



# ST6208L/ST6209L ST6210L/ST6220L

## LOW VOLTAGE 8-BIT ROM MCUs WITH A/D CONVERTER, TWO TIMERS & SAFE RESET

### ■ Memories

- 1K, 2K or 4K bytes ROM Program memory with read-out protection
- 64 bytes RAM

### ■ Clock, Reset and Supply Management

- Enhanced reset system
- Clock sources: crystal/ceramic resonator or RC network, external clock
- 2 Power Saving Modes: Wait and Stop

### ■ Interrupt Management

- 4 interrupt vectors plus NMI and RESET
- 12 external interrupt lines (on 2 vectors)

### ■ 12 I/O Ports

- 12 multifunctional bidirectional I/O lines
- 8 alternate function lines
- 4 high sink outputs (12mA)

### ■ 2 Timers

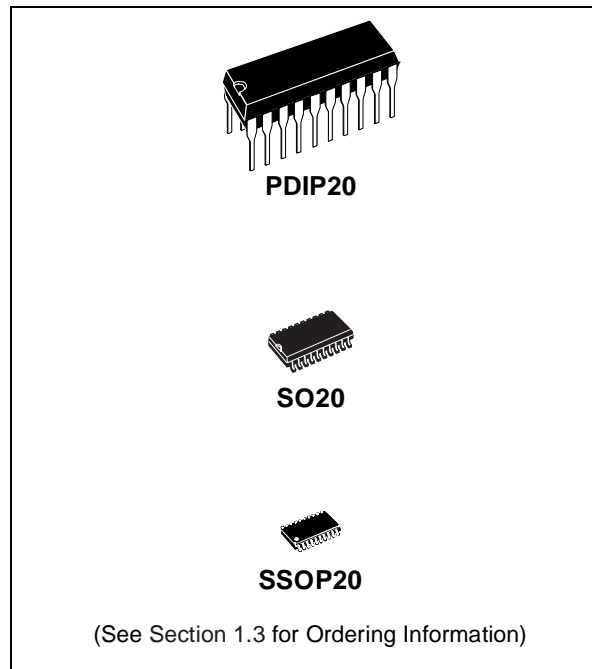
- Configurable watchdog timer
- 8-bit timer/counter with a 7-bit prescaler

### ■ Analog Peripheral

- 8-bit ADC with 4 or 8 input channels (except on ST6208L)

### ■ Instruction Set

- 8-bit data manipulation
- 40 basic instructions
- 9 addressing modes
- Bit manipulation



### ■ Development Tools

- Full hardware/software development package

### Device Summary

Features	ST6208L	ST6209L	ST6210L	ST6220L
Program memory - bytes		1K	2K	4K
RAM - bytes		64		
Operating Supply		2.4V to 3.9V		
Analog Inputs	-	4	8	
Clock Frequency		4MHz Max		
Operating Temperature		0°C to +70°C		
Packages		PDIP20/SO20/SSOP20		

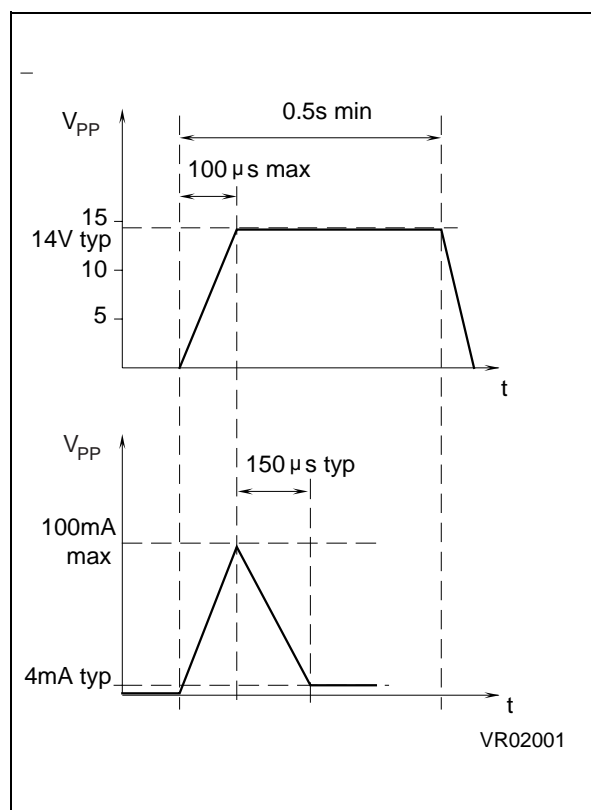
Rev. 1.1

# 1 GENERAL DESCRIPTION

## 1.1 INTRODUCTION

The ST6208L/09L/10L and 20L are low voltage mask programmed ROM version of ST62T08C, T09C, T10C and T20C OTP devices. They offer the same functionality as OTP devices, selecting as ROM options the options defined in the programmable option byte of the OTP version, with the exception of the LVD Reset and the OSG that are not available.

Figure 1. Programming wave form

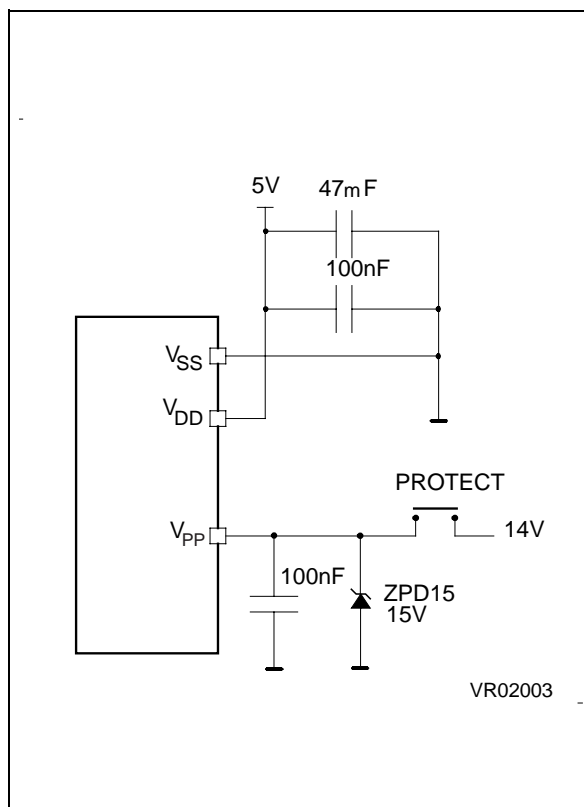


## 1.2 ROM READOUT PROTECTION

If the ROM READOUT PROTECTION option is selected, a protection fuse can be blown to prevent any access to the program memory content.

In case the user wants to blow this fuse, high voltage must be applied on the  $V_{PP}$  pin.

Figure 2. Programming Circuit



Note: ZPD15 is used for overvoltage protection

**1.3 ORDERING INFORMATION**

The following section deals with the procedure for transfer of customer codes to STMicroelectronics.

**1.3.1 Transfer of Customer Code**

Customer code is made up of the ROM contents and the list of the selected mask options. The ROM contents are to be sent on diskette, or by electronic means, with the hexadecimal file generated by the development tool. All unused bytes must be set to FFh.

The selected mask options are communicated to STMicroelectronics using the correctly filled OPTION LIST appended. See page 4.

**1.3.2 Listing Generation and Verification**

When STMicroelectronics receives the user's ROM contents, a computer listing is generated from it. This listing refers exactly to the mask which will be used to produce the specified MCU. The listing is then returned to the customer who must thoroughly check, complete, sign and return it to STMicroelectronics. The signed listing forms a part of the contractual agreement for the creation of the specific customer mask.

The STMicroelectronics Sales Organization will be pleased to provide detailed information on contractual points.

**Table 1. ROM Memory Map for ST6208L,09L**

Device Address	Description
0000h-0B9Fh	Reserved
0BA0h-0F9Fh	User ROM
0FA0h-0FEFh	Reserved
0FF0h-0FF7h	Interrupt Vectors
0FF8h-0FFBh	Reserved
0FFCh-0FFDh	NMI Interrupt Vector
0FFEh-0FFFh	Reset Vector

**Table 2. ROM Memory Map for ST6210L**

Device Address	Description
0000h-087Fh	Reserved
0880h-0F9Fh	User ROM
0FA0h-0FEFh	Reserved
0FF0h-0FF7h	Interrupt Vectors
0FF8h-0FFBh	Reserved
0FFCh-0FFDh	NMI Interrupt Vector
0FFEh-0FFFh	Reset Vector

**Table 3. ROM Memory Map for ST6220L**

Device Address	Description
0000h-007Fh	Reserved
0080h-0F9Fh	User ROM
0FA0h-0FEFh	Reserved
0FF0h-0FF7h	Interrupt Vectors
0FF8h-0FFBh	Reserved
0FFCh-0FFDh	NMI Interrupt Vector
0FFEh-0FFFh	Reset Vector

**Table 4. ROM version Ordering Information**

Sales Type	ROM	Analog inputs	Temperature Range	Package
ST6208LB1/XXX	1036 Bytes	None	0 to +70°C	PDIP20
ST6208LM1/XXX				PSO20
ST6208LN1/XXX				SSOP20
ST6209LB1/XXX		4		PDIP20
ST6209LM1/XXX		PSO20		
ST6209LN1/XXX		SSOP20		
ST6210LB1/XXX	1836 Bytes	8		PDIP20
ST6210LM1/XXX				PSO20
ST6210LN1/XXX				SSOP20
ST6220LB1/XXX	3884 Bytes			PDIP20
ST6220LM1/XXX				PSO20
ST6220LN1/XXX				SSOP20

**ST6208L/09L/10L/20L MICROCONTROLLER OPTION LIST**

Customer: .....  
 Address: .....  
 Contact: .....  
 Phone: .....  
 Reference: .....

**STMicroelectronics references:**

Device:                     ST6208L (1 KB)                     ST6209L (1 KB)  
                                ST6210L (2 KB)                     ST6220L (4 KB)

Package:                     Dual in Line Plastic  
                                    Small Outline Plastic with conditioning  
                                    Shrink Small Outline Plastic with conditioning

Conditioning option:         Standard (Tube)                     Tape & Reel

Temperature Range:         0°C to + 70°C

Marking:                     Standard marking  
                                    Special marking:  
     PDIP20 (10 char. max): \_\_\_\_\_  
     PSO20 (8 char. max): \_\_\_\_\_  
     SSOP20 (10 char. max): \_\_\_\_\_

Authorized characters are letters, digits, '.', '-', '/' and spaces only.

Watchdog Selection:         Software Activation                     Hardware Activation

Timer pull-up:               Enabled                                     Disabled

NMI pull-up:                 Enabled                                     Disabled

Oscillator Selection:         Quartz crystal / Ceramic resonator  
                                    RC network

Readout Protection:         Enabled:  
      Fuse is blown by STMicroelectronics  
      Fuse can be blown by the customer  
                                    Disabled

External STOP Mode Control:  Enabled                                     Disabled

**Comments:**

Oscillator Frequency in the application:  
 Supply Operating Range in the application: .....  
 Notes: .....  
 Date: .....  
 Signature: .....

## 2 ELECTRICAL CHARACTERISTICS

### 2.1 ABSOLUTE MAXIMUM RATINGS

This product contains devices to protect the inputs against damage due to high static voltages, however it is advisable to take normal precaution to avoid application of any voltage higher than the specified maximum rated voltages.

For proper operation it is recommended that  $V_I$  and  $V_O$  be higher than  $V_{SS}$  and lower than  $V_{DD}$ . Reliability is enhanced if unused inputs are connected to an appropriate logic voltage level ( $V_{DD}$  or  $V_{SS}$ ).

**Power Considerations.** The average chip-junction temperature,  $T_j$ , in Celsius can be obtained from:

$$T_j = T_A + P_D \times R_{thJA}$$

Where:  $T_A$  = Ambient Temperature.

$R_{thJA}$  = Package thermal resistance (junction-to ambient).

$P_D$  =  $P_{int}$  +  $P_{port}$ .

$P_{int}$  =  $I_{DD} \times V_{DD}$  (chip internal power).

$P_{port}$  = Port power dissipation (determined by the user).

Symbol	Parameter	Value	Unit
$V_{DD}$	Supply Voltage	-0.3 to 7.0	V
$V_I$	Input Voltage	$V_{SS} - 0.3$ to $V_{DD} + 0.3^{(1)}$	V
$V_O$	Output Voltage	$V_{SS} - 0.3$ to $V_{DD} + 0.3^{(1)}$	V
$I_O$	Current Drain per Pin Excluding $V_{DD}$ , $V_{SS}$	$\pm 10$	mA
$I_{V_{DD}}$	Total Current into $V_{DD}$ (source)	50	mA
$I_{V_{SS}}$	Total Current out of $V_{SS}$ (sink)	50	mA
$T_j$	Junction Temperature	150	°C
$T_{STG}$	Storage Temperature	-60 to 150	°C

**Notes:**

- Stresses above those listed as "absolute maximum ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these conditions is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.
- (1) Within these limits, clamping diodes are guaranteed to be not conductive. Voltages outside these limits are authorised as long as injection current is kept within the specification.

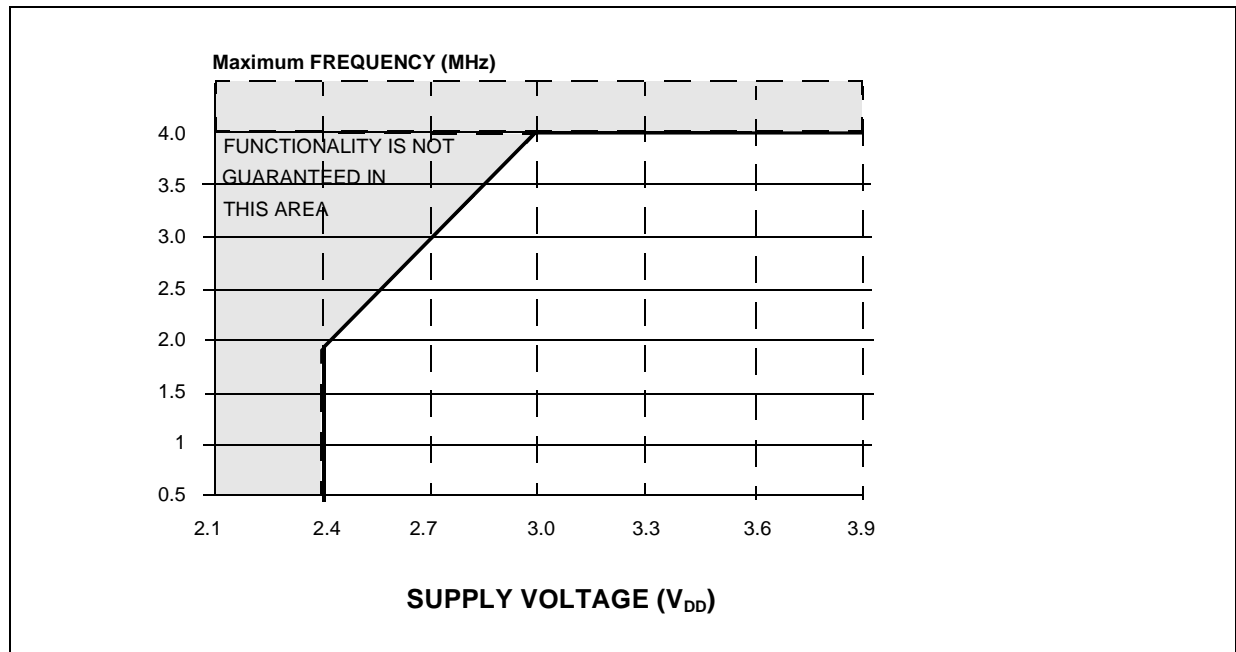
2.2 RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
T <sub>A</sub>	Operating Temperature	1 Suffix Version	0		70	°C
V <sub>DD</sub>	Operating Supply Voltage	f <sub>OSC</sub> = 2MHz f <sub>OSC</sub> = 4MHz	2.4 3		3.9 3.9	V
f <sub>OSC</sub>	Oscillator Frequency <sup>2)</sup>	V <sub>DD</sub> = 2.4V V <sub>DD</sub> = 3.0V	0 0		2.0 4.0	MHz
I <sub>INJ+</sub>	Pin Injection Current (positive)	V <sub>DD</sub> = 2.4 to 3.9V			+5	mA
I <sub>INJ-</sub>	Pin Injection Current (negative)	V <sub>DD</sub> = 2.4 to 3.9V			-5	mA

Notes:

- Care must be taken in case of negative current injection, where adapted impedance must be respected on analog sources to not affect the A/D conversion. For a -1mA injection, a maximum 10 KΩ is recommended.
- An oscillator frequency above 1MHz is recommended for reliable A/D results

Figure 3. Maximum Operating FREQUENCY (Fmax) Versus SUPPLY VOLTAGE (V<sub>DD</sub>)



The shaded area is outside the recommended operating range; device functionality is not guaranteed under these conditions.

### 2.3 DC ELECTRICAL CHARACTERISTICS

( $T_A = 0$  to  $+70^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
$V_{IL}$	Input Low Level Voltage All Input pins				$V_{DD} \times 0.2$	V
$V_{IH}$	Input High Level Voltage All Input pins		$V_{DD} \times 0.8$			V
$V_{Hys}$	Hysteresis Voltage <sup>(1)</sup> All Input pins	$V_{DD} = 3V$	0.2			V
$V_{OL}$	Low Level Output Voltage All Output pins	$V_{DD} = 3.0V; I_{OL} = +10\mu A$ $V_{DD} = 3.0V; I_{OL} = +3.0mA$ $V_{DD} = 2.4V; I_{OL} = +1.5mA$			0.1 0.8 0.8	V
	Low Level Output Voltage 20 mA Sink I/O pins	$V_{DD} = 3.0V; I_{OL} = +10\mu A$ $V_{DD} = 3.0V; I_{OL} = +8mA$ $V_{DD} = 3.0V; I_{OL} = +12mA$ $V_{DD} = 2.4V; I_{OL} = +5mA$			0.1 0.8 1.3 0.8	
$V_{OH}$	High Level Output Voltage All Output pins	$V_{DD} = 3.0V; I_{OH} = -10\mu A$ $V_{DD} = 3.0V; I_{OH} = -1.5mA$ $V_{DD} = 2.4V; I_{OH} = -10\mu A$	2.9 2.0 2.3			V
$R_{PU}$	Pull-up Resistance	All Input pins	100	250	600	K $\Omega$
		RESET pin	400	600	1200	
$I_{IL}$ $I_{IH}$	Input Leakage Current All Input pins but RESET	$V_{IN} = V_{SS}$ (No Pull-Up configured) $V_{IN} = V_{DD}$		0.1	1.0	$\mu A$
	Input Leakage Current RESET pin	$V_{IN} = V_{SS}$ $V_{IN} = V_{DD}$	-8	-16	-30 10	
$I_{DD}$	Supply Current in RESET Mode	$V_{RESET} = V_{SS}$ $f_{OSC} = 4MHz$			1.5	mA
	Supply Current in RUN Mode <sup>(2)</sup>	$V_{DD} = 3.0V$ $f_{INT} = 4MHz$			1.5	mA
	Supply Current in WAIT Mode <sup>(3)</sup>	$V_{DD} = 3.0V$ $f_{INT} = 4MHz$			0.5	mA
	Supply Current in STOP Mode <sup>(3)</sup>	$I_{LOAD} = 0mA$ $V_{DD} = 3.0V$			2	$\mu A$

**Notes:**

(1) Hysteresis voltage between switching levels

(2) All peripherals running

(3) All peripherals in stand-by

**DC ELECTRICAL CHARACTERISTICS (Cont'd)**

**2.4 AC ELECTRICAL CHARACTERISTICS**

((T<sub>A</sub> = 0 to +70°C unless otherwise specified

Symbol	Parameter	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
t <sub>REC</sub>	Supply Recovery Time <sup>(1)</sup>		100			ms
f <sub>RC</sub>	Internal frequency with RC oscillator <sup>2) 3)</sup>	VDD=3.0V R=47kΩ R=100kΩ R=470kΩ	2.5 1.4 450	3 1.7 520	3.5 2.1 600	MHz MHz kHz
C <sub>IN</sub>	Input Capacitance	All Inputs Pins			10	pF
C <sub>OUT</sub>	Output Capacitance	All Outputs Pins			10	pF

**Notes:**

1. Period for which V<sub>DD</sub> has to be connected at 0V to allow internal Reset function at next power-up.
2. An oscillator frequency above 1MHz is recommended for reliable A/D results.
3. Measure performed with OSCin pin soldered on PCB, with an around 2pF equivalent capacitance.



## 2.5 A/D CONVERTER CHARACTERISTICS

( $T_A = 0$  to  $+70^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
Res	Resolution			8		Bit
$A_{TOT}$	Total Accuracy <sup>(1)</sup> <sup>(2)</sup>	$f_{OSC} > 1.2\text{MHz}$ , $V_{DD}=3.0\text{V}$ $f_{OSC} > 1.2\text{MHz}$ , $V_{DD}=2.4\text{V}$ $f_{OSC} > 32\text{kHz}$ , $V_{DD}=3.0\text{V}$			$\pm 25$ $\pm 35$ $\pm 50$	mV
$t_C$	Conversion Time	$f_{OSC} = 2\text{MHz}$ $f_{OSC} = 4\text{MHz}$		280 140		$\mu\text{s}$
ZIR	Zero Input Reading	Conversion result when $V_{IN} = V_{SS}$	00			Hex
FSR	Full Scale Reading	Conversion result when $V_{IN} = V_{DD}$			FF	Hex
$AD_I$	Analog Input Current During Conversion	$V_{DD} = 4.0\text{V}$			1.0	$\mu\text{A}$
$AC_{IN}$	Analog Input Capacitance			2	5	pF

### Notes:

- Noise at  $V_{DD}$ ,  $V_{SS} < 10\text{mV}$
- With oscillator frequencies less than 1MHz, the A/D Converter accuracy is decreased.

## 2.6 TIMER CHARACTERISTICS

( $T_A = 0$  to  $+70^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
$f_{IN}$	Input Frequency on TIMER Pin				$\frac{f_{INT}}{4}$	MHz
$t_W$	Pulse Width at TIMER Pin	$V_{DD} = 2.4\text{V}$	250			ns

**Notes:**

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