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What would be your answer?

interrupts are disabled after CPSID
nach MRS R0 sind sie noch nicht disabled!

Hello Erich
i have a question regarding the "fixed" EnterCritical() code.

```
#define CpuCriticalVar() uint8_t cpuSR
#define CpuEnterCritical() \
do { \
asm ( \
"MRS R0, PRIMASK\n\t" \
"CPSID I\n\t" \
"STRB R0, %[output]" \
.....
```

Movie the Primask in to R0 (special kind of move) , save the interrupt status in R0

control processor status interrupt disable (disable interrupts, set the I bit, set the master bit)

store the R0 in the local variable

Imagine the following scenario:
EnterCritical() gets interrupted after storing PRIMASK into R0,
then the ISR modifies R0 and exits (nothing prevents R0 from being modified, or am i wrong?),
then EnterCritical() continues with disabling Interrupts and storing R0 (now with a wrong value) into cpuSR.
Could this scenario not disable all my interrupts and stop my program from working correctly?
...
Best regards,
Dorian

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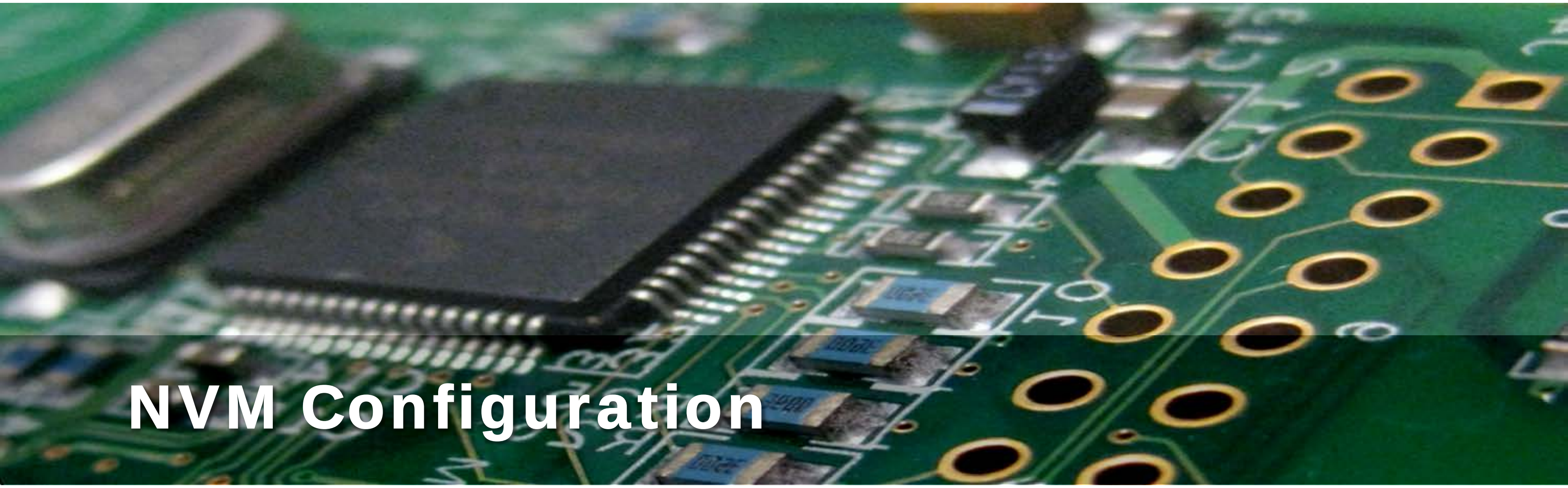

NVM Configuration

“My data is in RA…. Ahhhrg! Who turned off the power?!?”

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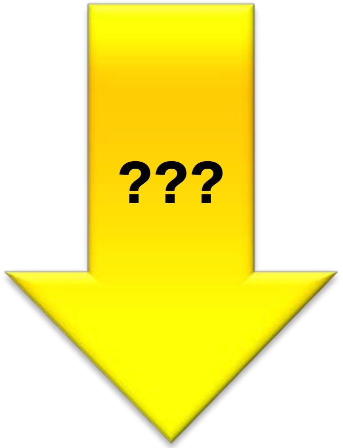
Learning Goals

- Goal: Storing persistent configuration Data

- Data
    - Calibration
    - Setup
- NVM Options
    - Disk/SD
    - EEPROM
    - FLASH
- Internal Flash
- Implementation Options



Configuration Data

- Data different from system to system
- Sensor calibration values, device ID, application configuration, ...
- RAM: lost after power up
- Need to store it in Non-Volatile-Memory (NVM)
- Possible solutions
  - Custom build Image
  - Store Data in NVM

```
#ifdef USE_FLASH_CONFIG
  static const uint16_t calibValues[3] =
     {0x1247, 0x5579, 0x59AE};
#else /* at runtime */
  static uint16_t calibValues[3];
#endif
```

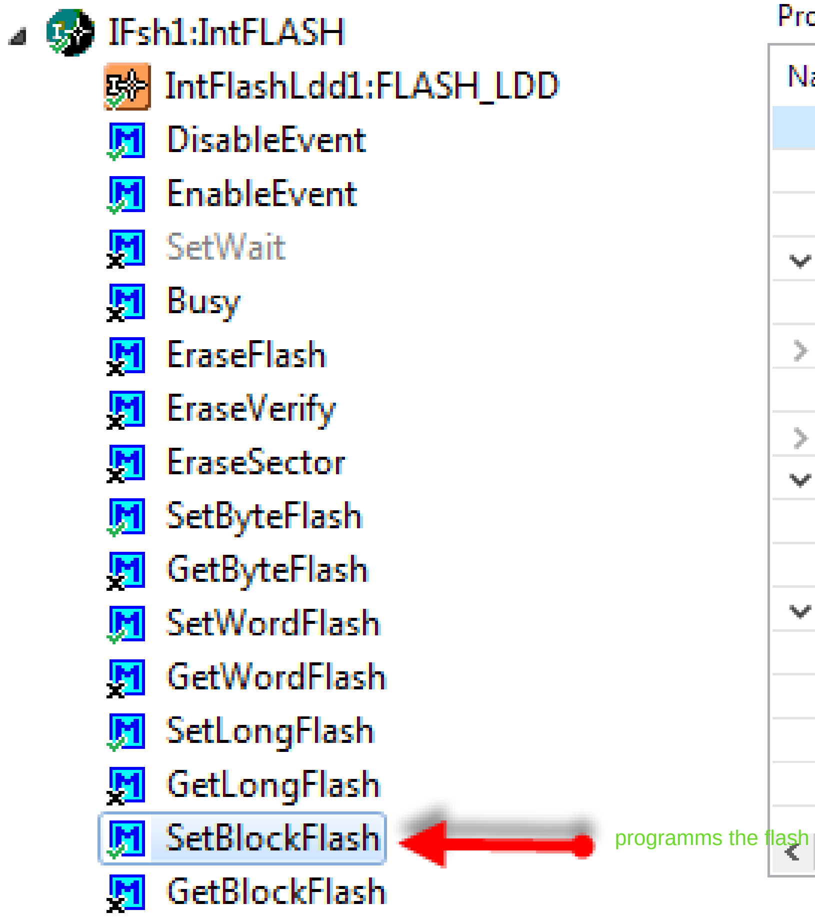
NVM Options

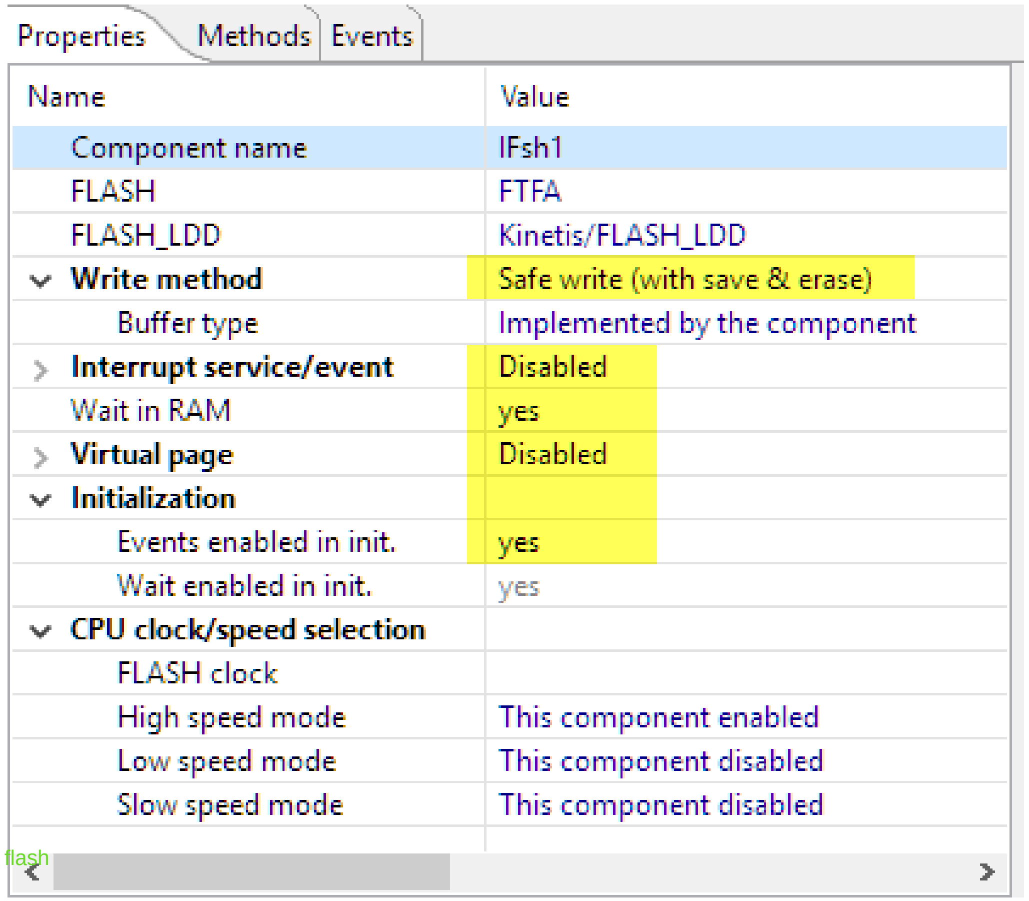
- Battery Buffered SRAM
  - E.g Maxim DS3232, combined with RTC
- SD, disk
  - Raw Block access
  - File System: data exchange with host
  - Consider overhead
  - SD: industrial or not
- External EEPROM/Flash IC
  - SPI, I2C
  - Erase/Program Cycles: ~100k-500k
  - Example: Microchip 24AA
- Internal Microprocessor EEPROM/FLASH
  - No external components
  - Flash Programming Algorithms
  - Erase/Program Cycles: ~50k

Internal Flash Programming

- Part of program flash is reserved for 'reprogramming' by the application
- Flash is Block oriented (1, 2, 4, 8, ... kByte)
    - Erase whole block, reprogram block
    - Erase: bring bits to 1 (0xFF)
- Need 'app'/function to reprogram the flash
    - Optional: Save block content
    - Erase block
    - Program block with new content
- Typically
    - Flash bus is blocked ➔ need to run in RAM!
    - Interrupts disabled

IntFLASH Component

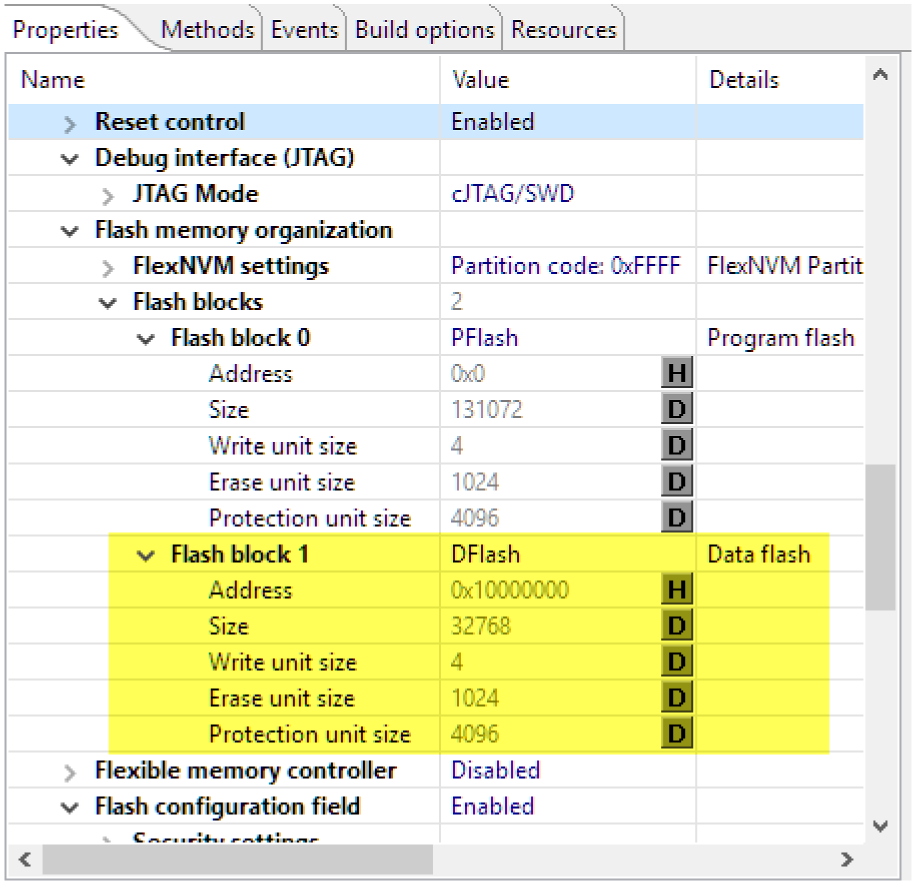




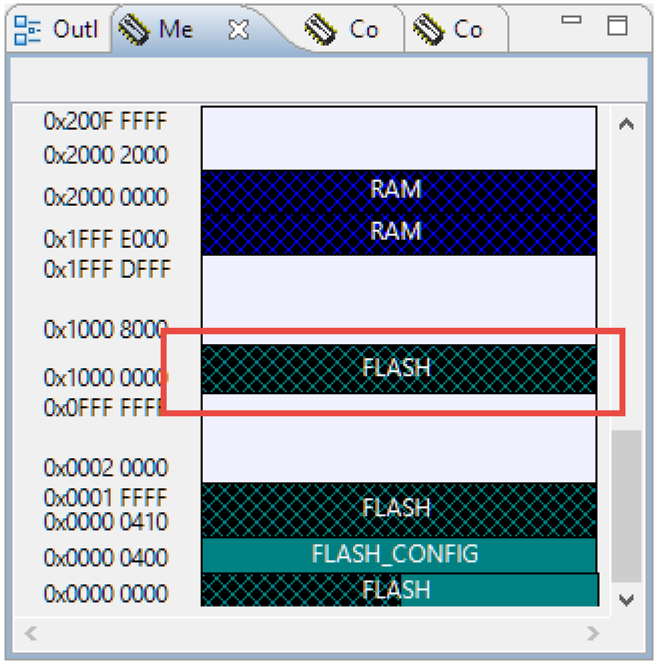
Name	Value
Component name	IFsh1
FLASH	FTFA
FLASH_LDD	Kinetis/FLASH_LDD
Write method	Safe write (with save & erase)
Buffer type	Implemented by the component
Interrupt service/event	Disabled
Wait in RAM	yes
Virtual page	Disabled
Initialization	
Events enabled in init.	yes
Wait enabled in init.	yes
CPU clock/speed selection	
FLASH clock	
High speed mode	This component enabled
Low speed mode	This component disabled
Slow speed mode	This component disabled

K20 (Remote)

- Enable Data Flash @ 0x1000’0000



Name	Value		Details
Reset control	Enabled		
Debug interface (JTAG)			
JTAG Mode	cJTAG/SWD		
Flash memory organization			
FlexNVM settings	Partition code: 0xFFFF		FlexNVM Partit
Flash blocks	2		
Flash block 0	PFlash		Program flash
Address	0x0	H	
Size	131072	D	
Write unit size	4	D	
Erase unit size	1024	D	
Protection unit size	4096	D	
Flash block 1	DFlash		Data flash
Address	0x10000000	H	
Size	32768	D	
Write unit size	4	D	
Erase unit size	1024	D	
Protection unit size	4096	D	
Flexible memory controller	Disabled		
Flash configuration field	Enabled		



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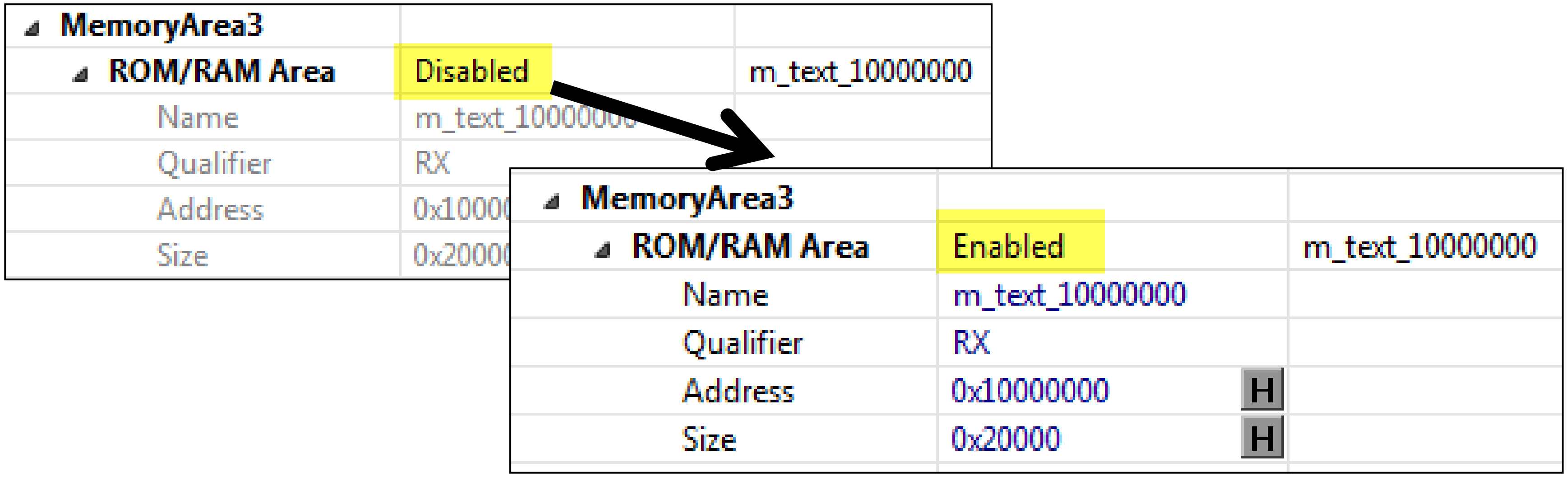
CPU Build Options (K22FX512)

- Enable Flex Memory area (0x1000'0000)
- Block size 0x1000! unit of 4kB
- Alignment!



MemoryArea3		
ROM/RAM Area	Disabled	m_text_10000000
Name	m_text_10000000	
Qualifier	RX	
Address	0x10000	
Size	0x2000	

MemoryArea3		
ROM/RAM Area	Enabled	m_text_10000000
Name	m_text_10000000	
Qualifier	RX	
Address	0x10000000 H	
Size	0x20000 H	

Implementation Options

- Struct in Flash at fixed address
  - Visible in debugger
  - Can provide default values at compile time
  - Compiler cares about alignment
  - Dependency to other modules
  - Need to make sure it is properly allocated by Linker

- Blocks in Flash
  - Start Address + Size
  - Raw flash blocks
  - Using absolute addresses
  - Programmer needs to care about alignment
  - Simple dependency to other modules

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Constant Struct

```
/* NVM_Config.h */
typedef struct {
  …
  int16_t pressureOffsetMbar;     /* pressure data offset */
  uint8_t pressureSamplingFreqHz; /* pressure measurement frequency */
  …
} NVMC_DataType;

extern const NVMC_DataType NVMC_Data;

#define NVMC_GetPressureOffsetMbar()            (NVMC_Data.pressureOffsetMbar)

uint8_t NVMC_SavePressureOffsetMBar(int16_t offset);
```

```
/* NVM_Config.c */
const NVMC_DataType NVMC_Data =
{
…
    800,            /* mbar offset */
    10,             /* pressure frequency */
…
};
```

Blocks: Address and Size

```
#if PL_IS_FRDM
  #define NVMC_FLASH_START_ADDR    0x1FC00
#elif PL_IS_ROBO
  #define NVMC_FLASH_START_ADDR    0x10000000
#else
  #error "unknown target?"
#endif
```

```
#define NVMC_REFLECTANCE_DATA_START_ADDR  \
   (NVMC_FLASH_START_ADDR)
#define NVMC_REFLECTANCE_DATA_SIZE        \
   (6*2*2) /* 6 sensors (min and max) 16bit each */
        min  max
#define NVMC_REFLECTANCE_END_ADDR        \
   (NVMC_REFLECTANCE_DATA_START_ADDR+NVMC_REFLECTANCE_DATA_SIZE)
```

Example Usage

- Consider your own/different Interface

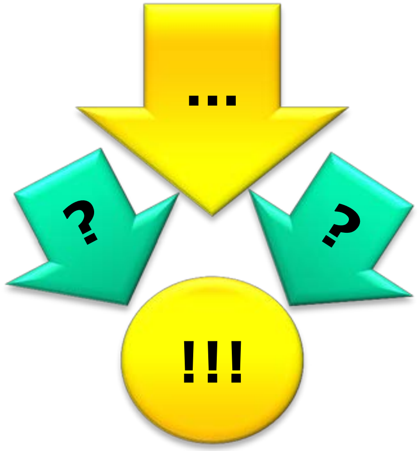
```
uint8_t NVMC_SaveReflectanceData(void *data, uint16_t dataSize) {
  if (dataSize>NVMC_REFLECTANCE_DATA_SIZE) {
    return ERR_OVERFLOW;
  }
  return IFsh1_SetBlockFlash(data,
    (IFsh1_TAddress)(NVMC_REFLECTANCE_DATA_START_ADDR), dataSize);
}

void *NVMC_GetReflectanceData(void) {
  if (isErased((uint8_t*)NVMC_REFLECTANCE_DATA_START_ADDR,
         NVMC_REFLECTANCE_DATA_SIZE)
      )
  {
    return NULL;
  }
  return (void*)NVMC_REFLECTANCE_DATA_START_ADDR;
}
```

if erased -> everything is FFFFF..

Summary

- Needs for NVM (for configuration data)
- Many options
    - Battery buffered SRAM
    - D/File System
    - Internal or external
    - Erase/Program Cycles
- Flash Applet
    - Run in RAM
    - Blocks
    - Constant structs
    - Constant Memory Pointers



Lab: NVM Config

- Add NVM Configuration Module
- Save your configuration data
  - Reflectance array
  - Sensor calibration data
  - Any other application data
- Note:
  - Detect if flash is erased or not

- NOTE: Segger J-Link does not a full FLASH erase! It only erases blocks defined by application!