Arithmetic Calculations

- Avoid using **multiplications** and **divisions** whenever possible. These complex mathmatic calculations need a lot processing power and (what's even worser) a huge library to be compiled at all.
- If you need to multiply with and divide through even numbers like 2, 4, 8, 16, 32 ... you can make use of the bitshifting operators “»” and “«”

```
unsigned char c;
c = 12 >> 1;  // c is 6 (division through 2)
c = 12 >> 2;  // c is 3 (division through 4)
c = 12 << 1;  // c is 24 (multiplication by 2)
c = 12 << 2;  // c is 48 (mulitplication by 4)
c = 1023 >> 3; //  c is 127 (10bit to 7bit ;)
```

- There's an excellent thread in the forum that discusses bitoperations: http://www.midibox.org/forum/index.php?topic=6981.0
- The Re: Scan Matrix extended : VOIRINOV thread has an explanation of what the declaration of the bitfield is all about.
- If this is not enough, you could search for ASM optimized custom functions. You'll find some in code examples of TK, the ACSensorizer and a lot of PIC-Specialized Webpages – or of course the forum.

MIOS LIBSDCC Library

If that still is not enough or you have no time and a lot of processing power / space available on your PIC, you can include the **libsdcc library**. Using the new MIOS GPUtils structure, this will be included automatically as required.

When using the library, sometimes the compiler will optimise multiplications to bitshifts (as demonstrated above) automatically. You can check the output files to see if this has occurred, but it is recommended to code the bitshifts manually, to be sure.

Bitfields, Unions & Structs

- Avoid using huge int- or char-arrays when you just need to store some ON/OFF values. Use a bitfield instead

```
// define the bitfield
typedef union {
    struct {
        unsigned ALL:8;    // by calling something.ALL, you get the whole
bitfield as 8-bit number
```

```
    };
    struct {
        unsigned led1:1;   // by calling something.led1 you get one bit-
state (1 or 0)
        unsigned led2:1;
        unsigned led3:1;
        unsigned led4:1;
        unsigned free:4;
    };
} something_t;

// declare var
something_t something;

// set bits
something.led1 = 1;
something.led3 = ;

// get number
mynum = something.ALL;
```

> It has been confirmed with recent versions of SDCC, that bitfields are not limited to 8bits as was previously expected.

C Functions

- MIOS_*_SRSet and _SRGet Functions refer to the pins in Little-Endian order, so for example:

MIOS_DOUT_SRSet(1, 00000001) Will set the 1st pin (aka Pin 0).... or
MIOS_DOUT_SRSet(1, 01000000) Will set the 7th pin (aka Pin 6)

C Optimizations

- How to mix C and ASM
- Compiled C Code Size

C Variables

- Declaring a variable as type 'const' will cause the compiler to store the variable in the PIC's

program flash memory, not the SRAM.

- Adding the keyword 'volatile' to a variable is a good idea when this variable can be changed or altered outside the sourcefile that declared this variable.
- Always use 'unsigned' if you are sure you don't need negative values. Although the default is an unsigned char, it's not always clear how C treats a 'char' (signed: -128 to 127; unsigned: 0 to 255), so it's better to be clear here.

SDCC Bugs/Workarounds

Some of these bugs have first been described in a german thread in the forum.

Array Access

Sometimes the transfer of an array between modules does not work properly, e.g. file 1:

```
unsigned char MIDIValues[8];
```

file 2:

```
MIOS_MIDI_TxBufferPut(MIDIValues[1]);
```

Instead, you need to do something like

```
unsigned char value = MIDIValues[1]; //explicit temp variable
MIOS_MIDI_TxBufferPut(value);
```

In most cases, adding parenthesis around your index variable has the same effect (see tip further down)

```
MIOS_MIDI_TxBufferPut((MIDIValues[1]));
```

Large Arrays

Arrays with more than 256 bytes of elements will produce compile (in fact linker) errors:

```
unsigned char myArray[256]; // will work
unsigned char myArray[257]; // will not be linked!
```

```
unsigned char myArray[64][4]; // will work
unsigned char myArray[64][5]; // will not be linked!

unsigned int myArray[128]; // will work
unsigned int myArray[129]; // will not be linked!
```

This is due to the fact that the PIC's RAM has been segmented into 256-byte banks in the linker script, and an array's contents may not span across more than one bank.

The linker script can be modified to work around the 256-byte limitation by creating larger banks, as per the Linker Script and Application Code tips on the 4620 page.

Thanks to Thomas for testing some workarounds with multiple single-dimensional arrays. These methods would be recommended if possible.

Bit Copy Operations

There is potential trouble with bit copy operations (See this posting). Instead of

```
  app_flags.SRAM_CARD_STATUS = PORTEbits.RE2;
```

you should use

```
  if( PORTEbits.RE2 ){
    app_flags.SRAM_CARD_STATUS = 1;
  }else{
    app_flags.SRAM_CARD_STATUS = ;
  }
```

It is less elegant, but it works safely.

Parenthesis

Always use parenthesis around expressions like

```
myarray[a+b];
```

instead use

```
myarray[(a+b)];
```

Preprocessor #ifs

Avoid #ifdef and #if preprocessor-statements wrapped around declarations and function prototypes. Even if the preprocessor's #if statement is true (eg defined as '1'), any access to it's vars and functions from outside these wrapped statements produce a compile-warning:

```
#define TEST 1

#if TEST
  unsigned char testvar;
#endif /* TEST */

void testfunction(void) {
  unsigned char c = testvar + 1;  // access to testvar produces compiler
error!
}
```

Zero Compare

Avoid comparisons of `unsigned char` with , e.g.

```
unsigned char i;
   for (i = ; i < ; i+ü) {
      // body
   }
```

`0` could be a constant that was defined using `#define`, e.g. the number of motorized faders. But you have no motorized faders... The main problem consists in the fact that your code depends on what else is done around the comparison or in the body. This provokes completely erratic behaviour.

Stack Size

TK says:
The stack boundaries are defined in the file header of mios_wrapper/mios_wrapper.asm:

```
; the upper boundary of the stacks are defined here
; customize the values for your needs
#ifndef STACK_HEAD
#define STACK_HEAD 0x37f
#endif

#ifndef STACK_IRQ_HEAD
#define STACK_IRQ_HEAD 0x33f
```

```
#endif
```

The default setup is 64 bytes for main tasks, 64 bytes for interrupt tasks. (stack pointer is counted down, there is no collision control to save runtime)

Since a PIC18F4620 has enough memory, you could use two 256 bytes stacks located at the upper RAM pages:

```
#define STACK_HEAD 0xeff
#define STACK_IRQ_HEAD 0xdff
```

this should relax the situation.

Note that the appr. memory area (0xd00-0xeff) should be reserved in the projekt.lkr file Note that stacks greater than 256 bytes will not work with SDCC at present.