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# GC230-TS16IP

## *8-bit Turbo Microcontroller*

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# 1 GC230-TS16IP Overview

## 1.1 General Description

**GC230-TS16IP** is a high-speed 80C52 compatible Microcontroller. It executes all of the conventional 80C52 instructions.

**GC230-TS16IP** has three timer/counters, 14 programmable I/O ports, 1 Watchdog timer, POR (Power-On Reset), and 1 LVD (Low Voltage Detector), 1 channel 8bit PWM, 8 channels 10bit ADC as peripherals. In addition, it contains an internal precision oscillator, which can generate the 12 MHz system clock signal instead of a crystal oscillator.

**GC230-TS16IP** operates over the extended -40°C to +85°C temperature range and is available in the 16-pin TSSOP package.

## 1.2 Features

- ◆ CPU
  - ✓ 8-bit turbo 80C52 architecture
  - ✓ 4 cycles/1 machine cycle
  - ✓ instruction level compatible with Intel 80C52
- ◆ 2 KB FLASH (Including 128B User EEPROM)
- ◆ Supporting ISP/IAP/MDS
- ◆ 128B Internal RAM
- ◆ Operating Voltage : +2.4V to +5.5V
- ◆ Operating Frequency (F<sub>sys</sub>)
  - ✓ 3.68 MHz (Internal POSC Clock, Default)
  - ✓ Max. 12 / 11.06 MHz @2.4V ~ 3.3V (External/Internal POSC Clock)
  - ✓ Max. 24 MHz @4.5V ~ 5.5V (External Clock)
- ◆ Operating temperature: -40 °C ~ 85 °C
- ◆ 14 Programmable I/O Pins
  - ✓ Pull-up control, Open drain, & Push-Pull output
  - ✓ TTL and CMOS compatible logic levels

- ◆ **Configurable Low Voltage Detector (LVD)**
- ◆ **Internal Precision OSC with Calibration function**
  - ✓ 11.06 MHz @+2.4V to +5.5V (Typ. +/- 1%)
- ◆ **8-channel 10-bit ADC**
  - ✓ Max. 120k SPS @ $F_{ADC} = 12$  MHz ( $F_{SYS} = 12$  MHz)
  - ✓ Programmable Input Clock Frequency
- ◆ **1-channel 8-bit High Speed PWM**
- ◆ **23-bit Programmable Watchdog Timer**
- ◆ **16-bit Stop Timer**
- ◆ **Two 16-bit Timer/Counters**
- ◆ **8 Interrupt Sources**
  - ✓ Timer0/1, WDT, ADC, PWM, LVD
  - ✓ 2 External Interrupt Sources: Both Edge/Level
  - ✓ Two-level Interrupt Priority
- ◆ **Reset Sources**
  - ✓ On-chip Power-On-Reset (POR/LVR)
  - ✓ External Reset
  - ✓ Configurable Low Voltage Detector Reset
  - ✓ Watchdog Timer Reset
- ◆ **Power Down Wake-up Sources**
  - ✓ Reset Sources + 2 External Interrupt (Both Levels)
  - ✓ WDT Interrupt
- ◆ **Power Consumption**
  - ✓ Active Current: Max. 2mA @+3.0V, 2MHz
  - ✓ Idle Current: Max. 500uA @+3.0V 2MHz
  - ✓ Stop Current: Max. 1uA @+5.0V (All Clock OFF)
- ◆ **E.S.D. Protection up to 2,000 V**
- ◆ **Latch-up Protection Up to  $\pm 200$ mA**
- ◆ **Package**
  - ✓ 16-TSSOP

### 1.3 Applications

- ◆ Mobile Devices
- ◆ Multimedia
- ◆ Navigation Systems
- ◆ Home Appliance
- ◆ Other Electronic Devices

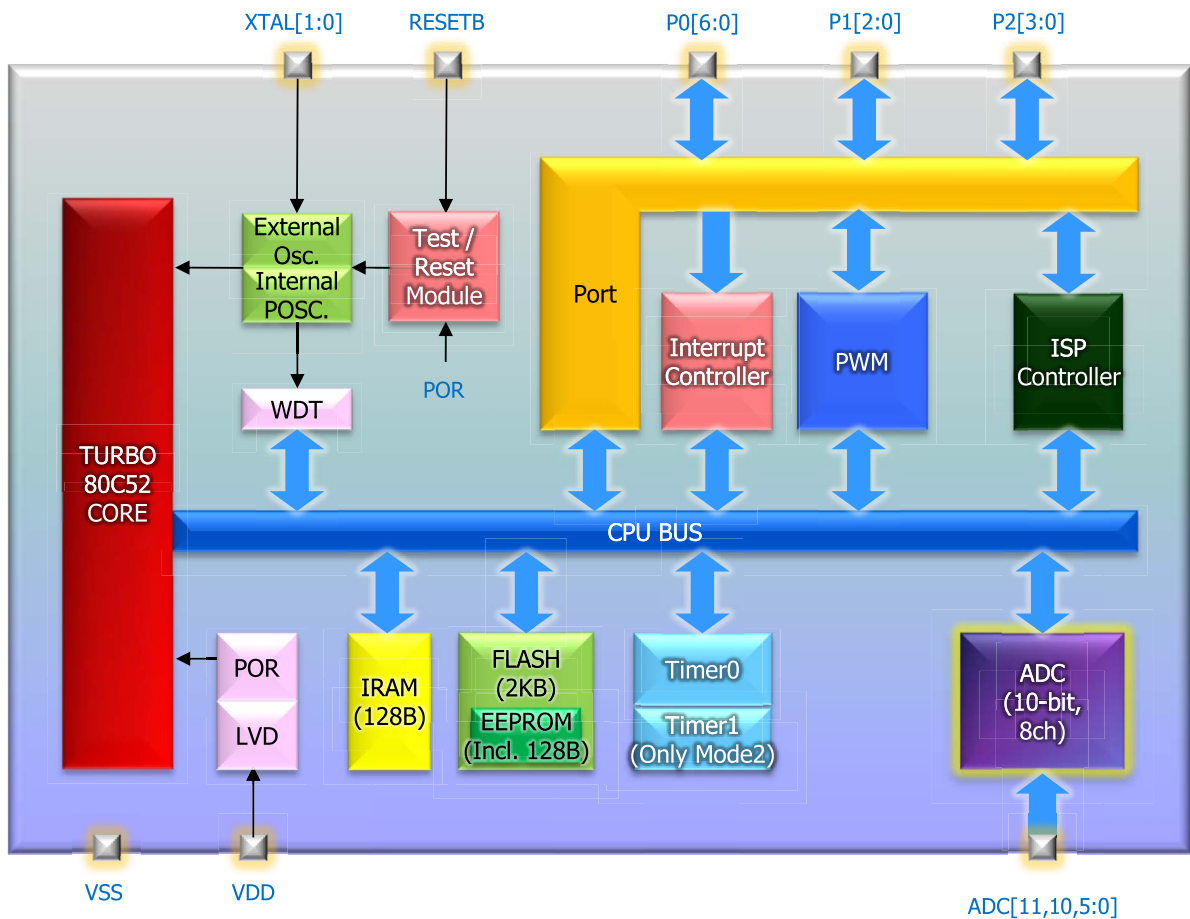
### 1.4 Product Family Guide

Product	Flash [Byte]	RAM [Byte]	Package	Programmable I/O	ADC (bit X Ch)	Other Peripherals
GC230-TS20I	2K	128	20-TSSOP	18	10 X12	2 Timer/Counters WDT IAP ISP EJTAG LVD POR Precision Oscillator 1-channel 8-bit PWM
GC230-SO20I	2K	128	20-SOP	18	10 X12	
<b>GC230-TS16I</b>	<b>2K</b>	<b>128</b>	<b>16-TSSOP</b>	<b>14</b>	<b>10 X 8</b>	
GC230-SO8I	2K	128	8-SOP	6	10 X 3	

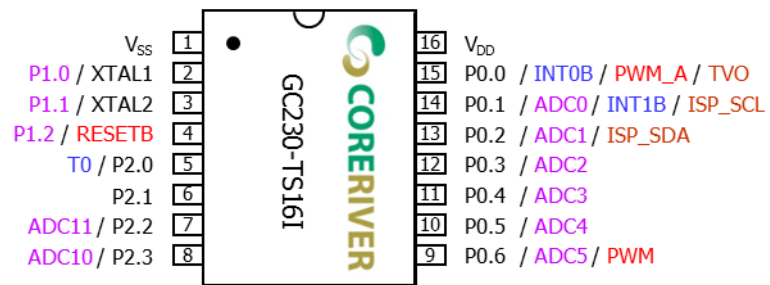
## 2 Block Diagram

Figure shows the block diagram of **GC230-TS16IP**. Programs reside in the internal program memory (Embedded Flash Memory). Data are read from or written to data memory (SRAM) or special function registers (SFRs).

The internal registers of **GC230-TS16IP** are configured as part of the on-chip RAM therefore, each register has an address. This is reasonable for **GC230-TS16IP**, since it has so many registers.



### 3 Pin Configuration



16-pin TSSOP Package Diagram

## 4 Pin Description

Pin No.	Name	Type	Description	Share Pins
1	VSS	GND		
2	XTAL1	I/O	Crystal Input	P1.0
3	XTAL2	I/O	Crystal Output	P1.1
4	RESETB	I/O	External Reset Input	P1.2
5	P2.0	I/O	General I/O	T0
6	P2.1	I/O	General I/O	
7	P2.2	I/O	General I/O	ADC11
8	P2.3	I/O	General I/O	ADC10
9	P0.6	I/O	General I/O	ADC5 / PWM
10	P0.5	I/O	General I/O	ADC4
11	P0.4	I/O	General I/O	ADC3
12	P0.3	I/O	General I/O	ADC2
13	P0.2	I/O	General I/O	ADC1 / ISP_SDA
14	P0.1	I/O	General I/O	ADC0 / INT1B / ISP_SCL
15	P0.0	I/O	General I/O	INT0B / TVO / PWM_A
16	VDD	PWR		

## 5 Absolute Maximum Ratings

Items	Conditions	Ranges
Voltage on any pin relative to Ground	-	-0.5 V to ( $V_{DD}+0.5V$ )
Voltage in $V_{DD}$ relative to Ground	-	-0.5V to 6.5V
Output Voltage	-	-0.5 V to ( $V_{DD}+0.5V$ )
Output Current High	One I/O pin active	-25mA
	All I/O pin active	-100mA
Output Current Low	One I/O pin active	+30mA
	All I/O pin active	+150mA
Storage Temperature	-	$\leq 40^{\circ}C$
Soldering Temperature	-	260 $^{\circ}C$ , 10 seconds within 5 $^{\circ}C$ of actual peak temperature

## 6 Recommended Operating Conditions

Symbol	Parameter	Rating
$V_{DD}$	DC supply voltage	2.4V to 5.5V
$T_A$	Industrial temperature range	-40 $^{\circ}C$ to 85 $^{\circ}C$



## 7 DC Characteristics

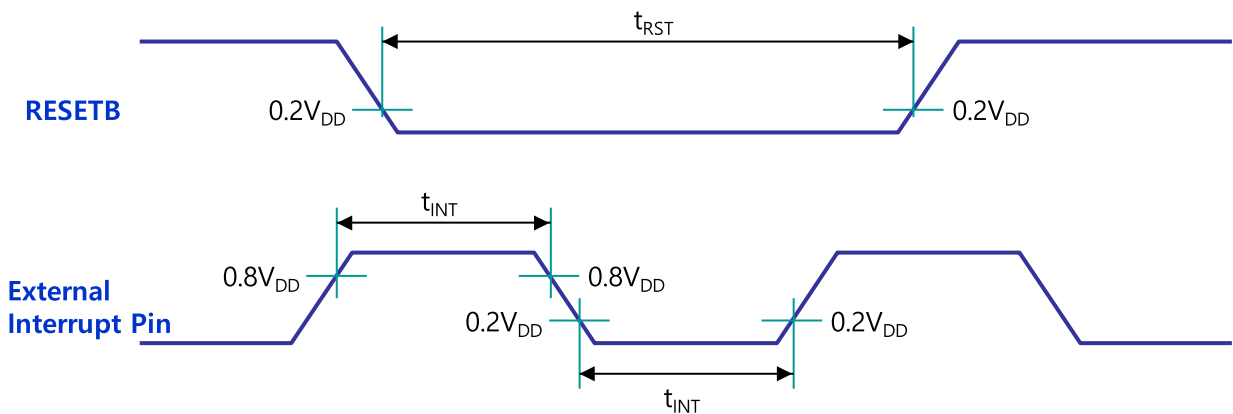
\*  $T_A = -40^{\circ}\text{C} \sim +85^{\circ}\text{C}$ ,  $V_{DD} = 2.2\text{V} \sim 5.5\text{V}$  unless otherwise specified

Parameter	Symbol	Pin	Conditions	Value			Unit
				Min.	Typ.	Max.	
Input Low Voltage	$V_{IL1}$	RESETB, P0, P1, P2	$V_{DD} = 2.4\text{V} \sim 5.5\text{V}$	-0.5	-	$0.2V_{DD} - 0.1$	V
	$V_{IL2}$	XTAL1, XTAL2		0.5		$0.3V_{DD}$	
Input high Voltage	$V_{IH1}$	RESETB, P0, P1, P2	$V_{DD} = 2.4\text{V} \sim 5.5\text{V}$	$0.2V_{DD} + 1.0$	-	$V_{DD} + 0.5$	V
	$V_{IH2}$	XTAL1, XTAL2		$0.7V_{DD}$	-	$V_{DD} + 0.5$	
Output Low Voltage	$V_{OL}$	All Pins	$I_{OL} = 17\text{mA} @ V_{DD} = 5\text{V}$ $I_{OL} = 7\text{mA} @ V_{DD} = 3\text{V}$ $I_{OL} = 4\text{mA} @ V_{DD} = 2.4\text{V}$	-	-	$0.3V_{DDIO}$	V
Output High Voltage	$V_{OH}$	All Pins	$I_{OH} = -18\text{mA} @ V_{DD} = 5\text{V}$ $I_{OH} = -6\text{mA} @ V_{DD} = 3\text{V}$ $I_{OH} = -3\text{mA} @ V_{DD} = 2.4\text{V}$	$0.7V_{DDIO}$	-	-	V
	$V_{OHP}$	ALL Pins (Pull-up Resistor Only)	$I_{OHP} = -49\mu\text{A} @ V_{DD} = 5\text{V}$ $I_{OHP} = -28\mu\text{A} @ V_{DD} = 3\text{V}$ $I_{OHP} = -22\mu\text{A} @ V_{DD} = 2.4\text{V}$	$0.7V_{DDIO}$	-	-	V
Input Leakage Current	$I_{IL}$	All Pins Except of XTAL1, XTAL2	$V_{IN} = V_{IH}$ or $V_{IL}$	-	-	$\pm 1$	$\mu\text{A}$
Pin Capacitance	$C_{IO}$	All Pins	$V_{DD} = 5\text{V}$	-	10	-	pF

## 8 AC Characteristics

\*  $T_A = -40\text{ }^{\circ}\text{C} \sim +85\text{ }^{\circ}\text{C}$  unless otherwise specified

Parameter	Symbol	Pin	Conditions	Value			Unit
				Min.	Typ.	Max.	
Operating Frequency	$F_{\text{OSC}}$	XTAL1, XTAL2	$V_{\text{DD}} = 5\text{V} \pm 10\%$	1	-	24	MHz
		Internal POSC		1	-	12	
		XTAL1, XTAL2, Internal POSC	$V_{\text{DD}} = 3\text{V} \pm 10\%$	1	-	12	
RESETB Input Width	$t_{\text{RST}}$	RESETB	$V_{\text{DD}} = 5\text{V} \pm 10\%$	24	-	-	$F_{\text{OSC}}$
			$V_{\text{DD}} = 3\text{V} \pm 10\%$	24	-	-	
External Interrupt Input Width	$t_{\text{INT}}$	External Interrupt	$V_{\text{DD}} = 5\text{V} \pm 10\%$	4	-	-	$F_{\text{OSC}}$
			$V_{\text{DD}} = 3\text{V} \pm 10\%$	4	-	-	

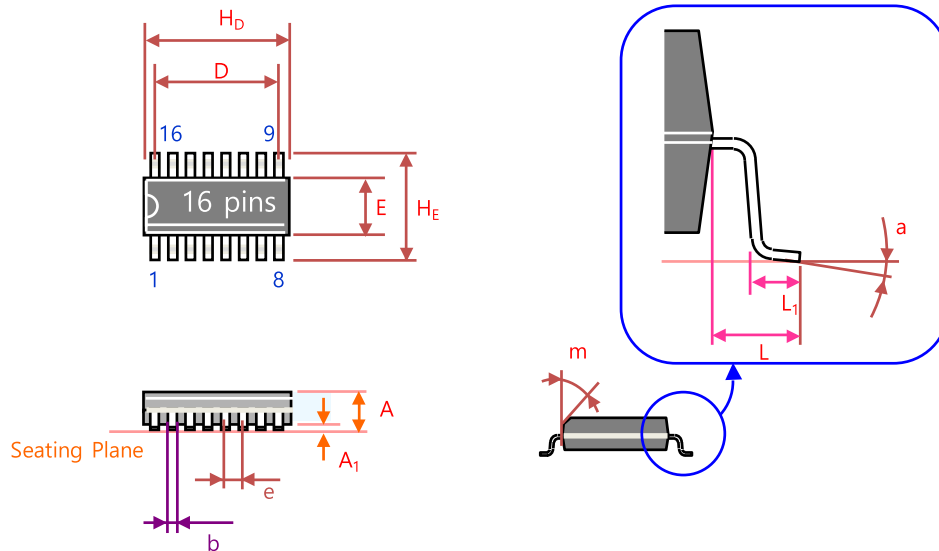


## 9 ADC Specifications

\* TA = -40 °C ~ +85 °C unless otherwise specified

Parameter	Symbol	Conditions	Value			Unit	
			Min.	Typ.	Max.		
Supply Voltage	$V_{DDADC}$	$V_{DDADC} = V_{DD}$	2.4	-	5.5	V	
Input Voltage	$V_{INADC}$	-	$V_{SS}$	-	$V_{DD}$	V	
Resolution	$RES_{ADC}$	-	-	10	-	bit	
Operating Frequency	$F_{ADC}$	$V_{DD} = 4.5V \sim 5.5V$ $V_{DD} = 2.4V \sim 3.3V$	-	-	10 5	MHz	
Conversion Time	$t_{ADC}$	-	-	$96 / F_{ADC}$	-	s	
Overall Accuracy	$OA_{ADC}$	$V_{DD} = 5V, F_{ADC} = 10MHz$ $V_{DD} = 3V, F_{ADC} = 5MHz$	-	$\pm 2$	$\pm 4$	LSB	
Integral Nonlinearity	$INL_{ADC}$	$V_{DD} = 5V, F_{ADC} = 10MHz$ $V_{DD} = 3V, F_{ADC} = 5MHz$	-	$\pm 2$	$\pm 4$	LSB	
Differential Nonlinearity	$DNL_{ADC}$	$V_{DD} = 5V, F_{ADC} = 10MHz$ $V_{DD} = 3V, F_{ADC} = 5MHz$	-	$\pm 0.5$	$\pm 1$	LSB	
Zero Input Error	$ZIE_{ADC}$	$V_{DD} = 5V, F_{ADC} = 10MHz$ $V_{DD} = 3V, F_{ADC} = 5MHz$	-	$\pm 2$	$\pm 4$	LSB	
Full Scale Error	$FSE_{ADC}$	$V_{DD} = 5V, F_{ADC} = 10MHz$ $V_{DD} = 3V, F_{ADC} = 5MHz$	-	$\pm 2$	$\pm 4$	LSB	
Analog Input Capacitance	$C_{INADC}$	-	-	10	15	pF	
ADC Current	Active	$I_{ADC}$	$V_{DD} = 5V, F_{ADC} = 10MHz$	-	1	2	mA
			$V_{DD} = 3V, F_{ADC} = 5MHz$	-	0.3	0.6	
	Power-down	$V_{DD} = 5V$	-	-	100	nA	

## 10 16-pin TSSOP Package Dimension



Symbol	Dimension in Inches			Dimension in mm		
	Min.	Nom.	Max.	Min.	Nom.	Max.
<b>A</b>	0.037	0.039	0.041	0.95	1.00	1.05
<b>A<sub>1</sub></b>	0.015	0.017	0.019	0.3865	0.4365	0.4865
<b>b</b>	0.008	0.009	0.009	0.20	0.22	0.24
<b>D</b>	0.176	0.179	0.182	4.47	4.55	4.63
<b>E</b>	0.171	0.173	0.175	4.35	4.4	4.45
<b>H<sub>b</sub></b>	0.200	0.202	0.204	5.077	5.127	5.177
<b>H<sub>E</sub></b>	0.248	0.252	0.248	6.30	6.40	6.30
<b>L</b>	0.033	0.037	0.041	0.85	0.95	1.05
<b>L<sub>1</sub></b>	0.020	0.024	0.028	0.50	0.60	0.70
<b>a</b>	1°	3°	5°	1°	3°	5°
<b>e</b>	0.026 BSC			0.65 BSC		
<b>m</b>	10°	12°	14°	10°	12°	14°

**Notes:**

1. Dimension D & E include mold mismatch and are determined at the mold parting line.
2. General appearance spec. should be based on final visual inspection spec