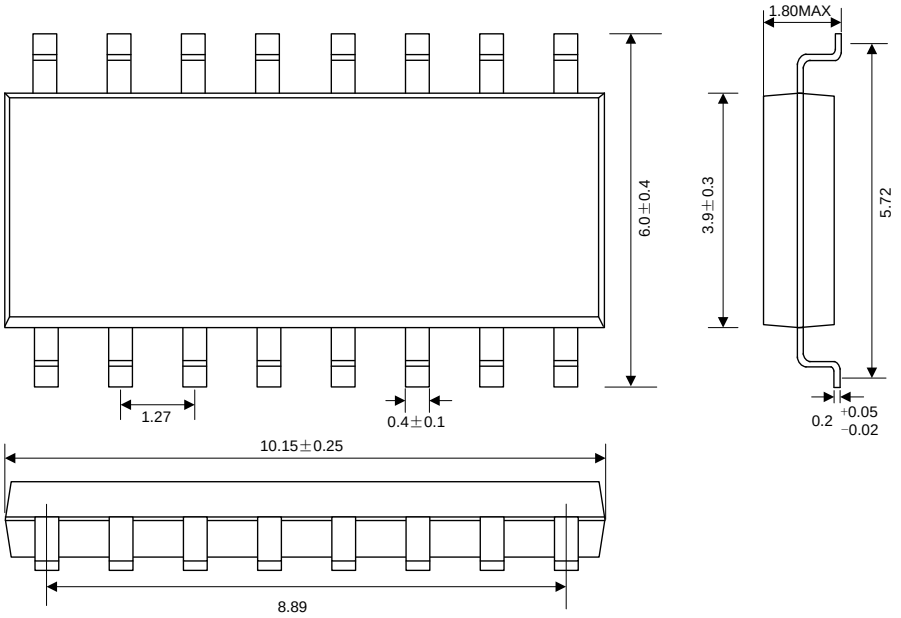

The accuracy of RCH frequency

## PACKAGE OUTLINE

**TSSOP-20-225-0.65** UNIT：mm




**SOP-16-225-1.27** UNIT：mm




**MOS DEVICES OPERATE NOTES:**

Electrostatic charges may exist in many things. Please take following preventive measures to prevent effectively the MOS electric circuit as a result of the damage which is caused by discharge:

- The operator must put on wrist strap which should be earthed to against electrostatic.
- Equipment cases should be earthed.
- All tools used during assembly, including soldering tools and solder baths, must be earthed.
- MOS devices should be packed in antistatic/conductive containers for transportation.

| | | | |
|---|---|---|---|
| Part No.: | SC51P2320 | Document Type: | Datasheet |
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Rev.: 1.2

Revision History:

1. Modify the DC ELECTRICAL CHARACTERISTICS of P3.0

Rev.: 1.1

Revision History:

1. Modify pin structure

Rev.: 1.0

Revision History:

1. First release