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### Analog Peripherals

- **10-Bit ADC** (\*T600/602/604 only)
  - Up to 500 ksp/s
  - Up to 8 external inputs
  - V<sub>REF</sub> external pin, Internal Regulator or V<sub>DD</sub>
  - Internal or external start of conversion source
  - Built-in temperature sensor
- **Comparator**
  - Programmable hysteresis and response time
  - Configurable as interrupt or reset source
  - Low current

### On-Chip Debug

- C8051F300 can be used as code development platform; complete development kit available
- On-chip debug circuitry facilitates full speed, non-intrusive in-system debug
- Provides breakpoints, single stepping, inspect/modify memory and registers

### Supply Voltage 1.8 to 3.6 V

- On-chip LDO for internal core supply
- Built-in voltage supply monitor

### Temperature Range: -40 to +85 °C

### Package Options:

- 3 x 3 mm QFN11
- 2 x 2 mm QFN10 (C8051T606 Only)
- MSOP10 (C8051T606 Only)
- SOIC14 (C8051T600/1/2/3/4/5 Only)

### High-Speed 8051 µC Core

- Pipelined instruction architecture; executes 70% of instructions in 1 or 2 system clocks
- Up to 25 MIPS throughput with 25 MHz clock
- Expanded interrupt handler

### Memory

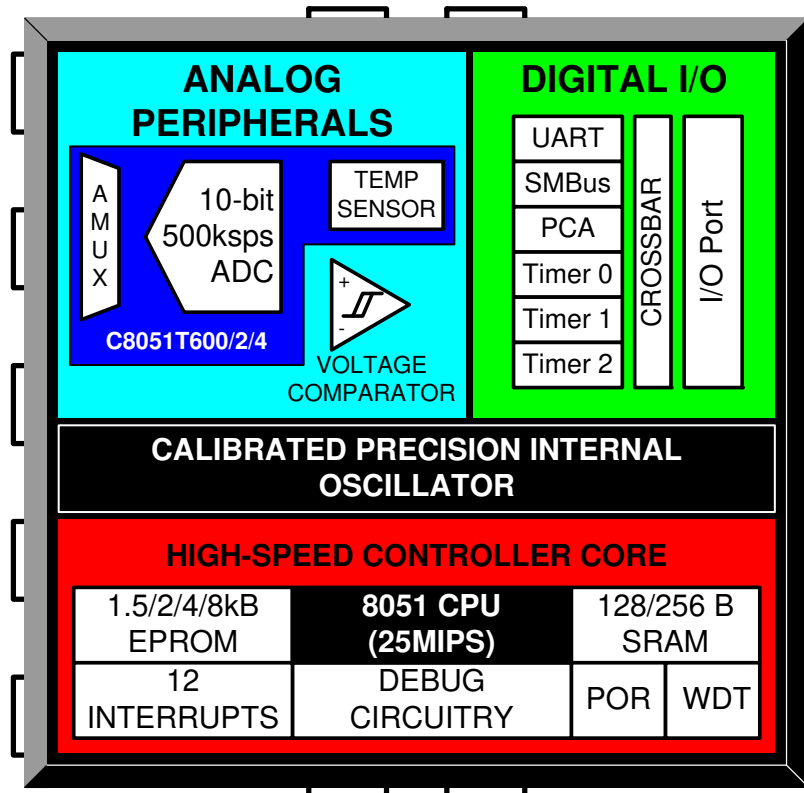
- 256 or 128 Bytes internal data RAM
- 8, 4, 2, or 1.5 kB byte-programmable EPROM code memory

### Digital Peripherals

- Up to 8 Port I/O with high sink current capability
- Hardware enhanced UART and SMBus™ serial ports
- Three general purpose 16-bit counter/timers
  - 8 or 16-bit PWM
  - Rising / falling edge capture
  - Frequency output
  - Software timer

### Clock Sources

- Internal oscillator: 24.5 MHz with ±2% accuracy supports crystal-less UART operation
- External oscillator: RC, C, or CMOS Clock
- Can switch between clock sources on-the-fly; useful in power saving modes



# C8051T600/1/2/3/4/5/6

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## Table of Contents

<b>1. System Overview</b> .....	<b>13</b>
<b>2. Ordering Information</b> .....	<b>16</b>
<b>3. Pin Definitions</b> .....	<b>17</b>
<b>4. QFN-11 Package Specifications</b> .....	<b>22</b>
<b>5. SOIC-14 Package Specifications</b> .....	<b>24</b>
<b>6. MSOP-10 Package Specifications</b> .....	<b>26</b>
<b>7. QFN-10 Package Specifications</b> .....	<b>28</b>
<b>8. Electrical Characteristics</b> .....	<b>30</b>
8.1. Absolute Maximum Specifications.....	30
8.2. Electrical Characteristics .....	31
8.3. Typical Performance Curves .....	38
<b>9. 10-Bit ADC (ADC0, C8051T600/2/4 only)</b> .....	<b>40</b>
9.1. Output Code Formatting .....	41
9.2. 8-Bit Mode .....	41
9.3. Modes of Operation .....	41
9.3.1. Starting a Conversion.....	41
9.3.2. Tracking Modes.....	42
9.3.3. Settling Time Requirements.....	43
9.4. Programmable Window Detector.....	47
9.4.1. Window Detector Example.....	49
9.5. ADC0 Analog Multiplexer (C8051T600/2/4 only).....	50
<b>10. Temperature Sensor (C8051T600/2/4 only)</b> .....	<b>52</b>
10.1. Calibration .....	52
<b>11. Voltage Reference Options</b> .....	<b>55</b>
<b>12. Voltage Regulator (REG0)</b> .....	<b>57</b>
<b>13. Comparator0</b> .....	<b>59</b>
13.1. Comparator Multiplexer .....	63
<b>14. CIP-51 Microcontroller</b> .....	<b>65</b>
14.1. Instruction Set.....	66
14.1.1. Instruction and CPU Timing .....	66
14.2. CIP-51 Register Descriptions .....	71
<b>15. Memory Organization</b> .....	<b>74</b>
15.1. Program Memory.....	74
15.2. Data Memory .....	75
15.2.1. Internal RAM .....	75
15.2.1.1. General Purpose Registers .....	76
15.2.1.2. Bit Addressable Locations .....	76
15.2.1.3. Stack .....	76
<b>16. Special Function Registers</b> .....	<b>77</b>
<b>17. Interrupts</b> .....	<b>80</b>
17.1. MCU Interrupt Sources and Vectors.....	81
17.1.1. Interrupt Priorities.....	81
17.1.2. Interrupt Latency .....	81

---

17.2. Interrupt Register Descriptions .....	82
17.3. INT0 and INT1 External Interrupt Sources .....	87
<b>18. Power Management Modes .....</b>	<b>89</b>
18.1. Idle Mode .....	89
18.2. Stop Mode .....	90
<b>19. Reset Sources .....</b>	<b>92</b>
19.1. Power-On Reset .....	93
19.2. Power-Fail Reset/VDD Monitor .....	94
19.3. External Reset .....	94
19.4. Missing Clock Detector Reset .....	94
19.5. Comparator0 Reset .....	94
19.6. PCA Watchdog Timer Reset .....	94
19.7. EPROM Error Reset .....	95
19.8. Software Reset .....	95
<b>20. EPROM Memory .....</b>	<b>97</b>
20.1. Programming and Reading the EPROM Memory .....	97
20.1.1. EPROM Write Procedure .....	97
20.1.2. EPROM Read Procedure .....	98
20.2. Security Options .....	98
20.3. Program Memory CRC .....	99
20.3.1. Performing 32-bit CRCs on Full EPROM Content .....	99
20.3.2. Performing 16-bit CRCs on 256-Byte EPROM Blocks .....	99
<b>21. Oscillators and Clock Selection .....</b>	<b>100</b>
21.1. System Clock Selection .....	100
21.2. Programmable Internal High-Frequency (H-F) Oscillator .....	101
21.3. External Oscillator Drive Circuit .....	103
21.3.1. External RC Example .....	105
21.3.2. External Capacitor Example .....	105
<b>22. Port Input/Output .....</b>	<b>106</b>
22.1. Port I/O Modes of Operation .....	107
22.1.1. Port Pins Configured for Analog I/O .....	107
22.1.2. Port Pins Configured For Digital I/O .....	107
22.1.3. Interfacing Port I/O to 5V Logic .....	108
22.2. Assigning Port I/O Pins to Analog and Digital Functions .....	109
22.2.1. Assigning Port I/O Pins to Analog Functions .....	109
22.2.2. Assigning Port I/O Pins to Digital Functions .....	109
22.2.3. Assigning Port I/O Pins to External Digital Event Capture Functions ...	110
22.3. Priority Crossbar Decoder .....	111
22.4. Port I/O Initialization .....	114
22.5. Special Function Registers for Accessing and Configuring Port I/O .....	118
<b>23. SMBus .....</b>	<b>120</b>
23.1. Supporting Documents .....	121
23.2. SMBus Configuration .....	121
23.3. SMBus Operation .....	121
23.3.1. Transmitter Vs. Receiver .....	122

---

# C8051T600/1/2/3/4/5/6

---

23.3.2. Arbitration.....	122
23.3.3. Clock Low Extension.....	122
23.3.4. SCL Low Timeout.....	122
23.3.5. SCL High (SMBus Free) Timeout .....	123
23.4. Using the SMBus.....	123
23.4.1. SMBus Configuration Register.....	123
23.4.2. SMB0CN Control Register .....	127
23.4.3. Data Register .....	130
23.5. SMBus Transfer Modes.....	131
23.5.1. Write Sequence (Master) .....	131
23.5.2. Read Sequence (Master).....	132
23.5.3. Write Sequence (Slave) .....	133
23.5.4. Read Sequence (Slave).....	134
23.6. SMBus Status Decoding.....	134
<b>24. UART0 .....</b>	<b>137</b>
24.1. Enhanced Baud Rate Generation.....	138
24.2. Operational Modes .....	139
24.2.1. 8-Bit UART .....	139
24.2.2. 9-Bit UART .....	140
24.3. Multiprocessor Communications .....	141
<b>25. Timers .....</b>	<b>145</b>
25.1. Timer 0 and Timer 1 .....	147
25.1.1. Mode 0: 13-bit Counter/Timer .....	147
25.1.2. Mode 1: 16-bit Counter/Timer .....	148
25.1.3. Mode 2: 8-bit Counter/Timer with Auto-Reload.....	149
25.1.4. Mode 3: Two 8-bit Counter/Timers (Timer 0 Only).....	150
25.2. Timer 2 .....	155
25.2.1. 16-bit Timer with Auto-Reload.....	155
25.2.2. 8-bit Timers with Auto-Reload.....	156
<b>26. Programmable Counter Array.....</b>	<b>160</b>
26.1. PCA Counter/Timer .....	161
26.2. PCA0 Interrupt Sources.....	162
26.3. Capture/Compare Modules .....	163
26.3.1. Edge-triggered Capture Mode.....	164
26.3.2. Software Timer (Compare) Mode.....	165
26.3.3. High-Speed Output Mode .....	166
26.3.4. Frequency Output Mode .....	167
26.3.5. 8-bit Pulse Width Modulator Mode .....	168
26.3.6. 16-Bit Pulse Width Modulator Mode.....	169
26.4. Watchdog Timer Mode .....	170
26.4.1. Watchdog Timer Operation .....	170
26.4.2. Watchdog Timer Usage .....	171
26.5. Register Descriptions for PCA0.....	173
<b>27. C2 Interface .....</b>	<b>178</b>
27.1. C2 Interface Registers.....	178

---

# C8051T600/1/2/3/4/5/6

---

27.2. C2 Pin Sharing .....	185
<b>Document Change List.....</b>	<b>186</b>
<b>Contact Information.....</b>	<b>188</b>

# C8051T600/1/2/3/4/5/6

---

## List of Figures

### 1. System Overview

Figure 1.1. C8051T600/2/4 Block Diagram .....	14
Figure 1.2. C8051T601/3/5 Block Diagram .....	14
Figure 1.3. C8051T606 Block Diagram .....	15

### 2. Ordering Information

### 3. Pin Definitions

Figure 3.1. C8051T600/1/2/3/4/5-GM QFN11 Pinout Diagram (Top View) .....	19
Figure 3.2. C8051T600/1/2/3/4/5-GS SOIC14 Pinout Diagram (Top View) .....	19
Figure 3.3. C8051T606-GM QFN11 Pinout Diagram (Top View) .....	20
Figure 3.4. C8051T606-GT MSOP10 Pinout Diagram (Top View) .....	20
Figure 3.5. C8051T606-ZM QFN10 Pinout Diagram (Top View) .....	21

### 4. QFN-11 Package Specifications

Figure 4.1. QFN-11 Package Drawing .....	22
Figure 4.2. QFN-11 PCB Land Pattern .....	23

### 5. SOIC-14 Package Specifications

Figure 5.1. SOIC-14 Package Drawing .....	24
Figure 5.2. SOIC-14 Recommended PCB Land Pattern .....	25

### 6. MSOP-10 Package Specifications

Figure 6.1. MSOP-10 Package Drawing .....	26
Figure 6.2. MSOP-10 PCB Land Pattern .....	27

### 7. QFN-10 Package Specifications

Figure 7.1. QFN-10 Package Drawing .....	28
Figure 7.2. QFN-10 PCB Land Pattern .....	29

### 8. Electrical Characteristics

Figure 8.1. C8051T600/1/2/3/4/5 Normal Mode Supply Current vs. Frequency (MPCE = 1) .....	38
Figure 8.2. C8051T606 Normal Mode Supply Current vs. Frequency (MPCE = 1) .....	38
Figure 8.3. C8051T600/1/2/3/4/5 Idle Mode Supply Current vs. Frequency (MPCE = 1) .....	39
Figure 8.4. C8051T606 Idle Mode Digital Current vs. Frequency (MPCE = 1) .....	39

### 9. 10-Bit ADC (ADC0, C8051T600/2/4 only)

Figure 9.1. ADC0 Functional Block Diagram .....	40
Figure 9.2. 10-Bit ADC Track and Conversion Example Timing .....	42
Figure 9.3. ADC0 Equivalent Input Circuits .....	43
Figure 9.4. ADC Window Compare Example: Right-Justified Data .....	49
Figure 9.5. ADC Window Compare Example: Left-Justified Data .....	49
Figure 9.6. ADC0 Multiplexer Block Diagram .....	50

### 10. Temperature Sensor (C8051T600/2/4 only)

Figure 10.1. Temperature Sensor Transfer Function .....	52
Figure 10.2. Temperature Sensor Error with 1-Point Calibration at 0 °C .....	53

### 11. Voltage Reference Options

Figure 11.1. Voltage Reference Functional Block Diagram .....	55
---	----

### 12. Voltage Regulator (REG0)

---

<b>13. Comparator0</b>	
Figure 13.1. Comparator0 Functional Block Diagram .....	59
Figure 13.2. Comparator Hysteresis Plot .....	60
Figure 13.3. Comparator Input Multiplexer Block Diagram .....	63
<b>14. CIP-51 Microcontroller</b>	
Figure 14.1. CIP-51 Block Diagram .....	65
<b>15. Memory Organization</b>	
Figure 15.1. Program Memory Map .....	74
Figure 15.2. RAM Memory Map .....	75
<b>16. Special Function Registers</b>	
<b>17. Interrupts</b>	
<b>18. Power Management Modes</b>	
<b>19. Reset Sources</b>	
Figure 19.1. Reset Sources .....	92
Figure 19.2. Power-On and VDD Monitor Reset Timing .....	93
<b>20. EPROM Memory</b>	
<b>21. Oscillators and Clock Selection</b>	
Figure 21.1. Oscillator Options .....	100
<b>22. Port Input/Output</b>	
Figure 22.1. Port I/O Functional Block Diagram .....	106
Figure 22.2. Port I/O Cell Block Diagram .....	107
Figure 22.3. Priority Crossbar Decoder Potential Pin Assignments .....	111
Figure 22.4. Priority Crossbar Decoder Example 1 - No Skipped Pins .....	112
Figure 22.5. Priority Crossbar Decoder Example 2 - Skipping Pins .....	113
<b>23. SMBus</b>	
Figure 23.1. SMBus Block Diagram .....	120
Figure 23.2. Typical SMBus Configuration .....	121
Figure 23.3. SMBus Transaction .....	122
Figure 23.4. Typical SMBus SCL Generation .....	124
Figure 23.5. Typical Master Write Sequence .....	131
Figure 23.6. Typical Master Read Sequence .....	132
Figure 23.7. Typical Slave Write Sequence .....	133
Figure 23.8. Typical Slave Read Sequence .....	134
<b>24. UART0</b>	
Figure 24.1. UART0 Block Diagram .....	137
Figure 24.2. UART0 Baud Rate Logic .....	138
Figure 24.3. UART Interconnect Diagram .....	139
Figure 24.4. 8-Bit UART Timing Diagram .....	139
Figure 24.5. 9-Bit UART Timing Diagram .....	140
Figure 24.6. UART Multi-Processor Mode Interconnect Diagram .....	141
<b>25. Timers</b>	
Figure 25.1. T0 Mode 0 Block Diagram .....	148
Figure 25.2. T0 Mode 2 Block Diagram .....	149
Figure 25.3. T0 Mode 3 Block Diagram .....	150
Figure 25.4. Timer 2 16-Bit Mode Block Diagram .....	155

---



# C8051T600/1/2/3/4/5/6

---

Figure 25.5. Timer 2 8-Bit Mode Block Diagram .....	156
<b>26. Programmable Counter Array</b>	
Figure 26.1. PCA Block Diagram .....	160
Figure 26.2. PCA Counter/Timer Block Diagram .....	161
Figure 26.3. PCA Interrupt Block Diagram .....	162
Figure 26.4. PCA Capture Mode Diagram .....	164
Figure 26.5. PCA Software Timer Mode Diagram .....	165
Figure 26.6. PCA High-Speed Output Mode Diagram .....	166
Figure 26.7. PCA Frequency Output Mode .....	167
Figure 26.8. PCA 8-Bit PWM Mode Diagram .....	168
Figure 26.9. PCA 16-Bit PWM Mode .....	169
Figure 26.10. PCA Module 2 with Watchdog Timer Enabled .....	170
<b>27. C2 Interface</b>	
Figure 27.1. Typical C2 Pin Sharing .....	185

# C8051T600/1/2/3/4/5/6

---

## List of Tables

<b>1. System Overview</b>	
<b>2. Ordering Information</b>	
Table 2.1. Product Selection Guide .....	16
<b>3. Pin Definitions</b>	
Table 3.1. Pin Definitions for the C8051T600/1/2/3/4/5 .....	17
Table 3.2. Pin Definitions for the C8051T606 .....	18
<b>4. QFN-11 Package Specifications</b>	
Table 4.1. QFN-11 Package Dimensions .....	22
Table 4.2. QFN-11 PCB Land Pattern Dimensions .....	23
<b>5. SOIC-14 Package Specifications</b>	
Table 5.1. SOIC-14 Package Dimensions .....	24
Table 5.2. SOIC-14 PCB Land Pattern Dimensions .....	25
<b>6. MSOP-10 Package Specifications</b>	
Table 6.1. MSOP-10 Package Dimensions .....	26
Table 6.2. MSOP-10 PCB Land Pattern Dimensions .....	27
<b>7. QFN-10 Package Specifications</b>	
Table 7.1. QFN-10 Package Dimensions .....	28
Table 7.2. QFN-10 PCB Land Pattern Dimensions .....	29
<b>8. Electrical Characteristics</b>	
Table 8.1. Absolute Maximum Ratings .....	30
Table 8.2. Global Electrical Characteristics .....	31
Table 8.3. Port I/O DC Electrical Characteristics .....	33
Table 8.4. Reset Electrical Characteristics .....	34
Table 8.5. Internal Voltage Regulator Electrical Characteristics .....	34
Table 8.6. EPROM Electrical Characteristics .....	34
Table 8.7. Internal High-Frequency Oscillator Electrical Characteristics .....	35
Table 8.8. Temperature Sensor Electrical Characteristics .....	35
Table 8.9. Voltage Reference Electrical Characteristics .....	35
Table 8.10. ADC0 Electrical Characteristics .....	36
Table 8.11. Comparator Electrical Characteristics .....	37
<b>9. 10-Bit ADC (ADC0, C8051T600/2/4 only)</b>	
<b>10. Temperature Sensor (C8051T600/2/4 only)</b>	
<b>11. Voltage Reference Options</b>	
<b>12. Voltage Regulator (REG0)</b>	
<b>13. Comparator0</b>	
<b>14. CIP-51 Microcontroller</b>	
Table 14.1. CIP-51 Instruction Set Summary .....	67
<b>15. Memory Organization</b>	
<b>16. Special Function Registers</b>	
Table 16.1. Special Function Register (SFR) Memory Map .....	77
Table 16.2. Special Function Registers .....	77
<b>17. Interrupts</b>	
Table 17.1. Interrupt Summary .....	82

---

<b>18. Power Management Modes</b>	
<b>19. Reset Sources</b>	
<b>20. EPROM Memory</b>	
Table 20.1. Security Byte Decoding .....	98
<b>21. Oscillators and Clock Selection</b>	
<b>22. Port Input/Output</b>	
Table 22.1. Port I/O Assignment for Analog Functions .....	109
Table 22.2. Port I/O Assignment for Digital Functions .....	109
Table 22.3. Port I/O Assignment for External Digital Event Capture Functions ....	110
<b>23. SMBus</b>	
Table 23.1. SMBus Clock Source Selection .....	124
Table 23.2. Minimum SDA Setup and Hold Times .....	125
Table 23.3. Sources for Hardware Changes to SMB0CN .....	129
Table 23.4. SMBus Status Decoding .....	135
<b>24. UART0</b>	
Table 24.1. Timer Settings for Standard Baud Rates Using The Internal 24.5 MHz Oscillator .....	144
Table 24.2. Timer Settings for Standard Baud Rates Using an External 22.1184 MHz Oscillator .....	144
<b>25. Timers</b>	
<b>26. Programmable Counter Array</b>	
Table 26.1. PCA Timebase Input Options .....	161
Table 26.2. PCA0CPM Bit Settings for PCA Capture/Compare Modules .....	163
Table 26.3. Watchdog Timer Timeout Intervals1 .....	172
<b>27. C2 Interface</b>	

# C8051T600/1/2/3/4/5/6

## List of Registers

SFR Definition 9.1. ADC0CF: ADC0 Configuration .....	44
SFR Definition 9.2. ADC0H: ADC0 Data Word MSB .....	45
SFR Definition 9.3. ADC0L: ADC0 Data Word LSB .....	45
SFR Definition 9.4. ADC0CN: ADC0 Control .....	46
SFR Definition 9.5. ADC0GTH: ADC0 Greater-Than Data High Byte .....	47
SFR Definition 9.6. ADC0GTL: ADC0 Greater-Than Data Low Byte .....	47
SFR Definition 9.7. ADC0LTH: ADC0 Less-Than Data High Byte .....	48
SFR Definition 9.8. ADC0LTL: ADC0 Less-Than Data Low Byte .....	48
SFR Definition 9.9. AMX0SL: AMUX0 Positive Channel Select .....	51
SFR Definition 10.1. TOFFH: Temperature Offset Measurement High Byte .....	54
SFR Definition 10.2. TOFFL: Temperature Offset Measurement Low Byte .....	54
SFR Definition 11.1. REF0CN: Reference Control .....	56
SFR Definition 12.1. REG0CN: Voltage Regulator Control .....	58
SFR Definition 13.1. CPT0CN: Comparator0 Control .....	61
SFR Definition 13.2. CPT0MD: Comparator0 Mode Selection .....	62
SFR Definition 13.3. CPT0MX: Comparator0 MUX Selection .....	64
SFR Definition 14.1. DPL: Data Pointer Low Byte .....	71
SFR Definition 14.2. DPH: Data Pointer High Byte .....	71
SFR Definition 14.3. SP: Stack Pointer .....	72
SFR Definition 14.4. ACC: Accumulator .....	72
SFR Definition 14.5. B: B Register .....	72
SFR Definition 14.6. PSW: Program Status Word .....	73
SFR Definition 17.1. IE: Interrupt Enable .....	83
SFR Definition 17.2. IP: Interrupt Priority .....	84
SFR Definition 17.3. EIE1: Extended Interrupt Enable 1 .....	85
SFR Definition 17.4. EIP1: Extended Interrupt Priority 1 .....	86
SFR Definition 17.5. IT01CF: INT0/INT1 Configuration .....	88
SFR Definition 18.1. PCON: Power Control .....	91
SFR Definition 19.1. RSTSRC: Reset Source .....	96
SFR Definition 21.1. OSCICL: Internal H-F Oscillator Calibration .....	101
SFR Definition 21.2. OSCICN: Internal H-F Oscillator Control .....	102
SFR Definition 21.3. OSCXCN: External Oscillator Control .....	104
SFR Definition 22.1. XBR0: Port I/O Crossbar Register 0 .....	115
SFR Definition 22.2. XBR1: Port I/O Crossbar Register 1 .....	116
SFR Definition 22.3. XBR2: Port I/O Crossbar Register 2 .....	117
SFR Definition 22.4. P0: Port 0 .....	118
SFR Definition 22.5. P0MDIN: Port 0 Input Mode .....	119
SFR Definition 22.6. P0MDOUT: Port 0 Output Mode .....	119
SFR Definition 23.1. SMB0CF: SMBus Clock/Configuration .....	126
SFR Definition 23.2. SMB0CN: SMBus Control .....	128
SFR Definition 23.3. SMB0DAT: SMBus Data .....	130
SFR Definition 24.1. SCON0: Serial Port 0 Control .....	142
SFR Definition 24.2. SBUF0: Serial (UART0) Port Data Buffer .....	143

---

SFR Definition 25.1. CKCON: Clock Control .....	146
SFR Definition 25.2. TCON: Timer Control .....	151
SFR Definition 25.3. TMOD: Timer Mode .....	152
SFR Definition 25.4. TL0: Timer 0 Low Byte .....	153
SFR Definition 25.5. TL1: Timer 1 Low Byte .....	153
SFR Definition 25.6. TH0: Timer 0 High Byte .....	154
SFR Definition 25.7. TH1: Timer 1 High Byte .....	154
SFR Definition 25.8. TMR2CN: Timer 2 Control .....	157
SFR Definition 25.9. TMR2RL: Timer 2 Reload Register Low Byte .....	158
SFR Definition 25.10. TMR2RHL: Timer 2 Reload Register High Byte .....	158
SFR Definition 25.11. TMR2L: Timer 2 Low Byte .....	158
SFR Definition 25.12. TMR2H: Timer 2 High Byte .....	159
SFR Definition 26.1. PCA0CN: PCA Control .....	173
SFR Definition 26.2. PCA0MD: PCA Mode .....	174
SFR Definition 26.3. PCA0CPMn: PCA Capture/Compare Mode .....	175
SFR Definition 26.4. PCA0L: PCA Counter/Timer Low Byte .....	176
SFR Definition 26.5. PCA0H: PCA Counter/Timer High Byte .....	176
SFR Definition 26.6. PCA0CPLn: PCA Capture Module Low Byte .....	177
SFR Definition 26.7. PCA0CPHn: PCA Capture Module High Byte .....	177
C2 Register Definition 27.1. C2ADD: C2 Address .....	178
C2 Register Definition 27.2. DEVICEID: C2 Device ID .....	179
C2 Register Definition 27.3. REVID: C2 Revision ID .....	179
C2 Register Definition 27.4. DEVCTL: C2 Device Control .....	180
C2 Register Definition 27.5. EPCTL: EPROM Programming Control Register .....	180
C2 Register Definition 27.6. EPDAT: C2 EPROM Data .....	181
C2 Register Definition 27.7. EPSTAT: C2 EPROM Status .....	181
C2 Register Definition 27.8. EPADDRH: C2 EPROM Address High Byte .....	182
C2 Register Definition 27.9. EPADDRL: C2 EPROM Address Low Byte .....	182
C2 Register Definition 27.10. CRC0: CRC Byte 0 .....	183
C2 Register Definition 27.11. CRC1: CRC Byte 1 .....	183
C2 Register Definition 27.12. CRC2: CRC Byte 2 .....	184
C2 Register Definition 27.13. CRC3: CRC Byte 3 .....	184

# C8051T600/1/2/3/4/5/6

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## 1. System Overview

C8051T600/1/2/3/4/5/6 devices are fully integrated, mixed-signal, system-on-a-chip MCUs. Highlighted features are listed below. Refer to Table 2.1 for specific product feature selection and part ordering numbers.

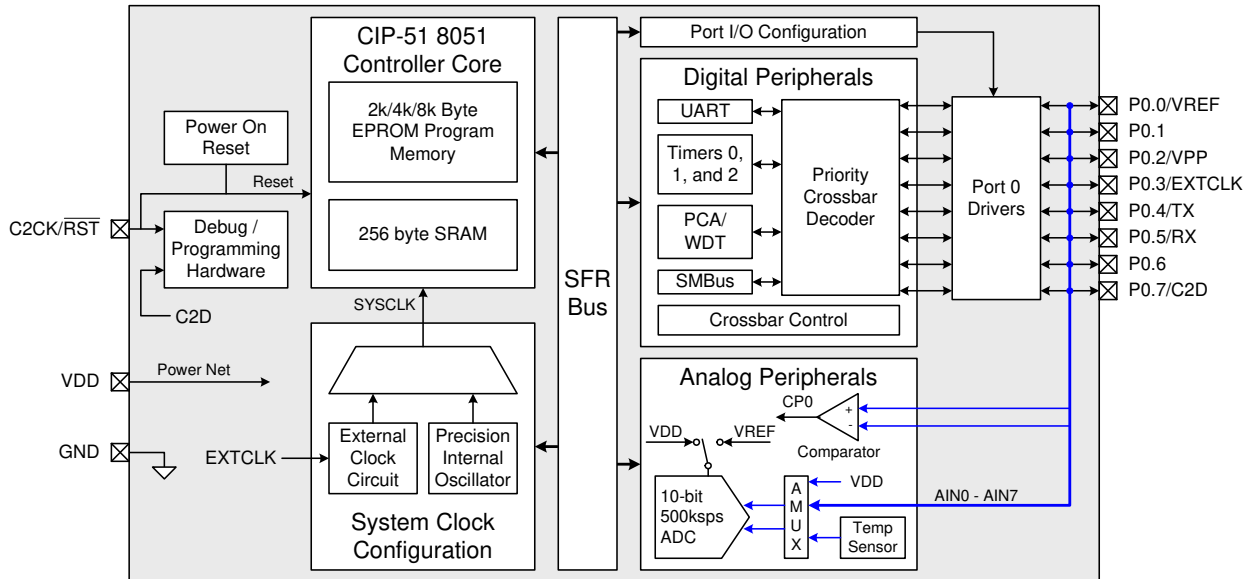
- High-speed pipelined 8051-compatible microcontroller core (up to 25 MIPS)
- In-system, full-speed, non-intrusive debug interface (on-chip)
- C8051F300 ISP Flash device is available for quick in-system code development
- 10-bit 500 ksps Single-ended ADC with analog multiplexer and integrated temperature sensor
- Precision calibrated 24.5 MHz internal oscillator
- 8 k, 4 k, 2 k or 1.5 kB of on-chip Byte-Programmable EPROM—(512 bytes are reserved on 8k version)
- 256 or 128 bytes of on-chip RAM
- SMBus/I<sup>2</sup>C, and ART serial interfaces implemented in hardware
- Three general-purpose 16-bit timers
- Programmable Counter/Timer Array (PCA) with three capture/compare modules and Watchdog Timer function
- On-chip Power-On Reset and Supply Monitor
- On-chip Voltage Comparator
- 8 or 6 Port I/O

With on-chip power-on reset, V<sub>DD</sub> monitor, watchdog timer, and clock oscillator, the C8051T600/1/2/3/4/5/6 devices are truly stand-alone, system-on-a-chip solutions. User software has complete control of all peripherals and may individually shut down any or all peripherals for power savings.

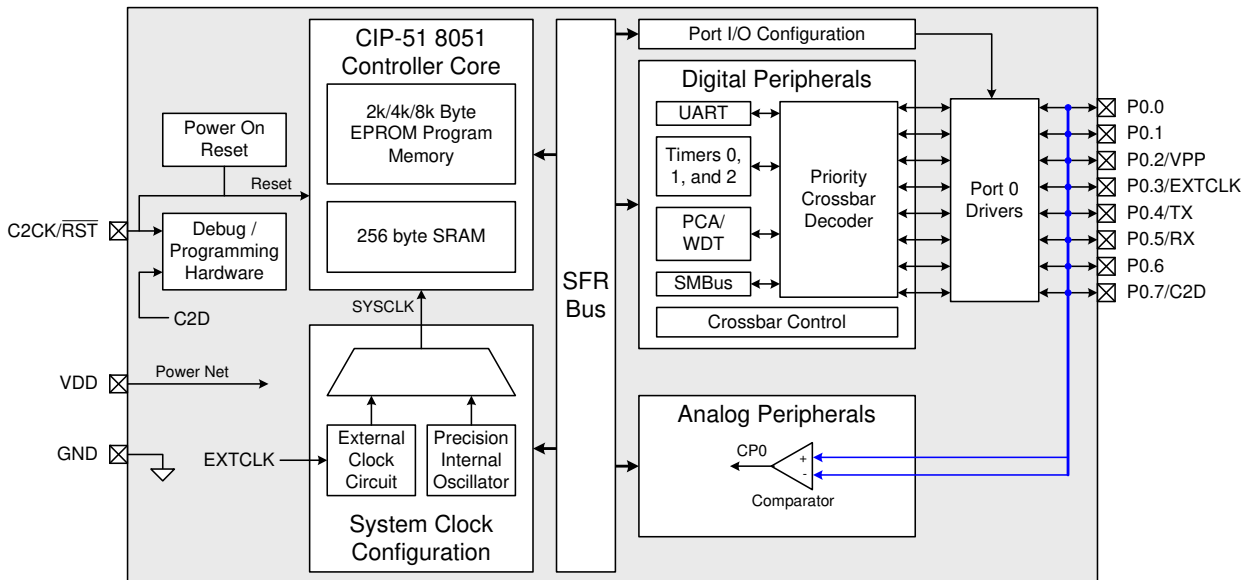
Code written for the C8051T600/1/2/3/4/5/6 family of processors will run on the C8051F300 Mixed-Signal ISP Flash microcontroller, providing a quick, cost-effective way to develop code without requiring special emulator circuitry. The C8051T600/1/2/3/4/5/6 processors include Silicon Laboratories' 2-Wire C2 Debug and Programming interface, which allows non-intrusive (uses no on-chip resources), full speed, in-circuit debugging using the production MCU installed in the final application. This debug logic supports inspection of memory, viewing and modification of special function registers, setting breakpoints, single stepping, and run and halt commands. All analog and digital peripherals are fully functional while debugging using C2. The two C2 interface pins can be shared with user functions, allowing in-system debugging without occupying package pins.

Each device is specified for 1.8–3.6 V operation over the industrial temperature range (–45 to +85 °C). An internal LDO is used to supply the processor core voltage at 1.8 V. The Port I/O and  $\overline{\text{RST}}$  pins are tolerant of input signals up to 5 V. See Table 2.1 for ordering information. Block diagrams of the devices in the C8051T600/1/2/3/4/5/6 family are shown in Figure 1.1, Figure 1.2, and Figure 1.3.

# C8051T600/1/2/3/4/5/6

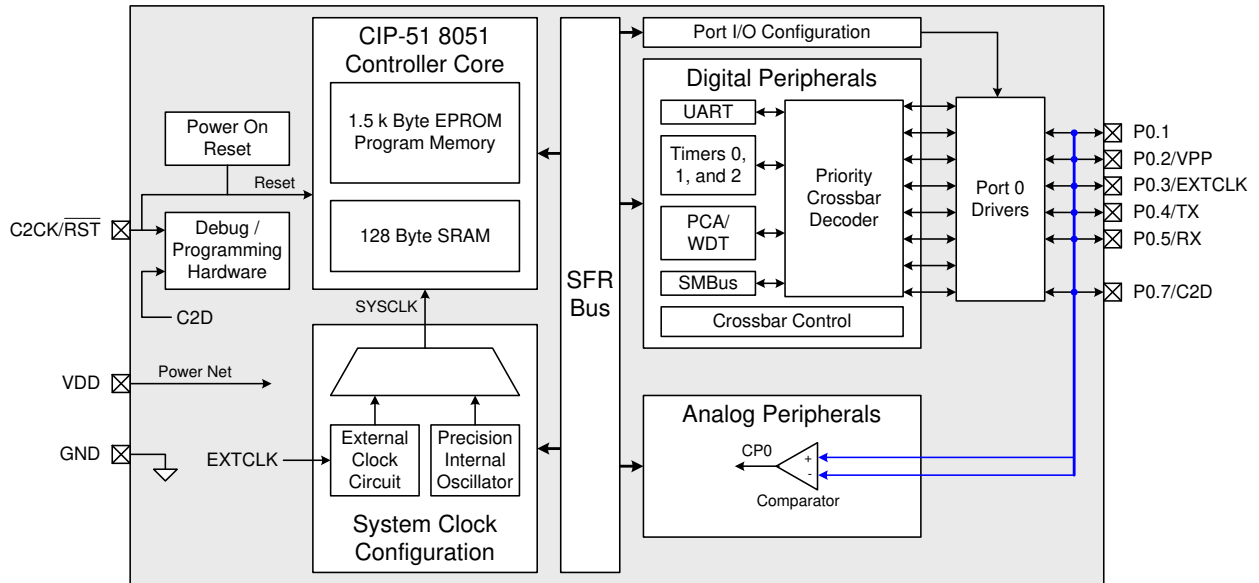


**Figure 1.1. C8051T600/2/4 Block Diagram**



**Figure 1.2. C8051T601/3/5 Block Diagram**

# C8051T600/1/2/3/4/5/6



**Figure 1.3. C8051T606 Block Diagram**



# C8051T600/1/2/3/4/5/6

## 2. Ordering Information

Table 2.1. Product Selection Guide

Part Number	MIPS (Peak)	OTP EPROM (Bytes)	RAM (Bytes)	Calibrated Internal Oscillator	SMBus/I <sup>2</sup> C	UART	Timers (16-bit)	Programmable Counter Array	Digital Port I/Os	10-bit 500ksp ADC	Temperature Sensor	Analog Comparators	Lead-Free (ROHS Compliant) <sup>2</sup>	Package
C8051T600-GM	25	8k <sup>1</sup>	256	Y	Y	Y	3	Y	8	Y	Y	1	Y	QFN-11
C8051T600-GS	25	8k <sup>1</sup>	256	Y	Y	Y	3	Y	8	Y	Y	1	Y	SOIC-14
C8051T601-GM	25	8k <sup>1</sup>	256	Y	Y	Y	3	Y	8	—	—	1	Y	QFN-11
C8051T601-GS	25	8k <sup>1</sup>	256	Y	Y	Y	3	Y	8	—	—	1	Y	SOIC-14
C8051T602-GM	25	4k	256	Y	Y	Y	3	Y	8	Y	Y	1	Y	QFN-11
C8051T602-GS	25	4k	256	Y	Y	Y	3	Y	8	Y	Y	1	Y	SOIC-14
C8051T603-GM	25	4k	256	Y	Y	Y	3	Y	8	—	—	1	Y	QFN-11
C8051T603-GS	25	4k	256	Y	Y	Y	3	Y	8	—	—	1	Y	SOIC-14
C8051T604-GM	25	2k	256	Y	Y	Y	3	Y	8	Y	Y	1	Y	QFN-11
C8051T604-GS	25	2k	256	Y	Y	Y	3	Y	8	Y	Y	1	Y	SOIC-14
C8051T605-GM	25	2k	256	Y	Y	Y	3	Y	8	—	—	1	Y	QFN-11
C8051T605-GS	25	2k	256	Y	Y	Y	3	Y	8	—	—	1	Y	SOIC-14
C8051T606-GM	25	1.5k	128	Y	Y	Y	3	Y	6	—	—	1	Y	QFN-11
C8051T606-GT	25	1.5k	128	Y	Y	Y	3	Y	6	—	—	1	Y	MSOP-10
C8051T606-ZM	25	1.5k	128	Y	Y	Y	3	Y	6	—	—	1	Y	QFN-10

**Notes:**

- 512 Bytes Reserved
- Lead Finish is 100% Matte Tin (Sn)

# C8051T600/1/2/3/4/5/6

## 3. Pin Definitions

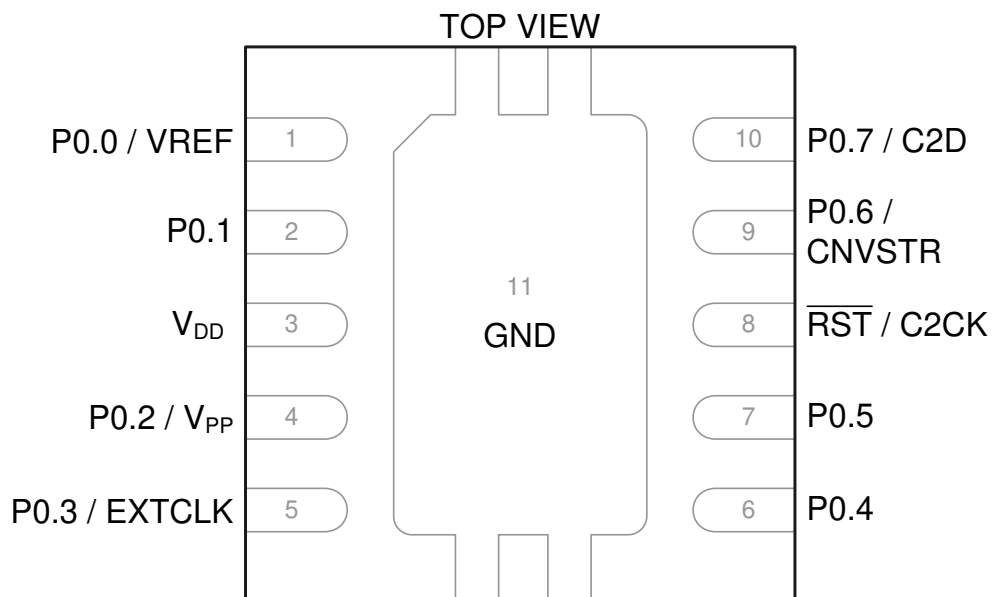
Table 3.1. Pin Definitions for the C8051T600/1/2/3/4/5

Name	QFN11 Pin	SOIC14 Pin	Type	Description
V <sub>DD</sub>	3	7		Power Supply Voltage.
GND	11	3		Ground.
$\overline{\text{RST}}$ / C2CK	8	14	D I/O D I/O	Device Reset. Open-drain output of internal POR or V <sub>DD</sub> monitor. Clock signal for the C2 Debug Interface.
P0.7 / C2D	10	2	D I/O or A In D I/O	Port 0.7. Bi-directional data signal for the C2 Debug Interface.
P0.0 / VREF	1	5	D I/O or A In A In	Port 0.0. External VREF input.
P0.1	2	6	D I/O or A In	Port 0.1.
P0.2 / V <sub>PP</sub>	4	8	D I/O or A In A In	Port 0.2. V <sub>PP</sub> Programming Supply Voltage.
P0.3 / EXTCLK	5	10	D I/O or A In A I/O or D In	Port 0.3. External Clock Pin. This pin can be used as the external clock input for CMOS, capacitor, or RC oscillator configurations.
P0.4	6	12	D I/O or A In	Port 0.4.
P0.5	7	13	D I/O or A In	Port 0.5.
P0.6 / CNVSTR	9	1	D I/O or A In D In	Port 0.6. ADC0 External Convert Start Input.
NC	—	4,9,11		No Connection.

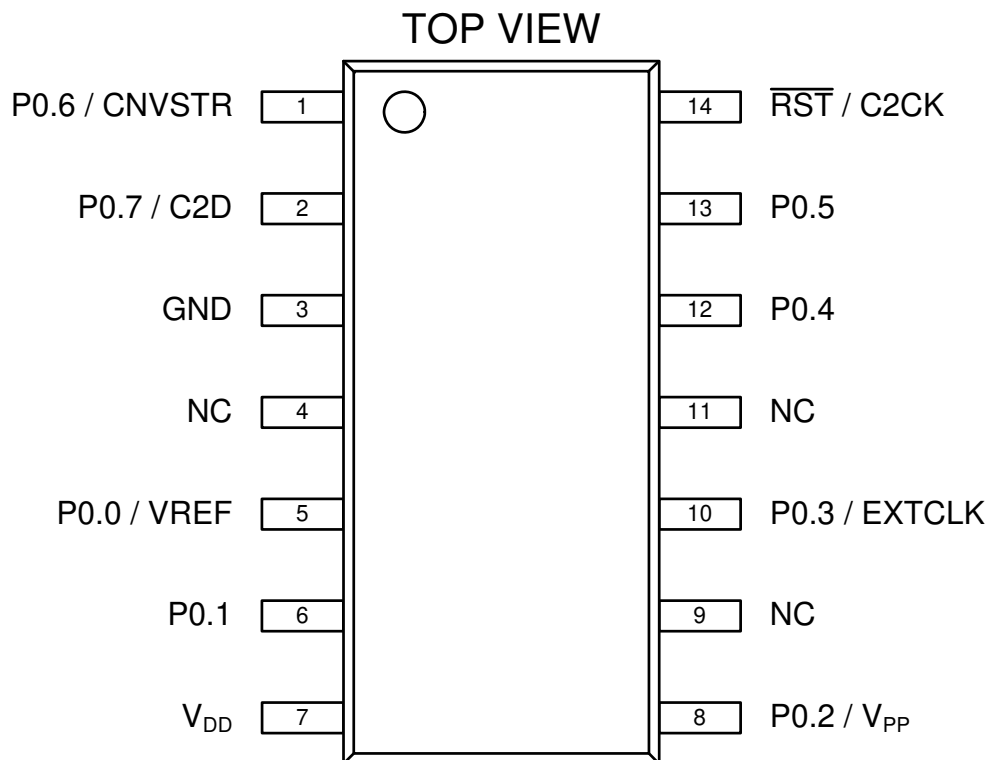
**Table 3.2. Pin Definitions for the C8051T606**

Name	QFN11 Pin	MSOP10 Pin	QFN10 Pin	Type	Description
V <sub>DD</sub>	3	3	2		Power Supply Voltage.
GND	9	9	8		Ground (Required).
GND*	11	—	—		Ground (Optional).
$\overline{\text{RST}}$ / C2CK	8	8	7	D I/O D I/O	Device Reset. Open-drain output of internal POR or V <sub>DD</sub> monitor. Clock signal for the C2 Debug Interface.
P0.7 / C2D	10	10	9	D I/O or A In D I/O	Port 0.7. Bi-directional data signal for the C2 Debug Interface.
P0.1	2	2	1	D I/O or A In	Port 0.1.
P0.2 / V <sub>PP</sub>	4	4	3	D I/O or A In A In	Port 0.2. V <sub>PP</sub> Programming Supply Voltage.
P0.3 / EXTCLK	5	5	4	D I/O or A In A I/O or D In	Port 0.3. External Clock Pin. This pin can be used as the external clock input for CMOS, capacitor, or RC oscillator configurations.
P0.4	6	6	5	D I/O or A In	Port 0.4.
P0.5	7	7	6	D I/O or A In	Port 0.5.
NC	1	1	10		No Connection.

# C8051T600/1/2/3/4/5/6



**Figure 3.1. C8051T600/1/2/3/4/5-GM QFN11 Pinout Diagram (Top View)**



**Figure 3.2. C8051T600/1/2/3/4/5-GS SOIC14 Pinout Diagram (Top View)**

# C8051T600/1/2/3/4/5/6

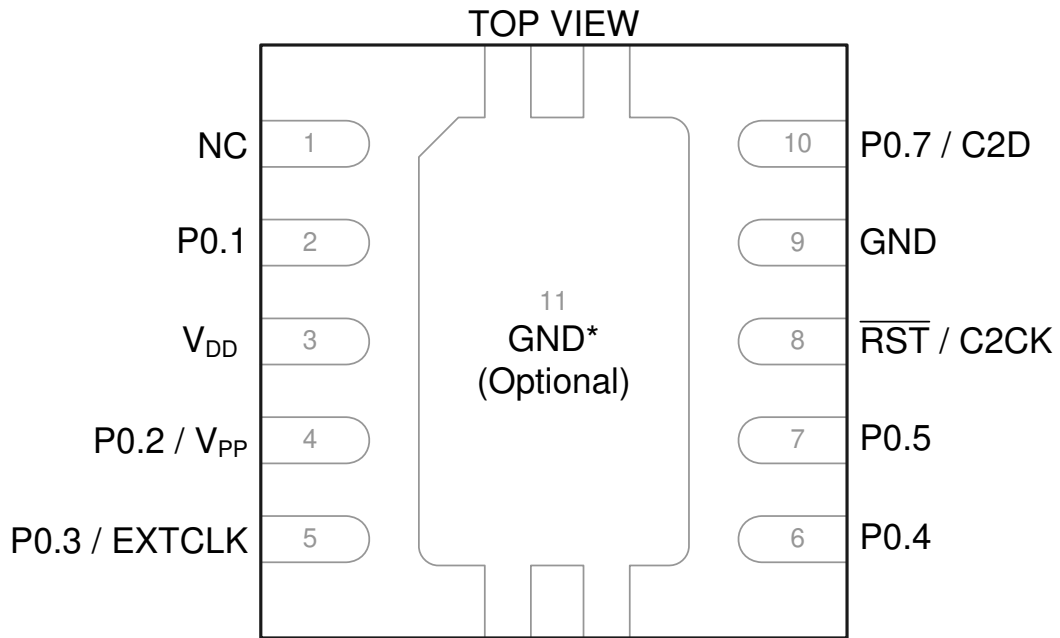


Figure 3.3. C8051T606-GM QFN11 Pinout Diagram (Top View)

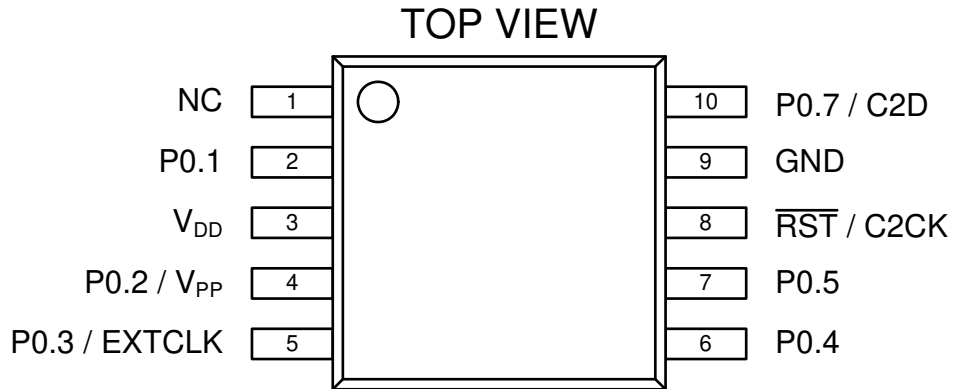


Figure 3.4. C8051T606-GT MSOP10 Pinout Diagram (Top View)

# C8051T600/1/2/3/4/5/6

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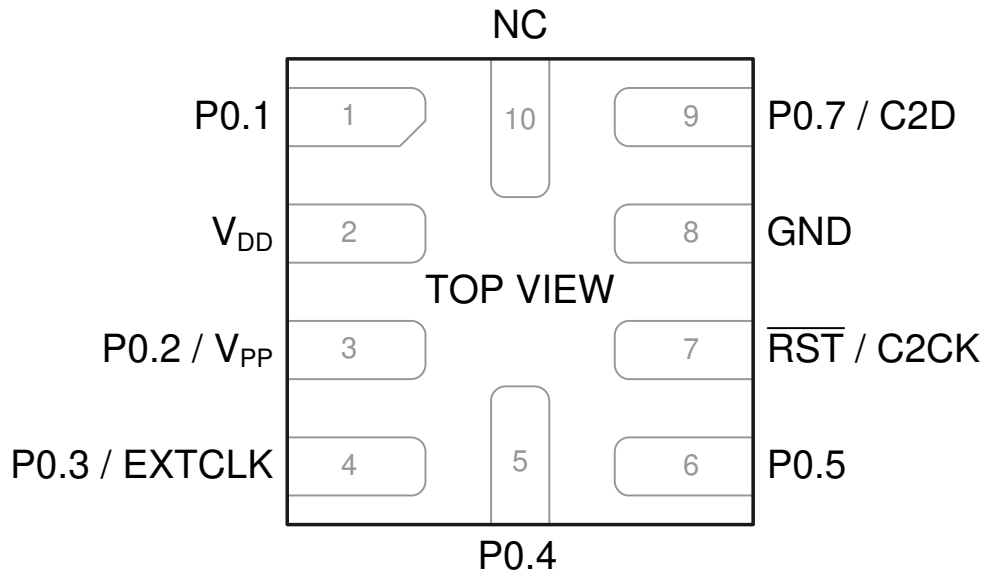


Figure 3.5. C8051T606-ZM QFN10 Pinout Diagram (Top View)

# C8051T600/1/2/3/4/5/6

## 4. QFN-11 Package Specifications

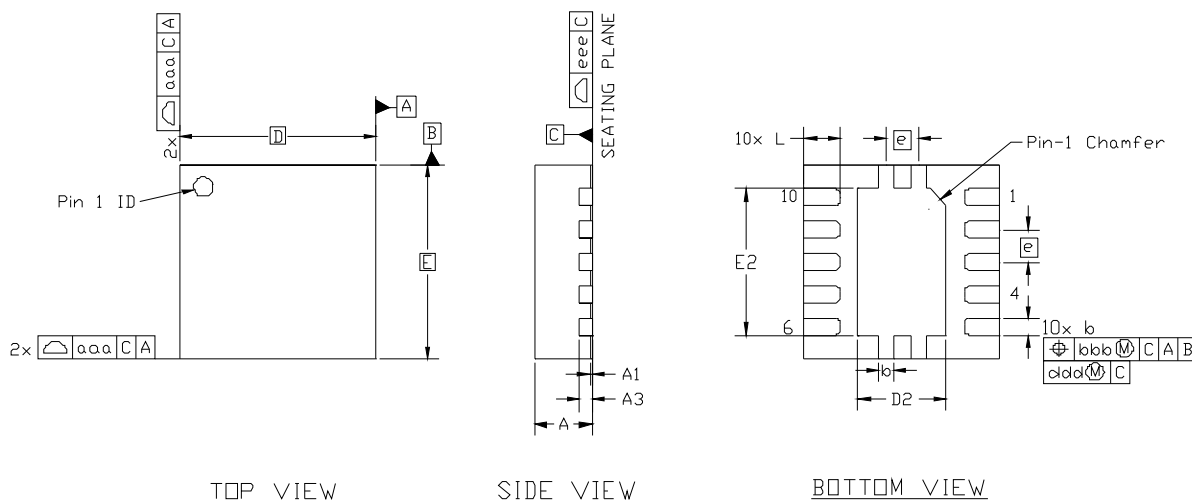


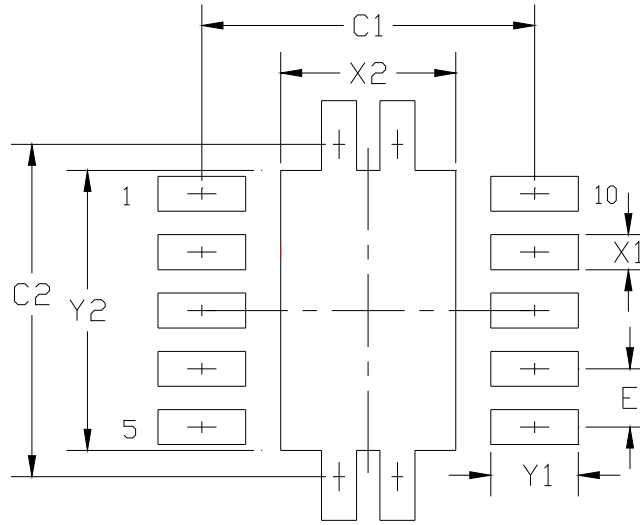
Figure 4.1. QFN-11 Package Drawing

Table 4.1. QFN-11 Package Dimensions

Dimension	Min	Nom	Max	Dimension	Min	Nom	Max
A	0.80	0.90	1.00	E	3.00 BSC		
A1	0.03	0.07	0.11	E2	2.20	2.25	2.30
A3	0.25 REF			L	0.45	0.55	0.65
b	0.18	0.25	0.30	aaa	—	—	0.15
D	3.00 BSC			bbb	—	—	0.15
D2	1.30	1.35	1.40	ddd	—	—	0.05
e	0.50 BSC			eee	—	—	0.08

**Notes:**

1. All dimensions shown are in millimeters (mm) unless otherwise noted.
2. Dimensioning and Tolerancing per ANSI Y14.5M-1994.
3. This drawing conforms to the JEDEC Solid State Outline MO-243, variation VEED except for custom features D2, E2, and L which are toleranced per supplier designation.
4. Recommended card reflow profile is per the JEDEC/IPC J-STD-020 specification for Small Body Components.



**Figure 4.2. QFN-11 PCB Land Pattern**

**Table 4.2. QFN-11 PCB Land Pattern Dimensions**

Dimension	Min	Max	Dimension	Min	Max
C1	2.75	2.85	X2	1.40	1.50
C2	2.75	2.85	Y1	0.65	0.75
E	0.50 BSC		Y2	2.30	2.40
X1	0.20	0.30			

**Notes:**

General

1. All dimensions shown are in millimeters (mm) unless otherwise noted.
2. This Land Pattern Design is based on the IPC-7351 guidelines.

Solder Mask Design

3. All metal pads are to be non-solder mask defined (NSMD). Clearance between the solder mask and the metal pad is to be 60  $\mu$ m minimum, all the way around the pad.

Stencil Design

4. A stainless steel, laser-cut and electro-polished stencil with trapezoidal walls should be used to assure good solder paste release.
5. The stencil thickness should be 0.125 mm (5 mils).
6. The ratio of stencil aperture to land pad size should be 1:1 for all perimeter pins.
7. A 3 x 1 array of 1.30 x 0.60 mm openings on 0.80 mm pitch should be used for the center pad.

Card Assembly

8. A No-Clean, Type-3 solder paste is recommended.
9. The recommended card reflow profile is per the JEDEC/IPC J-STD-020 specification for Small Body Components.



# C8051T600/1/2/3/4/5/6

## 5. SOIC-14 Package Specifications

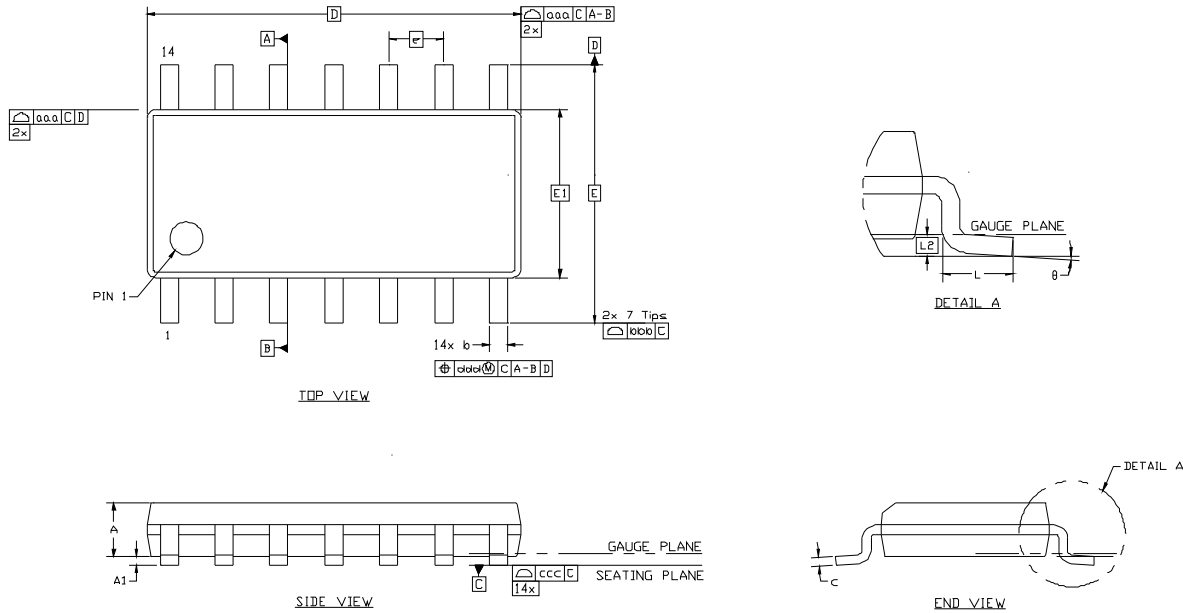


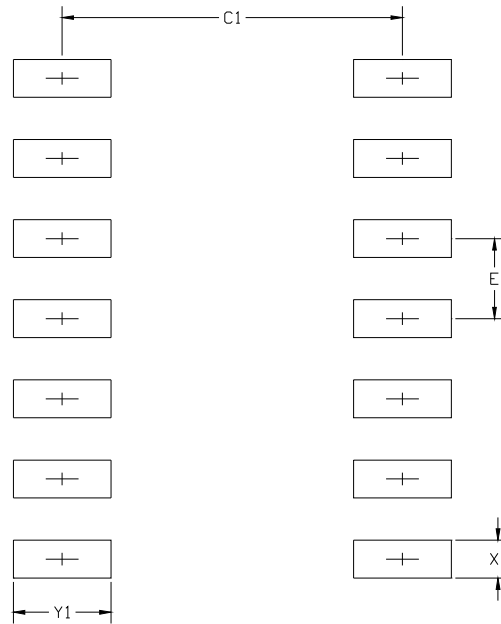
Figure 5.1. SOIC-14 Package Drawing

Table 5.1. SOIC-14 Package Dimensions

Dimension	Min	Nom	Max	Dimension	Min	Nom	Max
A	—	—	1.75	L	0.40	—	1.27
A1	0.10	—	0.25	L2	0.25 BSC		
b	0.33	—	0.51	θ	0°	—	8°
c	0.17	—	0.25	aaa	0.10		
D	8.65 BSC			bbb	0.20		
E	6.00 BSC			ccc	0.10		
E1	3.90 BSC			ddd	0.25		
e	1.27 BSC						

**Notes:**

1. All dimensions shown are in millimeters (mm).
2. Dimensioning and Tolerancing per ANSI Y14.5M-1994.
3. This drawing conforms to JEDEC outline MS012, variation AB.
4. Recommended card reflow profile is per the JEDEC/IPC J-STD-020 specification for Small Body Components.



**Figure 5.2. SOIC-14 Recommended PCB Land Pattern**

**Table 5.2. SOIC-14 PCB Land Pattern Dimensions**

Dimension	Min	Max	Dimension	Min	Max
C1	5.30	5.40	X1	0.50	0.60
E	1.27 BSC		Y1	1.45	1.55

**Notes:**

General

1. All dimensions shown are in millimeters (mm) unless otherwise noted.
2. This Land Pattern Design is based on the IPC-7351 guidelines.

Solder Mask Design

3. All metal pads are to be non-solder mask defined (NSMD). Clearance between the solder mask and the metal pad is to be 60  $\mu\text{m}$  minimum, all the way around the pad.

Stencil Design

4. A stainless steel, laser-cut and electro-polished stencil with trapezoidal walls should be used to assure good solder paste release.
5. The stencil thickness should be 0.125 mm (5 mils).
6. The ratio of stencil aperture to land pad size should be 1:1 for all perimeter pads.

Card Assembly

7. A No-Clean, Type-3 solder paste is recommended.
8. The recommended card reflow profile is per the JEDEC/IPC J-STD-020 specification for Small Body Components.