

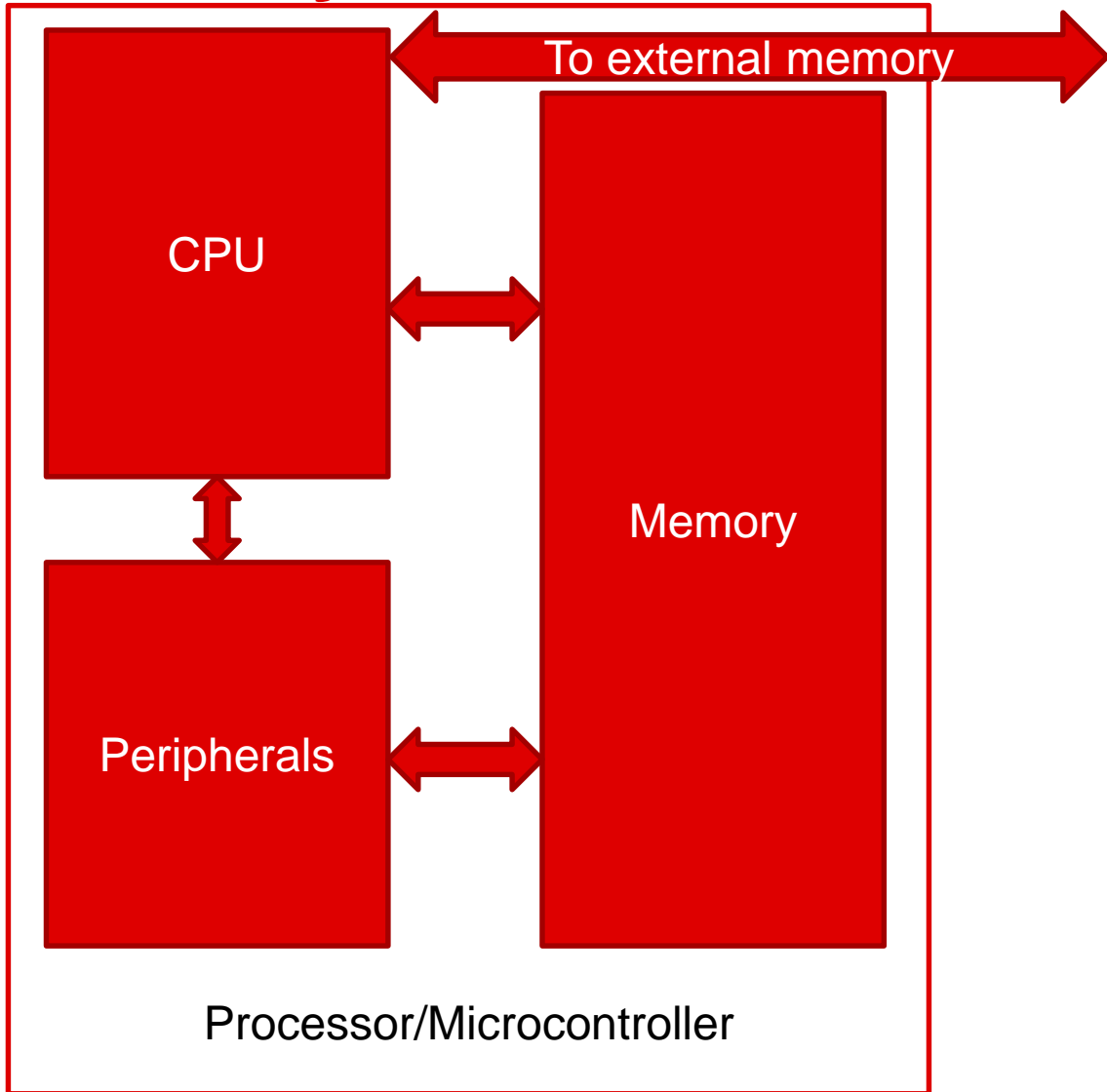
Embedded RAM

TI Precision Labs – Microcontrollers

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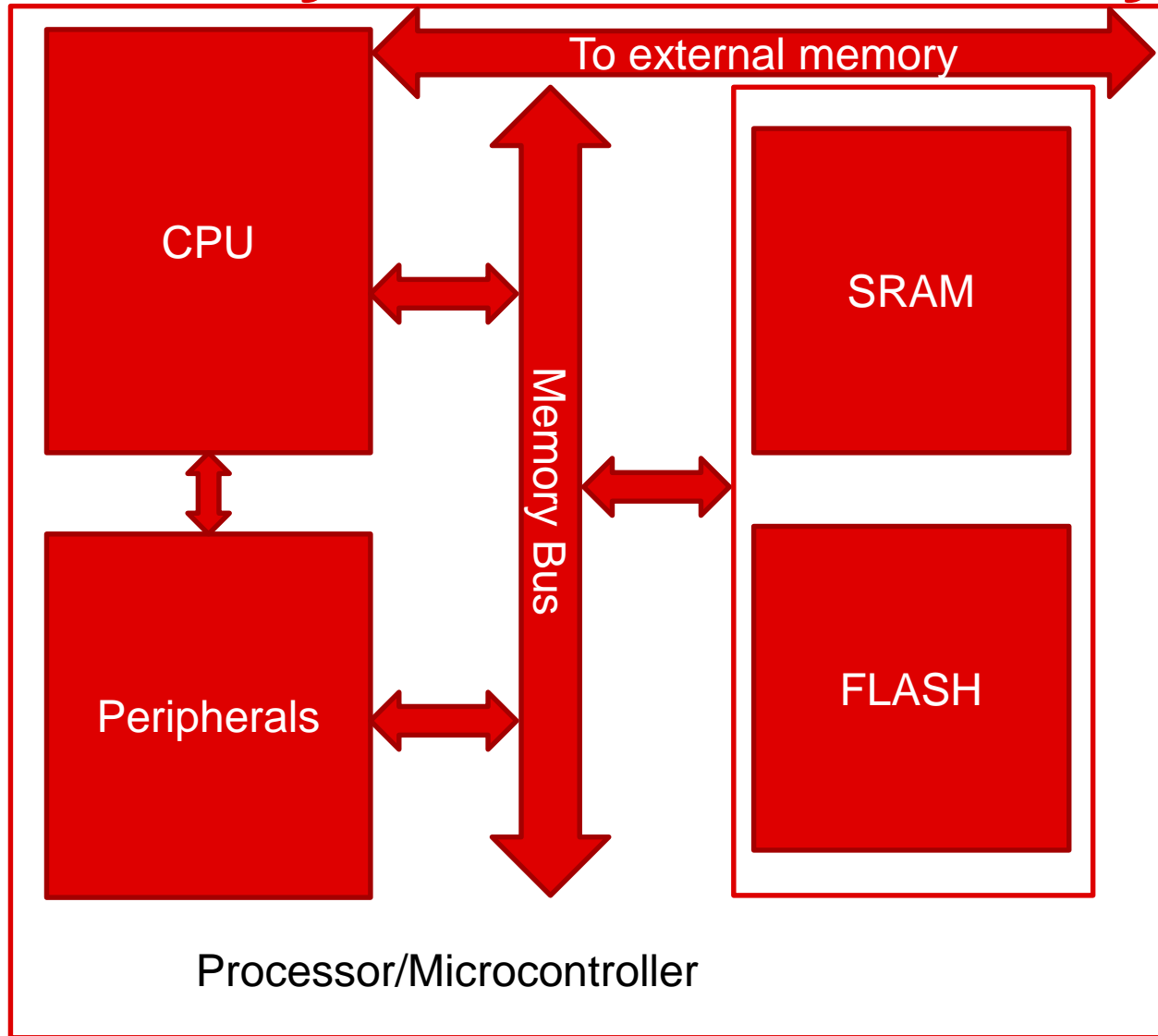


Memory in an embedded system



- All embedded devices have some type of memory
- Role in the system:
 - Program (code) storage for the CPU
 - Data storage for both CPU and Peripherals
- Two types of memory
 - Volatile: Contents lost when device is powered down
 - Non-volatile: Contents preserved when device is powered down
- Volatile
 - SRAM
 - DRAM
 - Caches
- Non-volatile
 - Flash
 - FRAM
 - ROM

Memory in an embedded system

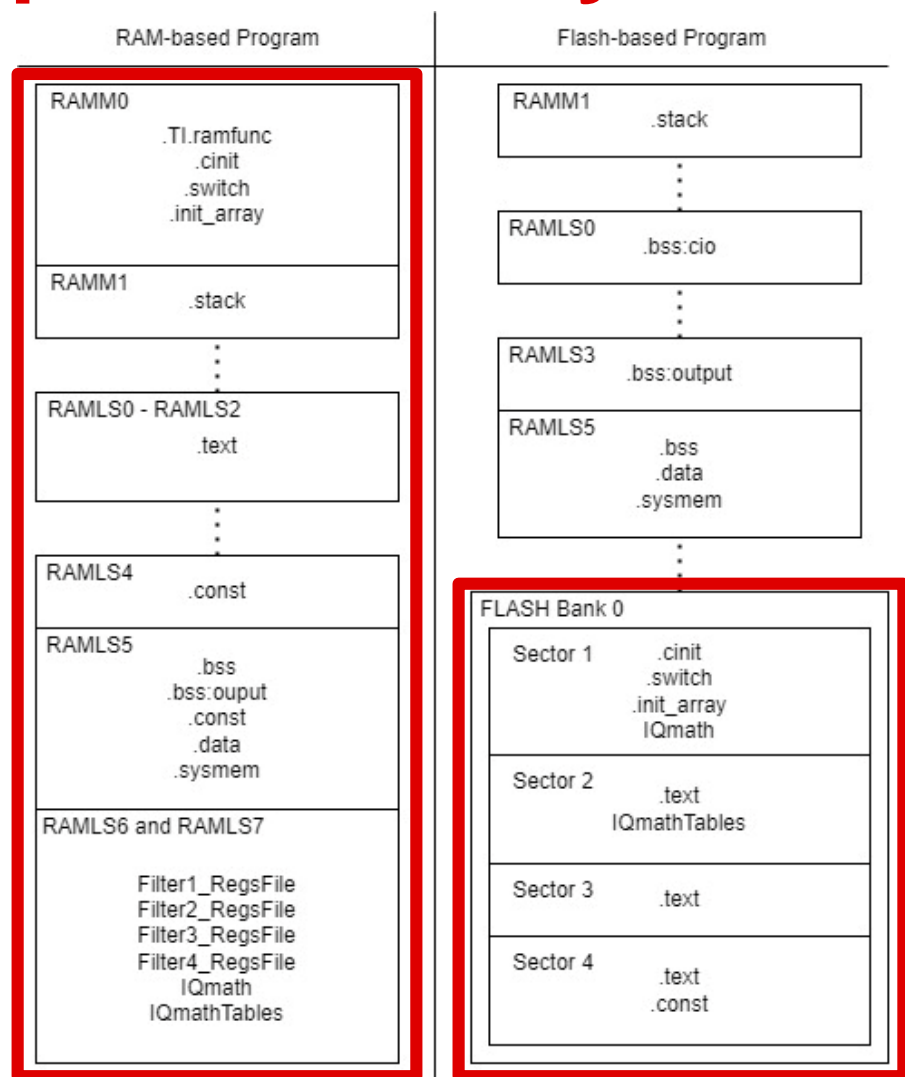


- Memory bus transfers data to different areas of the device
- Bus can be multiplexed depending on the device

Typical tradeoffs between memory types

| Topic | Volatile (SRAM) | Non-Volatile (Flash) |
|---------------------------------|---|--|
| Retention between power cycling | No | Yes |
| Speed | Faster, up to CPU max operating frequency | Slower, less than CPU max operating frequency |
| Writes | Direct from CPU | Requires special operations to change contents |
| Endurance | Limitless changes to memory contents | Capped in the range of tens of thousands changes |

Typical memory allocations



```

91 SECTIONS
92 {
93     codestart      : > BEGIN
94     .TI.ramfunc    : > RAMM0
95     .text          : >> RAMLS0 | RAMLS1 | RAMLS2 | RAMLS3 | RAMLS4
96     .cinit         : > RAMM0
97     .switch        : > RAMM0
98     .reset         : > RESET,                TYPE = DSECT /* not used, */
99
100    .stack         : > RAMM1
101
102    #if defined(__TI_EABI__)
103    .bss           : > RAMLS5
104    .bss:output    : > RAMLS5
105    .init_array    : > RAMM0
106    .const         : > RAMLS5 | RAMLS4
107    .data          : > RAMLS5
108    .systemem     : > RAMLS5
109    .bss:cio       : > RAMLS0
110    #else
111    .pinit         : > RAMM0
112    .ebss         : > RAMLS5
113    .econst       : > RAMLS5
114    .esystemem    : > RAMLS5
115    .cio          : > RAMLS0
116    #endif
117
118    ramgs0        : > RAMGS0
119    ramgs1        : > RAMGS1
120
121    /* The following section definition are for SDFM examples */
122    Filter1_RegsFile : > RAMLS6_7
123    Filter2_RegsFile : > RAMLS6_7
124    Filter3_RegsFile : > RAMLS6_7
125    Filter4_RegsFile : > RAMLS6_7

```

*These images are used in the context of the TMS320F280039C device

Memory terminology

| Term | Definition | Example |
|--------|--|-------------------------------------|
| Double | Grouping of multiple Words(64, 128, etc) | Decimal value = -1.22881872048e+303 |
| Float | Grouping of multiple words(32, 64, etc) | Decimal value = 1.0759593e+33 |
| Long | Grouping of multiple words(32, 64, etc) | Decimal value = 1,985,229,328 |
| Word | Grouping of multiple bits(16, 32, 64, etc) | 10 kilowords = 10KW |
| Byte | Grouping of 8 bits | 10 kilobytes = 10KB |
| Bit | Binary Value 0(b) or 1(b) | 10 kilobits = 10Kb |

0 x F E D C B A 9 8
0 x 7 6 5 4 3 2 1 0

0 x 7 6 5 4 3 2 1 0

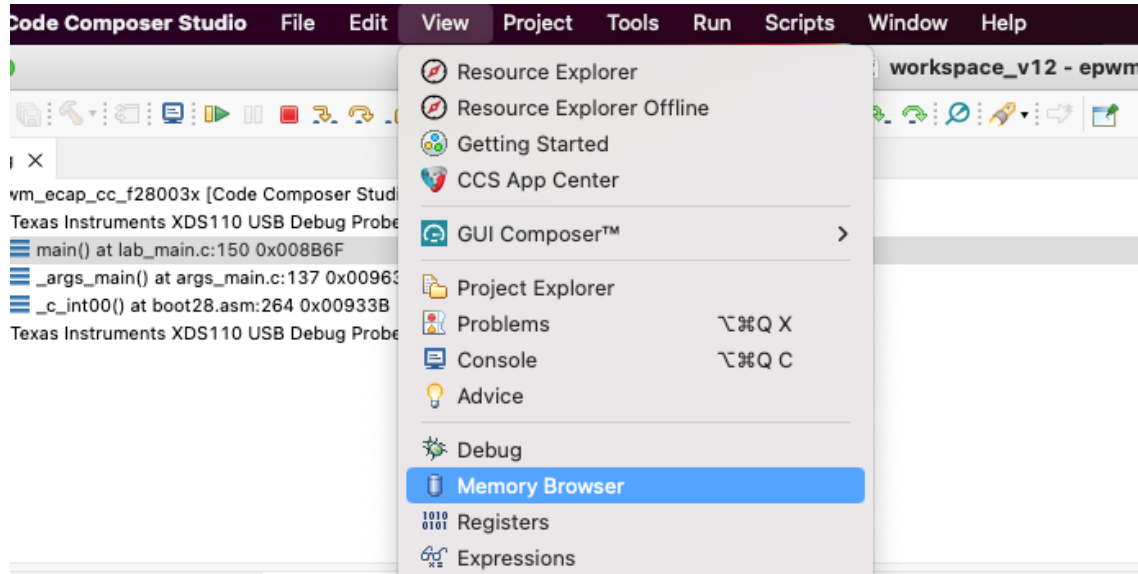
0 x 7 6 5 4 3 2 1 0

0 x 3 2 1 0

0 x 1 0

0 b

CCS Memory Window



Load Save Autos Refresh

Memory Type → Data

Datatype → 16-Bit Hex - TI Style

Address → 0xa800

The screenshot shows the Memory Browser window with several annotations. Red arrows point from the text 'Load Save Autos Refresh' to the corresponding icons in the toolbar. Another red arrow points from 'Memory Type' to the 'Data' dropdown menu. A third red arrow points from 'Datatype' to the '16-Bit Hex - TI Style' dropdown menu. A fourth red arrow points from 'Address' to the '0xa800' text input field. The main area of the window displays a memory dump for 'Data:0xa800 <Memory Rendering 1>'. The dump shows addresses from 0x0000A800 to 0x0000A834 with their corresponding values. The value at 0x0000A832 is 61A8 0000.

| Address | Value |
|------------|---|
| 0x0000A800 | AdcBuf |
| 0x0000A800 | 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 |
| 0x0000A80F | 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 |
| 0x0000A81E | 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 |
| 0x0000A82D | 0000 0000 0000 0000 0000 |
| 0x0000A832 | ePwm_TimeBase |
| 0x0000A832 | 61A8 0000 |
| 0x0000A834 | ePwm_MinDuty |

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<https://www.ti.com/microcontrollers-mcus-processors/overview.html>