# Debugger

PowerWriter 内置 Cortex-M Debugger 功能,支持主流的通用MCU,并保持不断的升级和维护,本节介绍调试器的具体使用方法。

## 准备工作

Power Writer ARM Debugger 基于 DAP 调试接口开发,支持Power Writer 适配的全品牌的芯片, 集成 ITM Trace,最大时钟速度10Mhz,请留意以下信息:

- Power Writer 集成的Debugger 为免驱 (HID设备),但是在部分系统上,可能存在偶尔驱动异常的问题,在设备管理器中检查Power Writer 驱动是否正常,如驱动出现异常,请参考 驱动 常见问题,进行排查。
- Power Writer 在Debugger 模式下,可以不断开PowerWriter 的连接,PowerWriter 会自动 在Debugger 形态或者是Writer 形态下进行切换,在Debugger 模式下,PowerWriter 中额外 提供的串口助手,此时可以当做日志打印,命令输入端口,或者使用Trace 功能,在MDK 中 虚拟串口1中输入输出命令,关于这部分的功能请参考MDK 的官方文档:CMSIS-DAP
   Debugger User's Guide: About CMSIS-DAP (keil.com)。

## **PowerWriter Debugger For MDK**

本节描述PowerWriter Debugger 在MDK 的应用方法。

### PowerWriter Debugger For MDK 调试

连接好目标板之后,在调试器选择页面选择 CMSIS-DAP Debugger 作为调试器,如下图所示:

Device   Target	Output Listing Vser C/C++	Asm Linker Debug Vtilities
C Use Simulator Limit Speed to Load Applicat Initialization File: Restore Debug Restore Debug Watch Wi Watch Wi Memory D	with restrictions     Settings       a Real-Time     Image: Constraint of the setting of the settin	Image: ST-Link Debugger     ✓     Setting       ULINK Pro Cottex Debugger     ✓       ULINK Pro Cottex Debugger     ✓       Initializatic Models Cottex-M Debugger     ✓       NULink Debugger     ✓       NULink Debugger     ✓       Restore     SiLabs UDA Debugger       SiLabs UDA Debugger     ✓       Watch winnows     ✓       ✓     Memory Display
CPU DLL:	Parameter:	Driver DLL: Parameter:
SARMCM3.DLL	-MPU -REMAP	SARMCM3.DLL -MPU
Dialog DLL:	Parameter:	Dialog DLL: Parameter:
DCM.DLL	pCM3	TCM.DLL pCM3
Wam Foundat	ted Executable is loaded	Wam if outdated Executable is loaded

接下来点击设置页按钮,进入Debugger的设置页,如图所示,从左侧列表选择已经连接好的

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CMSIS-DAP	DCODE Device Name	Move
Serial No: 000100030040002	SWDIC O 0x0BB11477 ARM CoreSight SW-DP	Up
Firmware Version: 1.11		Down
SWJ Port: SW 💌	Automatic Detection ID CODE:	
Max Clock: 10MHz	Add Delete Undate 2	P: 0x00
		. Jacob
Debug		<b>e</b>
Connect & Reset Options	Cache Options Download	Options

最后一步,需要添加 Debugger 所需的Flash Algorithm,点击Flash Download 标签页进入到下载配置页面,点击ADD 按钮从列表中选择对应芯片的Flash Algorithm,如图所示:

Teries Terget Output Listing Vaer GrC++ Aan Linker Debog Utilities	Add Flash Programming Algorithm	×
Debug Trave Elash Domlowd Park   Download Function C Ensee Full Onp IF Program C Ensee Sectors IF Verfy C Do not Ersses IF Verfy C Do not Ersses IF Retet and Run	Description         Rath Size         Device Type         Origin           SN227750         32NB         Lear ROM         32k         On-chip Rath         MDX Core           SN227750         52NB         Lear ROM         54k         On-chip Rath         MDX Core           SN227750         52NB         Lear ROM         64k         On-chip Rath         MDX Core           STN52700x         128k         Rear Not         128k         On-chip Rath         MDX Core           STN52700x         128k         Rear         52k         On-chip Rath         MDX Core           STN52700x         54k         Rearh         52k         On-chip Rath         MDX Core	^
Deschption Device Size Device Type Address Range	STM32F0x 54kB Haah b4k On-chip Haah MDK Cone STM32F10x Hachen Haah 10 K Cone STM32F10x Hachentty Flash 11 M On-chip Flash MDK Cone STM32F10x Mod-density Flash 12 K On-chip Flash MDK Cone STM32F10x Lon-density Flash 18 K On-chip Flash MDK Cone STM32F10x Lon-density Flash 18 C On-chip Flash MDK Cone STM32F10x Connectivity Lin. 25 K On-chip Flash MDK Cone STM32F10x M3F64 SPI Fla 8 M Est. Flash SPI MDK Cone	
Start: Stre: Stre:	STM32F2xx Reah 1M On-chip Reah MDK Core  C:Kel_v6VARM/deah/STM32F0x_128 FLM  Add Cancel	>

当添加好Flash Algorithm 之后,点击确定关闭窗口,回到MDK 主页面,点击工具栏的 ④ · 按 钮或者键盘的 **CTRL + F5** 即可进入Debug模式,如图所示,进入调试功能后,Power Writer 的Debug 功能和 STLINK、NULINK、GDLINK、J-LINK 功能一致。

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:::caution 注意

- 如调试器设置页面无法看到目标芯片ID,或者是提示错误,请参考 <u>调试器常见问题</u>进行问题 排查,确保目标芯片能正常被检测。
- 其他IDE的应用方式和MDK 基本一致,比如CUBEIDE,IAR等IDE 工具。
- 如果在Flash Algorithm找不到指定芯片的Algorithm 项,需要安装芯片对应的 **DFP**包,下载 方式包括:
  - 使用MDK 自带的 pack installer: 🚵 ,
  - 。从MDK 设备适配包站点下载: MDK5 Software Packs (keil.com)
  - 。 从芯片厂家官方渠道获取 DFP 包
- 部分旧芯片型号 DFP 包可能已经停止更新和维护,可以从 <u>MDK v4 Legacy Support</u> (<u>keil.com</u>)处下载安装。

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### **PowerWriter Debugger For MDK Trace**

Power Writer 集成的Debugger 除了调试器之外,也集成了ITM Trace 功能,此功能可以代替串口等工具,跟MDK 配合使用将超过串口的实用性,在Power Writer的教学视频有完整的介绍如何使用Power Writer Debugger ITM Trace 功能,本节只介绍概要性的功能,支持ITM Trace 功能的芯片内核如表 4.1.1.3 所示:

内核版本	是否支持ITM
cm3、cm33	支持ITM Trace
cm35+	
cm4	
cm55	
cm7	

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内核版本	是否支持ITM
armv81mml	
sc300	
Cm0	不支持TM Trace
Cm0+	
Cm1	
Cm23	
Armv7	
Armv8	
Armv8mbl	
Sc000	
	其他内核请自行查阅官方文档手册

### 查询当前芯片是否支持ITM:可以通过当前用户手册进行查询,如下图所示:

Status SHP protocol sequence     Status SHP protocol sequence     Table 223. Packet response (1 bits)     Table 224. ACK response (1 bits)     Table 224. ACK response (1 bits)     Table 225. DNTA transfer (33 bits)     Status SH-OP networks (sequence)     Status SH-OP networks     Status SH-OP Netw		<ul> <li>The ITM is an application-driven trace source that supports printf style debugging to trace Operating System (OS) and application events, and emits diagnostic system information. The ITM emits trace information as packets which can be generated as:</li> <li>Software trace. Software can write directly to the ITM stimulus registers to emit packets.</li> <li>Hardware trace. The DWT generates these packets, and the ITM emits them.</li> <li>Time stamping. Timestamps are emitted relative to packets. The ITM contains a 21-bit counter to generate the timestamp. The Cortex<sup>®</sup>-M3 clock or the bit clock rate of the Serial Wire Viewer (SWV) output clocks the counter.</li> <li>The packets emitted by the ITM are output to the TPIU (Trace Port Interface Unit). The formatter of the TPIU and then output the complete</li> </ul>
Table 228. Core debug registers	31.14.2	Time stamp packets encode time stamp information, generic control and synchronization. It uses a 21-bit timestamp counter (with possible prescaters) which is reset at each time stamp packet emission. This counter can be either clocked by the CPU clock or the SWV
31.15.2 ETN (31.15 ETM (Embedded trace macrocell)     31.53 Hain ETM registers     31.53 Hain ETM registers     31.54 ETM configuration example     31.154 ETM configuration example     31.154 ETM configuration example     31.154 Debug support for timers, watchdog, bxCAN and E2C     31.16.2 Debug support for timers, watchdog, bxCAN and E2C     31.16.3 Debug MCU configuration register		clock. A synchronization packet consists of 5 bytes equal to 0x80_00_00_00_00_00 which is emitted to the TPIU as 00 00 00 00 00 80 (LSB emitted first). A synchronization packet is a timestamp packet control. It is emitted at each DWT trigger.

ITM 的开启方法:在调试器设置页Trace设置页面,进行开启,设置好相关参数,如下图所示:

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e Simulator	CMSIS-DAP Cortex-M Target Driver Setup	×
nt Speed to Re ad Application a sation File:	Debug Trace Flash Download Pack Core Clock 36.000000 MHz I Trace Enable Trace Clock: 36.000000 MHz I Use Core Clock	
tore Debug Ses Breakpoints Watch Windor Memory Displa	Trace Port       Timestamps       Trace Evente         Serial Wire Output - UART/NRZ ▼       Imestamps       Imestamps         SWO Clock Prescaler:       36       Prescaler:       Imestamps         Autodetect       Prescaler:       1024*16 ▼       Imestamps         SWO Clock:       1.000000 MHz       Periodic       Periodic       Disabled>         Image: Optimized in the structure of the structur	s 9
DLL: Par DLL pC am if outdated i	ITM Stimulus Ports         B1         Port         24         23         Port         16         15         Port         8         7         Port         0           Enable:         DxFFFFFFFF         DxF00000008         Port         24         23         Port         16         15         Port         8         7         Port         0           Privilege:         0x00000008         Port         3124         Port         Port         2316         Port         15         Port         70         T           0K         Cancel         Help	

Trace 功能设置页面:

- Core Clock: 填写芯片的实际时钟。
- Trace Enable: 开启Trace 功能。
- Use Core Clock: 使用内核时钟。
- Clock Prescaler预分频: 推介设置为和内核时钟一致, 过高的速度, 可能会导致缓冲区溢出 (PowerWriter内置Cache为4K)。
- 端口部分:按照实际开启:具体查阅芯片手册。
- Trace Events:可按照实际的需求,开启时事件追踪。

Trace 功能支持输入输出,需要在项目中,代理fputc 和fgetc 接口,最基本的标准输入输出重载代码,如下所示:

```
int fputc(int ch,FILE *f){
 1
2
        return ITM_SendChar(ch);
3
    }
4
5
   volatile int32_t ITM_RxBuffer = ITM_RXBUFFER_EMPTY;
6
7
    int fgetc(FILE * f){
8
        while(ITM_CheckChar()!=1) __NOP();
9
        return (ITM_ReceiveChar());
10
    }
11
    int ferror(FILE *f){
12
13
       return EOF;
14
    }
15
16 void _ttywrch(int c){
17
        return fputc(c,&__stdout);
18
    }
19
20 int __backspace(){
21 return 0:
```

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```
23
24 void _sys_exit(int code){
25 label:
26 goto label;
27 }
28
```

添加终端托管代码之后,即可正常执行打印日志,和输入信息,如下所示:

```
1 while(1){
2 printf("PowerWriter Trace (please input number): ");
3 scanf("%d",&input);
4 printf("\r\nYou input number is: %d",input);
5 }
```

MDK Trace 菜单入口如图所示:

EIS * xPS Banked	Call Stack Window Watch Windows	,	<pre>/* Reset of all peripheral HAL_Init();</pre>	ls, Initiali
System	Memory Windows	•	A HORD CODE DECIN Tala. 1	,
Mod	Serial Windows	<b>b</b> •	🞲 UART #1	
- Pri Sta	Analysis Windows	•	UART #2	
Sta	Trace	•	UART #3	Lock */
Sec	System Viewer	•	📴 Debug (printf) Viewer	
×	Toolbox Window		A HERD CODE BEATH CHATNEL	

MDK Trace 演示效果如图所示,可代替串口使用:

```
Debug (printf) Viewer

ower Writer Trace (Please input number):

You input number is: 123

Power Writer Trace (Please input number):

You input number is: 123

Power Writer Trace (Please input number):

You input number is: 456
```

Trace 功能除了能作为输入输出使用之后,还可以使用MDK 自带的虚拟示波器,事件追踪等功能, 具体请查阅视频教程,以及相关demo 资料,以下列举出Trace 功能比较常见的高级应用:



Power Writer Trace 逻辑分析仪:

Power Writer Trace 系统分析:



### Power Writer Trace 系统Trace 记录:

	Display: All	$\sim$	10 🛃 🚉 🖾 🐺	✓ in All	
Т	îme	Address / Port	Instruction / Data	Src Code / Trigger Addr	Functio
	295.997 971 889 s		Exception Exit - SysTick		
	D 295.998 001 583 s		Exception Return		
_	295.998 971 500 s		Exception Entry - SysTick		
	295.998 971 889 s		Exception Exit - SysTick		
_	D 295.999 001 583 s		Exception Return		
	295.999 971 500 s		Exception Entry - SysTick		
	295.999 971 889 s		Exception Exit - SysTick		
	D 296.000 001 583 s		Exception Return		
	296.000 971 500 s		Exception Entry - SysTick		
	296.000 971 889 s		Exception Exit - SysTick		
_	D 296.001 001 583 s		Exception Return		
	296.001 872 750 s	R:0x20000004	0x0000026B		
	D 296.001 892 583 s	W:0x2000004	0x0000026C		
	296.001 971 500 s		Exception Entry - SysTick		
	DO 296.002 012 583 s		Exception Return		
	296.002 971 500 s		Exception Entry - SysTick		
	296.002 971 889 s		Exception Exit - SysTick		
	D 296.003 001 583 s		Exception Return		
_	296.003 971 500 s		Exception Entry - SysTick		
	296.003 971 889 s		Exception Exit - SysTick		
_	D 296.004 001 583 s		Exception Return		

### Power Writer Trace 系统Trace 模块追踪:

03 🖯 (										
Trace	Exceptions									
	2	EXCTRC	Exception Tracing	Timest	amps Enable					
	Name	Count	Total Time	Min Time In	Max Time In	Min Time Out	Max Time Out	First Time [s]	Last Time [s]	
11	SVCall	0	0 s							
12	DebugMonitor	0	0 s							
14	PendSV	0	0 s							
15	SysTick	318846	318.027 s	0 s	73.441 ms	30.083 us	4.947 s	0.00063939	326.15276764	
16	WWDG	0	0 s							
17	PVD	0	0 s							
18	TAMPER	0	0 s							
19	RTC	0	0 s							
20	FLASH	0	0 s							
21	RCC	0	0 s							
22	EXTI0	0	0 s							
23	EXT11	0	0 s							
24	EXTI2	0	0 s							
25	EXTI3	0	0 s							
26	EXTI4	0	0 s							
27	DMA1_Channel1	0	0 s							
28	DMA1_Channel2	0	0 s							
29	DMA1_Channel3	0	0 s							
30	DMA1_Channel4	0	0 s							
31	DMA1_Channel5	0	0 s							

:::caution 注意

- ITM (SWO),需要芯片有ITM 模块,比较常见的CM3,具体请看Trance 功能中的列举。
- IAR For ARM 中的Trance 功能为**ETM**, PowerWriter 接口引脚不够暂未支持,请关注后续产品。

:::

## **PowerWriter Debugger For IAR**

Power Writer 集成的Debugger 除了在MDK 中使用之外,也可以在IAR中使用,首先在Debugger 页面选择CMSIS-DAP 调试器,如下图所示:

* Q )	stm32ffxx_hal_msp.c x
-	HAL_Mspinit()
۰ ە	/* USER CODE END ExternalPunctions */
-POWER 🖌	/* USE Options for node "POWER WRITER IAR" ×
L_msp.c	** In Category:     **     ** In Category:     **
	/* t     Assembler       Output Converter     Driver       R0     Build Actions       B0     Build Actions       B0     Build Actions       ST-LINK     main       Chorper     CADI       CMDI     CMDIS SAPE
	CMSIS DAP     CDB Server     Ljet     CDB Server     J-Link/J-Trace     J-trik/J-Trace     J-trik/J-Trace     Nu-Link     TI Stellaris     PE micro     Nu-Link     ST-LINK     Third-Party Driver     TSt-LINK     Third-Party Driver
	Third-Party Driver     Ti XDS     Vdebugger\ST\STM32F107VC.ddf
WER WRITER IAR - F	POWER WRITEI
	OK. Cancel

然后在CMSIS DAP 中的Interface 接口选择 SWD 接口,如图所示:

C++ Compiler Setup Inte	erface Breakpoints
sembler Probe cont	fig Probe configuration file
istom Build   Auto	Override default
Id Actions	
bugger	lie
imulator O Explicit	CPU: Select
MSIS DAP	Explicit probe configuration
De Server	Multi-target debug system
jet	Treast and the TAD as Multidate 0
Link/J-Trace SWD	larget number (TAP or Multidrop
u-Link	Target with multiple CPUs
*E micro	CPU number on 0
T-LINK Interface spe	eed
MSP-FFT Auto doto	et

设置完成后,执行启动调试操作后即可进入调试页面,如下图所示:

OWER WRITER LAR			Dissourchiy 🔻 🛡			
	4L_bit0	fo	Gata	- Memory		
Ries Over WRITER IAR_  Constraints of the second se	<pre>* Bote dyufick is used as the hase for the ANL Delay() function, the application</pre>		Disamentaly Desition Peed Desition Peed Balance Peed Desition Peed Desit	Back640 Back741 Outdo5 Dist741 Outdo5 Back902 Back902 Back903	NOW BL BL IDR. S NOVS STR ALD POCE DC322 SID DC322 SID DC322 SID DC322 SID DC322 SID DC322 SID DC322 SID DC322 SID DC322 SID DC322 SID DC322 SID DC322 SID DC322 SID DC322 SID DC322 SID SID SID SID SID SID SID SID SID SID	
RUVER WRITER MR			e fiviliti tita	Extering	POP	1

:::caution 注意

- PowerWriter For IAR 调试时,没有Trace 功能,IAR中的Trace 功能使用的是ETM,如有必要 请使用PowerWriter串口代替。
- PowerWriter 中Debugger和 串口可以同时使用,两者为异步。
- PowerWriter 提供的调试协议为SWJ协议,原因在于PowerWriter 需要兼顾Debugger,Writer,以及生产控制,串口功能。

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## **PowerWriter Debugger For Other**

Power Writer 的调试器兼容DAPLINK,其他DAPLINK 调试器方法,同样可以在PowerWriter 上使用,如配合OpenOCD + GDB 使用,由于此类配置方法比较灵活,请自行查阅相关资料来配置对应的调试环境,Openocd 官方站点:

Open On-Chip Debugger (openocd.org)

:::tip 提示

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