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Applications of "<u>Embedded -</u> <u>Microcontrollers</u>"

#### Details

Product Status	Obsolete
Core Processor	Z8
Core Size	8-Bit
Speed	8MHz
Connectivity	-
Peripherals	HLVD, POR, WDT
Number of I/O	24
Program Memory Size	16KB (16K x 8)
Program Memory Type	OTP
EEPROM Size	-
RAM Size	237 x 8
Voltage - Supply (Vcc/Vdd)	2V ~ 3.6V
Data Converters	-
Oscillator Type	Internal
Operating Temperature	-40°C ~ 105°C (TA)
Mounting Type	Through Hole
Package / Case	28-DIP (0.600", 15.24mm)
Supplier Device Package	-
Purchase URL	https://www.e-xfl.com/product-detail/zilog/zgp323lep2816g

Email: info@E-XFL.COM

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- Port 1: 0–3 pull-up transistors
- Port 1: 4–7 pull-up transistors
- Port 2: 0–7 pull-up transistors
- EPROM Protection
- WDT enabled at POR
- **Note:** The mask option pull-up transistor has a *typical* equivalent resistance of 200 K $\Omega$  ±50% at V<sub>CC</sub>=3 V and 450 K $\Omega$  ±50% at  $V_{CC}=2$  V.

# **General Description**

The Z8 GP<sup>TM</sup> OTP MCU Family is an OTP-based member of the MCU family of infrared microcontrollers. With 237B of general-purpose RAM and up to 32KB of OTP, ZiLOG<sup>®</sup>'s CMOS microcontrollers offer fast-executing, efficient use of memory, sophisticated interrupts, input/output bit manipulation capabilities, automated pulse generation/reception, and internal key-scan pull-up transistors.

The Z8 GP<sup>TM</sup> OTP MCU Family architecture (Figure 1) is based on ZiLOG's 8-bit microcontroller core with an Expanded Register File allowing access to registermapped peripherals, input/output (I/O) circuits, and powerful counter/timer circuitry. The Z8<sup>®</sup> offers a flexible I/O scheme, an efficient register and address space structure, and a number of ancillary features that are useful in many consumer, automotive, computer peripheral, and battery-operated hand-held applications.

There are three basic address spaces available to support a wide range of configurations: Program Memory, Register File and Expanded Register File. The register file is composed of 256 Bytes (B) of RAM. It includes 4 I/O port registers, 16 control and status registers, and 236 general-purpose registers. The Expanded Register File consists of two additional register groups (F and D).

To unburden the program from coping with such real-time problems as generating complex waveforms or receiving and demodulating complex waveform/pulses, the Z8 GP OTP MCU offers a new intelligent counter/timer architecture with 8-bit and 16-bit counter/timers (see Figure 2). Also included are a large number of userselectable modes and two on-board comparators to process analog signals with separate reference voltages.

**Note:** All signals with an overline, "", are active Low. For example,  $B/\overline{W}$ , in which WORD is active Low, and  $\overline{B}/W$ , in which BYTE is active Low.

Power connections use the conventional descriptions listed in Table 2.



ERF (Expanded Register File). Bits 7–4 of register RP select the working register group. Bits 3–0 of register RP select the expanded register file bank.

>

**Note:** An expanded register bank is also referred to as an expanded register group (see Figure 15).

#### T8/T16\_Logic/Edge \_Detect

In TRANSMIT Mode, this field defines how the outputs of T8 and T16 are combined (AND, OR, NOR, NAND).

In DEMODULATION Mode, this field defines which edge should be detected by the edge detector.

#### Transmit\_Submode/Glitch Filter

In Transmit Mode, this field defines whether T8 and T16 are in the PING-PONG mode or in independent normal operation mode. Setting this field to "NORMAL OPERATION Mode" terminates the "PING-PONG Mode" operation. When set to 10, T16 is immediately forced to a 0; a setting of 11 forces T16 to output a 1.

In DEMODULATION Mode, this field defines the width of the glitch that must be filtered out.

#### Initial\_T8\_Out/Rising\_Edge

In TRANSMIT Mode, if 0, the output of T8 is set to 0 when it starts to count. If 1, the output of T8 is set to 1 when it starts to count. When the counter is not enabled and this bit is set to 1 or 0, T8\_OUT is set to the opposite state of this bit. This ensures that when the clock is enabled, a transition occurs to the initial state set by CTR1, D1.

In DEMODULATION Mode, this bit is set to 1 when a rising edge is detected in the input signal. In order to reset the mode, a 1 should be written to this location.

#### Initial\_T16 Out/Falling \_Edge

In TRANSMIT Mode, if it is 0, the output of T16 is set to 0 when it starts to count. If it is 1, the output of T16 is set to 1 when it starts to count. This bit is effective only in Normal or PING-PONG Mode (CTR1, D3; D2). When the counter is not enabled and this bit is set, T16\_OUT is set to the opposite state of this bit. This ensures that when the clock is enabled, a transition occurs to the initial state set by CTR1, D0.

In DEMODULATION Mode, this bit is set to 1 when a falling edge is detected in the input signal. In order to reset it, a 1 should be written to this location.

**Note:** Modifying CTR1 (D1 or D0) while the counters are enabled causes unpredictable output from T8/16\_OUT.

## CTR2 Counter/Timer 16 Control Register—CTR2(D)02H

Table 14 lists and briefly describes the fields for this register.

#### Table 15. CTR3 (D)03H: T8/T16 Control Register (Continued)

Field	Bit Position		Value	Description
Reserved	43210	R	1	Always reads 11111
		W	х	No Effect

Note: \*Indicates the value upon Power-On Reset.

\*\*Indicates the value upon Power-On Reset. Not reset with Stop Mode recovery.

# **Counter/Timer Functional Blocks**

#### Input Circuit

The edge detector monitors the input signal on P31 or P20. Based on CTR1 D5– D4, a pulse is generated at the Pos Edge or Neg Edge line when an edge is detected. Glitches in the input signal that have a width less than specified (CTR1 D3, D2) are filtered out (see Figure 18).



#### Figure 18. Glitch Filter Circuitry

#### **T8 Transmit Mode**

Before T8 is enabled, the output of T8 depends on CTR1, D1. If it is 0, T8\_OUT is 1; if it is 1, T8\_OUT is 0. See Figure 19.



into LO8; if it is a negative edge, data is put into HI8. From that point, one of the edge detect status bits (CTR1, D1; D0) is set, and an interrupt can be generated if enabled (CTR0, D2). Meanwhile, T8 is loaded with FFh and starts counting again. If T8 reaches 0, the timeout status bit (CTR0, D5) is set, and an interrupt can be generated if enabled (CTR0, D1). T8 then continues counting from FFH (see Figure 23 and Figure 24).



Figure 23. Demodulation Mode Count Capture Flowchart



#### **T16 Transmit Mode**

In NORMAL or PING-PONG mode, the output of T16 when not enabled, is dependent on CTR1, D0. If it is a 0, T16\_OUT is a 1; if it is a 1, T16\_OUT is 0. You can force the output of T16 to either a 0 or 1 whether it is enabled or not by programming CTR1 D3; D2 to a 10 or 11.

When T16 is enabled, TC16H \* 256 + TC16L is loaded, and T16\_OUT is switched to its initial value (CTR1, D0). When T16 counts down to 0, T16\_OUT is toggled (in NORMAL or PING-PONG mode), an interrupt (CTR2, D1) is generated (if enabled), and a status bit (CTR2, D5) is set. See Figure 25.



Figure 25. 16-Bit Counter/Timer Circuits

**Note:** Global interrupts override this function as described in "Interrupts" on page 48.

If T16 is in SINGLE-PASS mode, it is stopped at this point (see Figure 26). If it is in Modulo-N Mode, it is loaded with TC16H \* 256 + TC16L, and the counting continues (see Figure 27).

You can modify the values in TC16H and TC16L at any time. The new values take effect when they are loaded.

Z8 GP<sup>™</sup> OTP MCU Family Product Specification



Caution: Do not load these registers at the time the values are to be loaded into the counter/timer to ensure known operation. An initial count of 1 is not allowed. An initial count of 0 causes T16 to count from 0 to FFFFH to FFFFH. Transition from 0 to FFFFH is not a timeout condition.







Figure 27. T16\_OUT in Modulo-N Mode

## **T16 DEMODULATION Mode**

The user must program TC16L and TC16H to FFH. After T16 is enabled, and the first edge (rising, falling, or both depending on CTR1 D5; D4) is detected, T16 captures HI16 and LO16, reloads, and begins counting.

## If D6 of CTR2 Is 0

When a subsequent edge (rising, falling, or both depending on CTR1, D5; D4) is detected during counting, the current count in T16 is complemented and put into HI16 and LO16. When data is captured, one of the edge detect status bits (CTR1, D1; D0) is set, and an interrupt is generated if enabled (CTR2, D2). T16 is loaded with FFFFH and starts again.

This T16 mode is generally used to measure space time, the length of time between bursts of carrier signal (marks).



#### **During PING-PONG Mode**

The enable bits of T8 and T16 (CTR0, D7; CTR2, D7) are set and cleared alternately by hardware. The timeout bits (CTR0, D5; CTR2, D5) are set every time the counter/timers reach the terminal count.

#### **Timer Output**

The output logic for the timers is illustrated in Figure 29. P34 is used to output T8-OUT when D0 of CTR0 is set. P35 is used to output the value of TI6-OUT when D0 of CTR2 is set. When D6 of CTR1 is set, P36 outputs the logic combination of T8-OUT and T16-OUT determined by D5 and D4 of CTR1.

#### Interrupts

The Z8 GP<sup>TM</sup> OTP MCU Family features six different interrupts (Table 16). The interrupts are maskable and prioritized (Figure 30). The six sources are divided as follows: three sources are claimed by Port 3 lines P33–P31, two by the counter/ timers (Table 16) and one for low voltage detection. The Interrupt Mask Register (globally or individually) enables or disables the six interrupt requests.

The source for IRQ is determined by bit 1 of the Port 3 mode register (P3M). When in digital mode, Pin P33 is the source. When in analog mode the output of the Stop mode recovery source logic is used as the source for the interrupt. See Figure 35, Stop Mode Recovery Source, on page 57.



## Port 0 Output Mode (D2)

Bit 2 controls the output mode of port 0. A 1 in this location sets the output to push-pull, and a 0 sets the output to open-drain.

#### Stop-Mode Recovery Register (SMR)

This register selects the clock divide value and determines the mode of Stop Mode Recovery (Figure 33). All bits are write only except bit 7, which is read only. Bit 7 is a flag bit that is hardware set on the condition of Stop recovery and reset by a power-on cycle. Bit 6 controls whether a low level or a high level at the XOR-gate input (Figure 35 on page 57) is required from the recovery source. Bit 5 controls the reset delay after recovery. Bits D2, D3, and D4 of the SMR register specify the source of the Stop Mode Recovery signal. Bits D0 determines if SCLK/TCLK are divided by 16 or not. The SMR is located in Bank F of the Expanded Register Group at address <code>0BH</code>.



#### Table 19. Stop Mode Recovery Source

SMR:432			Operation	
D4	D3	D2	Description of Action	
0	0	0	POR and/or external reset recovery	
0	0	1	Reserved	
0	1	0	P31 transition	
0	1	1	P32 transition	
1	0	0	P33 transition	
1	0	1	P27 transition	
1	1	0	Logical NOR of P20 through P23	
1	1	1	Logical NOR of P20 through P27	

**Note:** Any Port 2 bit defined as an output drives the corresponding input to the default state. For example, if the NOR of P23-P20 is selected as the recovery source and P20 is configured as an output, the remaining SMR pins (P23-P21) form the NOR equation. This condition allows the remaining inputs to control the AND/OR function. Refer to SMR2 register on page 59 for other recover sources.

#### Stop Mode Recovery Delay Select (D5)

This bit, if Low, disables the  $T_{POR}$  delay after Stop Mode Recovery. The default configuration of this bit is 1. If the "fast" wake up is selected, the Stop Mode Recovery source must be kept active for at least 5 TpC.

**Note:** It is recommended that this bit be set to 1 if using a crystal or resonator clock source. The  $T_{POR}$  delay allows the clock source to stabilize before executing instructions.

#### Stop Mode Recovery Edge Select (D6)

A 1 in this bit position indicates that a High level on any one of the recovery sources wakes the device from Stop Mode. A 0 indicates Low level recovery. The default is 0 on POR.

## Cold or Warm Start (D7)

This bit is read only. It is set to 1 when the device is recovered from Stop Mode. The bit is set to 0 when the device reset is other than Stop Mode Recovery (SMR).

#### Table 20. Watch-Dog Timer Time Select

D1	D0	Timeout of Internal RC-Oscillator
0	0	5ms min.
0	1	10ms min.
1	0	20ms min.
1	1	80ms min.

## WDTMR During Halt (D2)

This bit determines whether or not the WDT is active during HALT Mode. A 1 indicates active during HALT. The default is 1. See Figure 38.



\* CLR1 and CLR2 enable the WDT/POR and 18 Clock Reset timers respectively upon a Low-to-High input translation.

#### Figure 38. Resets and WDT



#### Low-Voltage Detection Register—LVD(D)0Ch

**Note:** Voltage detection does not work at Stop mode. It must be disabled during Stop mode in order to reduce current.

Field	Bit Position			Description
LVD	76543			Reserved No Effect
	2	R	1 0*	HVD flag set HVD flag reset
	1-	R	1 0*	LVD flag set LVD flag reset
	0	R/W	1 0*	Enable VD Disable VD
*Default	after POR			

**Note:** Do not modify register P01M while checking a low-voltage condition. Switching noise of both ports 0 and 1 together might trigger the LVD flag.

#### **Voltage Detection and Flags**

The Voltage Detection register (LVD, register 0CH at the expanded register bank 0Dh) offers an option of monitoring the V<sub>CC</sub> voltage. The Voltage Detection is enabled when bit 0 of LVD register is set. Once Voltage Detection is enabled, the the V<sub>CC</sub> level is monitored in real time. The flags in the LVD register valid 20uS after Voltage Detection is enabled. The HVD flag (bit 2 of the LVD register) is set only if V<sub>CC</sub> is higher than V<sub>HVD</sub>. The LVD flag (bit 1 of the LVD register) is set only if V<sub>CC</sub> is lower than the V<sub>LVD</sub>. When Voltage Detection is enabled, the LVD flag also triggers IRQ5. The IRQ bit 5 latches the low voltage condition until it is cleared by instructions or reset. The IRQ5 interrupt is served if it is enabled in the IMR register. Otherwise, bit 5 of IRQ register is latched as a flag only.

**Notes:** If it is necessary to receive an LVD interrupt upon power-up at an operating voltage lower than the low battery detect threshold, enable interrupts using the Enable Interrupt instruction (EI) prior to enabling the voltage detection.





**Notes:** Take care in differentiating the Transmit Mode from Demodulation Mode. Depending on which of these two modes is operating, the CTR1 bit has different functions.

Changing from one mode to another cannot be performed without disabling the counter/timers.





Note: If used in conjunction with SMR, either of the two specified events causes a Stop-Mode Recovery.

\* Default setting after reset

\* \* At the XOR gate input









Figure 66. 40-Pin CDIP Package



MILLIMETER INCH SYMBOL MIN MAX MIN MAX .040 A1 0.51 .020 A2 3.94 .125 .155 3.18 В 0.38 0.53 .015 .021 B1 .040 .060 1.02 1.52 С 0.38 .009 .015 0.23 D 2.050 2.070 52.07 52.58 Ε 15.24 15.75 .600 .620 .100 TYP E1 13.59 .59 14.22 2.54 TYP .535 e .660 eA 15.49 16.76 .610 3.81 .120 .150 L 3.05 Q1 1.91 .075 1.40 .055 S .060 1.52 2.29 .090

Figure 67. 40-Pin PDIP Package Diagram

CONTROLLING DIMENSIONS : INCH







Figure 68. 48-Pin SSOP Package Design

**Note:** Check with ZiLOG on the actual bonding diagram and coordinate for chip-on-board assembly.

>

For fast results, contact your local ZiLOG sales office for assistance in ordering the part desired.

## Codes

ZG = ZiLOG General Purpose Family

P = OTP

- 323 = Family Designation
- L = Voltage Range

2V to 3.6V

T = Temperature Range:

S = 0 to 70 degrees C (Standard)

- E = -40 to +105 degrees C (Extended)
- A = -40 to +125 degrees C (Automotive)
- P = Package Type:
  - K = Windowed Cerdip
  - P = PDIP
  - H = SSOP
  - S = SOIC
- ## = Number of Pins
- CC = Memory Size
- M = Packaging Options
  - C = Non Lead-Free
  - G = Lead-Free
  - E = CDIP



## Example



# Z8 GP<sup>™</sup> OTP MCU Family Product Specification



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