

8051 Interrupt Vectors**APNT_103****OVERVIEW**

We receive a number of calls from customers who are confused by the numbering system for 8051 interrupts. This application note addresses how to declare interrupts in your programs and where the interrupt numbers come from.

INTERRUPT VECTORS

When the original 8051 and 8031 were introduced, only 5 interrupts were provided.

Interrupt Number	Interrupt Vector Address	Description
0	0003h	EXTERNAL 0
1	000Bh	TIMER/COUNTER 0
2	0013h	EXTERNAL 1
3	001Bh	TIMER/COUNTER 1
4	0023h	SERIAL PORT

As the vendors of 8051 derivatives created new parts, more interrupts were added. The Keil C51 compiler supports interrupt functions for 32 interrupts (0-31). Use the interrupt vector address in the following to determine the interrupt number for a particular interrupt.

Interrupt Number	Interrupt Vector Address
0	0003h
1	000Bh
2	0013h
3	001Bh
4	0023h
5	002Bh
6	0033h
7	003Bh
8	0043h
9	004Bh
10	0053h
11	005Bh
12	0063h
13	006Bh
14	0073h

Interrupt Number	Interrupt Vector Address
16	0083h
17	008Bh
18	0093h
19	009Bh
20	00A3h
21	00ABh
22	00B3h
23	00BBh
24	00C3h
25	00CBh
26	00D3h
27	00DBh
28	00E3h
29	00EBh
30	00F3h

8051 Interrupt Vectors**APNT_103**

Interrupt Number	Interrupt Vector Address
15	007Bh

Interrupt Number	Interrupt Vector Address
31	00FBh

INTERRUPT FUNCTIONS

The C51 compiler provides a method of calling a C function when an interrupt occurs. This support lets you write interrupt service routines in C. You only need to be concerned with the interrupt number and register bank selection. The compiler automatically generates the interrupt vector and entry and exit code for the interrupt routine. The interrupt function attribute, when included in a function declaration, specifies that the associated function is an interrupt function. For example:

```
unsigned int  int_count;
unsigned char second;

void timer0 (void) interrupt 1 using 2 {
    if (++int_count == 4000) {          /* count to 4000 */
        second++;                      /* second counter */
        int_count = 0;                 /* clear interrupt counter */
    }
}
```

The interrupt attribute takes as an argument an integer constant in the 0 to 31 value range. Expressions with operators are not allowed, and the interrupt attribute is not allowed in function prototypes. The interrupt attribute affects the object code of the function as follows:

- The contents of the SFR ACC, B, DPH, DPL, and PSW, when required, are saved on the stack at the function invocation time.
- All working registers that are used in the interrupt function are stored on the stack if a register bank is not specified with the using attribute.
- The working registers and special registers that were saved on the stack are restored before exiting the function.
- The function is terminated by the 8051 RETI instruction.

The following rules apply to interrupt functions.

- Interrupt functions may not include a return value or function arguments. The compiler emits an error message if an interrupt function is declared with a return value or arguments.
- The compiler recognizes direct invocations of interrupt functions and summarily rejects them. It is pointless to invoke interrupt procedures directly, because exiting the procedure causes execution of the RETI instruction which affects the hardware interrupt system of the 8051. Because no interrupt request on the part of the hardware existed, the effect of this instruction is indeterminate and usually fatal. Do not call an interrupt function indirectly through a function pointer.

8051 Interrupt Vectors**APNT_103**

- The compiler generates an interrupt vector for each interrupt function. The code generated for the vector is a jump to the beginning of the interrupt function. Generation of interrupt vectors can be suppressed by including the NOINTVECTOR control directive in the C51 command line. In this case, you must provide interrupt vectors from separate assembly modules.
- The C51 compiler allows interrupt numbers within the 0 to 31 range. Refer to your 8051 derivative document to determine which interrupts are available.
- Functions that are invoked from an interrupt procedure must function with the same register bank as the interrupt procedure. When the NOAREGS directive is not explicitly specified, the compiler may generate absolute register accesses using the register bank selected (by the using attribute or by the REGISTERBANK control) for that function. Unpredictable results may occur when a function assumes a register bank other than the one currently selected.

CONCLUSION

Keil C51 makes it easy to declare interrupt functions in your C programs. Just look up the interrupt vector addresses specified in your data book and use the tables provided here to get the interrupt number to use in your interrupt functions.

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