# User's Guide **MCF8329A** 调优指南

TEXAS INSTRUMENTS

#### 摘要

本调优指南提供了分步指南,用于指导设置 MCF8329EVM,将 MCF8329EVM 连接到 Motor Studio 以及使用 MCF8329A 电机驱动器对三相无刷直流电机进行调优。

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### 商标

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### 1 简介

MCF8329A 是一款具有无代码无传感器场定向控制 (FOC) 的 4.5V 至 60V 三相无刷直流 (BLDC) 栅极驱动器 IC, 适用于电机驱动应用。该器件集成了单个分流电流检测放大器 (CSA) 以及用于检测电机电流的外部分流电阻。本 文档可帮助客户设置 MCF8329A,使他们能够体验器件强大的性能和灵活的可编程性。



图 1-1. 事件调优序列

备注

在继续学习本调优指南之前,请务必执行以下操作:

- 1. 阅读 MCF8329A 无传感器场定向控制 (FOC) 三相 BLDC 栅极驱动器数据表、MCF8329EVM 用户 指南,并观看快速入门视频。
- 2. 获取 MCF8329EVM 电路板。
- 3. 安装 Motor Studio 应用程序。



### 2 硬件设计和设置

本节旨在帮助用户为 MCF8329A 的外部功率级选择合适的元件,并设置 MCF8329EVM 的用户可配置设置。

### 2.1 电路板设计

以下各节提供了选择功率级元件以实现电机驱动器系统所需性能的公式和指南。

#### 2.1.1 外部 MOSFET 选型

MCF8329A 可支持的外部半桥的 MOSFET 可以通过将 MOSFET 栅极电荷、输出 PWM 开关频率和 PVDD 电压 输入到 TI.com 上的 Max Qg MOSFET Calcualtor Tool 中来确定。

#### 2.1.2 栅极电阻器选型

选择合适的栅极电阻来限制栅极驱动电流,以便将漏源电压压摆率 (VDS) 设置为适合外部 MOSFET 的水平,这 对于实现良好的系统性能至关重要。有关选择合适栅极电阻值的重要性和方法的更多信息,请参阅 MCF8329A 无 传感器场定向控制 (FOC) 三相 BLDC 栅极驱动器数据表中的栅极驱动电流和栅极电阻器选型部分。为了简化栅 极电阻选择过程,可以使用栅极电阻计算器来估算实现所需 VDS 上升和下降时间(精度为±30%)所需的栅极电 阻。

#### 2.1.3 自举电容器和 GVDD 电容器选型

自举电容器和 GVDD 电容器的大小必须适当,能够在正常运行期间维持自举电压高于欠压锁定阈值。有关为自举 电容器和 GVDD 电容器确定合适电容的说明,请参阅 MCF8329A 无传感器场定向控制 (FOC) 三相 BLDC 栅极驱 动器数据表 的自举电容器和 GVDD 电容器选型 部分。

#### 2.1.4 电流采样电阻选型

内部 FOC 算法在计算中使用内部电流检测放大器 (CSA) 的输出。建议将内部 CSA 的最大可测量电流设置为比电 机失速电流高 10%。要确定 CSA 增益和外部低侧分流电阻的合适值,请参阅 MCF8329A 无传感器场定向控制 (FOC) 三相 BLDC 栅极驱动器数据表 的第 7.3.5 节。

#### 2.1.5 VREG MOSFET 选型

GCTRL 引脚可用于驱动外部 MOSFET,该 MOSFET 可用作稳压器,为 VREG 引脚供电,从而降低 MCF8329A 内的功率耗散。*MCF8329A 无传感器场定向控制 (FOC) 三相 BLDC 栅极驱动器数据表*的第 8.2.1 节提供了有关 如何选择合适 MOSFET 的说明。

#### 2.1.6 额外的外部功率级元件

有关 MCF8329A 外部元件和大功率系统的其他注意事项,请参阅 MCF8329A 无传感器磁场定向控制 (FOC) 三相 BLDC 栅极驱动器数据表 的大功率设计中的系统注意事项、电容器电压额定值 和外部功率级元件 部分。



# 3 连接到 GUI

在将 MCF8329EVM 连接到计算机之前,启动 Motor Studio 应用程序并从下拉列表中选择 MCF8329A。点击 *Proceed*,然后点击 *Setup Now* 按钮,获取有关如何连接电源、连接电机以及配置 EVM 上的跳线和开关的说明。

Motor Studio File Options Tools Help Documents	
Select Device MCF8329A - 1	Hardware Setup
Commentation Comm	
Outick Spin Gat your motor spining in just few steps.	<ol> <li>Connect motor phases to A, B, C on connector J11</li> <li>Do not turn on the power supply self-Connect motor supply to PVDD and GND on connector J10</li> <li>Select.48 bit QVLSB and JB as SU2COM to power MSR400 from USB power supply</li> </ol>
So here after your motor spin consistently.	<ol> <li>Connect the micro-USB cable into the computer</li> <li>Turn the potentionethr fully cockets is saft the moder to zero speed upon powerup</li> <li>Fight the switch S1 to the top to configure BRACKET = RUM, switch S2 to the top to configure DRACFET = CM, switch S3 to the bottom to configure UIR + ABC, and switch S4 to the bottom to configure to VARCET</li> </ol>
Access all your centrol in one single page.	7. Fig the watch SWT has that configure SHEED/Watch pit to SHEEL Index and UACUUT rook SHEED_WATCh pit to BACCUIT mode Neth Rest Training and switch SWT is only with configure SHEED/WATCh pit to WATCH and a watch SWT is only with Configure SHEED/WATCh pit to WATCH and a watch SWT is only with SWT and the Watch SHEED watch and the set to put the device in SLEEP of WATCH and to advertain the WATCH and the Watch SHEED watch and the set to put the device in SLEEP of WATCH and the optimization of the set to put the device in SLEEP of WATCH and the optimization of the set to put the device in SLEEP of WATCH and the optimization of the set to put the device in SLEEP of WATCH and the optimization of the set to put the device in SLEEP of WATCH and the set to put the device in SLEEP.
EII Register Map Full interactive device register map.	Select J12 to lethnost position(closer to C8) to apply AVDD to VREG     Select J12 to lethnost position to apply analog voltage from potentiometer R47 to SPEED/WAKE pin     To Turn on the motor power supply
»	11. Use the potentiometer R47 to control the speed of the motor and the switches to disable the motor driver, change the direction, or apply a brake to the motor. Optionally, use the GUI (as shown in Section 6) to monitor real-time speed of the motor, put the MCF8329A into a low-power sleep mode, and read status of the LEbs.
60	Hardware setup has been done manually Setup New 3

图 3-1. EVM 硬件设置

硬件设置完成后,打开连接到 EVM 的电源。PVDD LED D3 亮起后,在 EVM 和 PC 之间连接一条 micro-USB 转 USB 电缆。几秒钟后, Motor Studio 应连接到 EVM,图 3-2 中所示的两个图标将变为绿色。如果 EVM 未连接,请点击 *Re-Scan* 按钮。



### 图 3-2. EVM 连接指示器

**备注** 如果 GUI 无法在一分钟后连接到 GUI,请断开 EVM 与 PC 的连接,重新启动 Motor Studio GUI。 Motor Studio 再次启动后,将 EVM 重新连接到 PC。

# 4 旋转进入闭环

本节提供了对 MCF8329A 设置进行调优的标准化步骤,以便电机能够成功旋转并进入闭环控制。

图 4-1 中概述了对 MCF8329A 寄存器进行调优以使电机旋转并进入闭环控制的一般步骤。



图 4-1. 基本控制流程图

### 4.1 基本配置

### 4.1.1 加载推荐的默认值

在 Motor Studio 主页上或窗口左侧的菜单中选择 Quick Spin 选项。使用 Load Default 部分中的 Select Preset 下 拉菜单,选择与应用用例或 Default MCF8329A Registers 选项最相似的寄存器配置。选择所需的寄存器配置后, 点击 Load Preset Values 按钮。



图 4-2. 加载默认寄存器配置

### 4.1.2 设置基极电流

根据节 2.1.4 中确定的分流电阻值和 CSA 增益值,使用方程式 1 计算内部 CSA 的最大可测量电流。

 $\frac{1.5}{\textit{RSENSE}} \times \frac{32768}{1200}$ 

将方程式 1 中的结果转换为十六进制值后,使用 *Register Map* 页面将结果输入寄存器 GD\_CONFIG2 中的 BASE\_CURRENT 位字段。

ል	Search registers by name, address or biffie	Id name Q Show bits		Registe	rs - Controls Faults	Charts Logs
₩ ₩ ⊗	Register Name Algorithm Configuration	Address	Value	Field View GD_CONFIG2	I2C CONTROLS Speed Control via I2C	Disabled
	Fault Configuration			BASE_CURRENT	0 12C Speed Command Percentage	Find Address
\$,	Internal Algorithm Configuration			RESERVED	0% 25% 50%	75% 100% 0.00 \$
	Hardware Configuration		8	PARITY	MOTOR STATUS	Auto Read Motor Status 🌑 Disabl
	PIN_CONFIG	0x000000A4	0x00000000	PARITY	Status Select	~
	DEVICE_CONFIG1	0x000000A6	0x00000000		Algorithm State MOTOR_JDLE	VM Voltage 00.0 V
	DEVICE_CONFIG2	0×000000A8	0x00000000		Reference for Speed Loop 00.0 Hz	Speed FDBK 00.0 Hz
	PERI_CONFIG1	0x000000AA	0x00000000			
	GD_CONFIG1	0x00000AC	0x00000000			
	GD_CONFIG2	0x000000AE	0x00000000			
	Fault Status					
»	System Status		,			
œ	Device Control		3		EEPROM Controls	EEDDOM -

图 4-3. BASE\_CURRENT 位字段



(1)



### 4.1.3 设置电流限值

MCF8329A 中的所有电流限值都设置为 BASE\_CURRENT 位字段中编程的值的百分比。例如,如果 BASE\_CURRENT 设置为 37.5A 且 ILIMIT 设置为 50%,则 ILIMIT 设置的电流限值将为 18.75A。

HW\_LOCK\_ILIMIT 和 LOCK\_ILIMIT 是可配置的电流限值,用于保护系统免受损坏。建议将这些限值设置为电机 额定峰值相电流的三倍。如果电机额定峰值相电流介于配置中的两个相邻限值设置之间,请选择两个设置中的较高者。

Mot	or Studio File Options Tools	Help Documents				
	Pre-Startup Motor Startup Open Loop and Ha	ndoff Closed Loop. Motor Step	Show Advance Settings Show Modified Registers Auto Read All Registers	Controls Faults  I2C CONTROLS  Speed Control via I2C  I2C Target Address (GUI side)	Charts Logs D Enabled	^
.:]	Control Configuration- Open Loop		~	0	Find Addres	18
•	Control Configuration- Control Fault Setting	25 - Look detection current Threshold (A) (LOCK_LILBRIT) 76 %	Lost current Limit Mode [LCCK_ILIMIT_MODE]     Fault automatically cleared after LCK_RETRY I	12C Speed Command Percenta 0% 25% 50%	ge (%) 75% 100% Auto Read Motor Status C Di	(c)
	Lock Detection current limit deglitch time (LOCK_JLIMIT_DEG)     S ms.	Lack detection retry time (LCK_RETRY) 2 s	Fault automatically cleared after LCK_RETRY t Y	Status Select		~
	IPD timesof fault Enable [IPD_TIMEOUT_FAULT_EN]  Enable	IPD frequency fault Enable [IPD_FREQ_FAULT_EN]  Enable	Look 1 (Abnormal Speed) Enable [LOCK1_EN]  Enable	Algorithm State MOTOR_IDLE	VM Voltage 0.0000 V	
	Lock 2 (Abnormal BEMF) Enable [LOCK2_EN]	Lock 3 (No Motor) Enable [LOCK3_EN]	Calculated Abnormal Speed Look Threshold (Hz) 0.00	Reference for Speed Loop 0.0000 Hz	Speed FDBK 0.0000 Hz	
	Atrosmal speed lock threshold (LOCK_ABN_SPEED)  130%	Abnornal BEMF lock threshold (% of expected BEMF) (ABNORMA	No motor lock threshold (A) (NO_MTR_THR)			
	Herdware Lock Detection current limit mode [HW_LOCK_ILIMIT_M Fault automatically cleared after LCK_RETRY t ~	Hardware Lock Detection current limit deglitch time [HW_LOCK_UL2 us	[WLUX_OV_HYS] TV for UV and 2V for OV			
	Undervoltage Fault Recovery Mode (WIN_VM_MODE) Automatic clear if voltage in bounds	Overvoltage Fault Recovery Mode (NAX_VM_MODE)  Automatic: clear if voltage in bounds	Automatic retry attempts (AUTO_RETRY_TIMES) No Limit			
»	Control Configuration- Closed Loop		· · · · · · · · · · · · · · · · · · ·			
œ	Algorithm Configuration- Reference Profile		×	EEPROM Controls	EEPROM	•

图 4-4. 电流保护限值

ILIMIT、OL\_ILIMIT、ALIGN\_OR\_SLOW\_CURRENT\_ILIMIT和 IPD\_CURR\_THR 是电机驱动器在电机运行的各个阶段使用的最大电流。建议将这些值设置为小于或等于电机的额定最大相电流。

otor Studio File Options Tools	Help Documents			
Pre-Startup Motor Startup Open Loop and Harr	Additional and the second seco	Show Advance Settings     Show Modified Registers     Auto Read All Registers	Controls Faults I2C CONTROLS Speed Control via 12C C	Charts Logs
Control Configuration-Motor Startup Station	Align or show first cycle ourrent remp rate (ALIGN_SLOW, RANDER	Align time (ALIGN_TINE) 3.6 V	0% 25% 50%	Find Address           age (%)         0.00         ¢           75%         100%         ¢
- Align or slow first cycle current limit (A) (ALIGN_OR_SLOW_CURR 30 % V	IPD Clock Frequency (JPD_CLK_FREQ)	IPD Current Threshold (A) [IPO_CURR_THR]	MOTOR STATUS	Auto Read Motor Status 💿 Disab
IFD release mode (IPD_RLS_MODE)	IPD advance angle (IPD_AOV_ANGLE) 90° V	Number of times IPD is executed [IPD_REPEAT]	Status Select	×
Align Time (ALIGN_ANGLE) B0 deg	Calculated Frequency of First Clyde (Hz) 2.78	Frequency of first cycle in close loop startup (% of MAX_SPEED) [ 0.7%	Algorithm State MOTOR_IDLE Reference for Speed Loop	VM Voltage 00.0 V Speed FDBK 00.0 Hz
Starting frequency of first cycle (FIRST_CYCLE_FREQ_SEL) 0 Hz	IPD high resolution enable [PO_HIGH_RESOLUTION_EN] Disable			
Control Configuration-Motor Parameters Ex	traction Tool(MPET)	v		
Control Configuration-Motor Parameters		~		
Control Configuration- Open Loop Ceen loss current limit configuration (OL_LIMT_CONFIG) Open loop current limit defined by OL_ILIMIT	lq ramp down after transition to cleve loop [IQ_RAMP_EN] C Enable Iq ramp down	Open Loop current limit (A) (OL_LUNIT).	1	
Open loop acceleration coefficient A1 (DL_ACC_A1) 25 Hz/s	Open loco acceleration coefficient A2 (OL_ACC_A2)     10 Hz/s2	Auto Hartost Enstre (AUTO_HANDOFF_EN) Enable Auto Handoff	EEPROM Controls	EEPROM •

图 4-5. OL\_ILIMIT、ALIGN\_OR\_SLOW\_CURRENT\_ILIMIT 和 IPD\_CURR\_THR 电流限值



			Show Advance Setting:		> Controls Faults	Charts L
rre-Startup Motor Startup Open Loo		doff Closed Loop Motor S	Auto Read All Registers	rs D	I2C CONTROLS Speed Control via I2C	Enabled
Control Configuration- Open Loop				~	0x0	Eind Av
Control Configuration- Control Fault	Setting	s		-	I2C Speed Command Perce	ntage (%)
Orabel Orabel Oracel Land					0% 25% 50%	75% 100%
Control Conliguration- Closed Loop		Owned inter-development (O) DEC_CONE(0)	Classed loss deceleration rate (C)_DEC1	Ŷ	MOTOR STATUS	Auto Read Motor Status
500	~	<ul> <li>Closed loop deceleration defined by CL_AC</li> </ul>	500	~	Status Select	
Kp coefficient for current lq and ld loop (CURR_LOOP_KP) = $0$	ä	Ki coefficient for current lig and Id loop (CURR_LOOP_KI)	Kp coefficient for speed loop (SPD_LOOP_KP) 0	×	Algorithm State MOTOR_IDLE	VM Voltage 0.0000 V
Min Range: 0, Max Range: 255		Min Range: 0, Max Range: 255000	Nin Range: 0, Nax Range: 2.55		Reference for Speed Loop	Speed FDBK
0	٥	60 %	1.6	0	( <u></u>	
Min Range: 0, Max Range: 25.5			Min Range: 0, Max Range: 25.5			
Flux Weakening KI (FLUX_WEAKENING_KI) 160	•	Close loop acceleration when estimator is not yet fully aligned ( Hz /. 200	Maximum Power [Maximum Power]     100	2		
Min Range: 0, Max Range: 2550			Nin Range: 0, Max Range: 3070			
Enable Maximum Torque Per Ampere Operation (MTPA_EN) MTPA disabled		Resonse_to_cnerge_ct_CIR_pin_status (DIR_CHANGE_MODE) Change the direction through Reverse Drive while continuously driving the motor	- PLUX WEAKENING REFERENCE (FLUX_WEAKENIN 95%	o_REFERE		
Control mode (CTRL_MODE)	~					

图 4-6. ILIMIT 电流限值

#### 4.1.4 设置电压限值

BUS\_VOLT 用于对 MCF8329A 将使用的调制算法进行标准化。为了在较低电机电压下提高调制算法的分辨率, 请将 BUS\_VOLT 设置为最接近的值,该值仍然大于预期的直流母线电压或相电压。确定最大预期电压值时,确保 考虑相位节点上的电压尖峰。

在电机电压不能高于特定电平的应用中,可使用 MAX\_VM\_MOTOR 来设置所需的电压限值。

otor Studio File Options Tools	Help Documents			
Pre-Startup Motor Startup Open Loop and Ha	ndoff Closed Loop Motor Stop	Show Advance Settings Show Modified Registers Auto Read All Registers	Controls Faults	Charts Logs
System Level Configuration Enables Over medulation [OVERMODULATION_ENABLE] Disable Over Modulation	PVM output frequency [PVM_FREQ_OUT]	PWM modulation [PVM_MODE] Continous Space Vector Modulation	0x0 I2C Speed Command Percenta 0% 25% 50%	Find Address           ige (%)         0.00 ♀           75%         100%
F0 select [F0_SEL]     Output FG in ISD,open loop and closed loop (      F0 output BEMF threshold [F0_BEMF_THR]     +/- 10mV	P6 Diversite factor (FG_DN) - Divide by 1 (2-pole motor mechanical speed) Av3 enable (Av3_EN) Divide by 1 (2-pole motor mechanical speed) P1 Division factor (FG_DN) - Divide by 1 (2-pole motor mechanical speed) P1 Division factor (FG_DN) - Divide by 1 (2-pole motor mechanical speed) P1 Division factor (FG_DN) - Divide by 1 (2-pole motor mechanical speed) P1 Division factor (FG_DN) - Divide by 1 (2-pole motor mechanical speed) P1 Division factor (FG_DN) - Divide by 1 (2-pole motor mechanical speed) P1 Division factor (FG_DN) - Division (FG_DN) - Division factor	F0 adput centiguration (F0_CONFID)  F0 adput centiguration (F1 dops below BEMF threshold defined by FG_BEMF_THR  Deadtime compensation enable [DEADTIME_COMP_EN] Disable	MOTOR STATUS Status Select Algorithm State	Auto Read Motor Status Disabl
Minimum voltage for running motor(V) [MIN_VM_MOTOR]	Undervoltage Fault Recovery Mode [MIN_VM_MODE] C Automatic clear if voltage in bounds	Maximum voltage for runing motor (MAX_VM_MOTOR)     No Limit	Reference for Speed Loop 0.0000 Hz	0.0000 V Speed FDBK 0.0000 Hz
Overvoltage Fault Recovery Mode [MAX_VM_MODE] Automatic clear if voltage in bounds	Maximum Bus Voltage Configuration (BUS_VOLT) 60 V	Dynamic CSA Gain adust [DYNAMIC_CSA_GAIN_EN] Disable		
Dynamic Voltage Gain adjust [DYNAMIC_VOLTAGE_GAIN_EN] Dynamic Voltage Gain is Disabled	Spread Spectrum Modulation Disable [SPREAD_SPECTRUM_MO SSM is Disabled	500 ns		
Bus Current Limit (BUS_CURRENT_LIMIT)	Bus Current Limit Enable (BUS_CURRENT_LIMIT_ENABLE) Disable	Current Sente Amplifier's Gain (CSA_GAIN)		
Driver Configuration-Gate Driver Settings		~		
Driver Configuration-Gate Driver Fault Set	tings	~	EEPROM Controls	EEPROM ·

图 4-7. 电压限值



### 4.1.5 输入电机的相电阻和电感

根据电机参数常见问题解答中的说明,找出电机相电阻和电感。找到这些值后,在 Advanced Tuning 页面上的 Motor Parameters 选项卡中将相电阻输入到 Motor Phase Resistance 框中,并将相电感输入到 Lq 和 Ld 框中。

otor Studio File Options Tools Help Documents			
Pre-Startup Meter Startup Core top and Lucear Core Core Core and Core Core Core Core Core Core Core Core	rs	Controls Faults      I2C CONTROLS      Speed Control via I2C	Charts Logs
System Level Configuration Driver Configuration-Gate Driver Settings	~ ~	0 12C Speed Command Percent 0% 25% 50%	Find Address Rge (%) 0.00 75% 100%
Driver Configuration-Gate Driver Fault Settings	*	MOTOR STATUS	Auto Read Motor Status 🖱 Dis
Device and Pin Configuration Control Configuration-Reverse Drive Settings Control Configuration-Pre-Startup	*	Status Select Algorithm State MOTOR_IDLE Reference for Speed Loop	Vild Voltage 6.000 V Speed FDBK
Control Configuration-Motor Stop Control Configuration-Motor Startup Stationary	*	0.0000 Hz	0.0000 Hz
Control Configuration-Motor Parameters Extraction Tool(MPET)	~		
Control Configuration-Motor Parameters			
0         10 </td <td>2</td> <td></td> <td></td>	2		
- Moor BMD* Centre (30/01/4, BMD?)         200         20         2           - Moor BMD* Moor BMD* Centre (30/01/4, BMD* 200         200         2         2		EEPROM Controls	EEPROM

图 4-8. 电机电阻和电感

### 4.1.6 最大电气速度 (Hz)

转至 GUI 中 Quick Spin 选项卡上的 Motor Information 部分,并使用以下步骤设置电机的最大速度:

- 1. 选择 Speed in RPM 或 Speed in Hz,具体取决于电机数据表提供的速度单位。
- 2. 在"Max Speed"框中输入速度。如果输入以 RPM 为单位的速度,则还要使用 Pole Pairs 框输入电机具有的 极对数。

Motor Studio					- 0 ×
MODOF Studio         Fell         Options         Tools         Help           Image: Status	Documents	Advanced Tuning Select Preset Select	RegisterMap	Controls Faults > I2C CONTROLS Speed Control via I2C	Charts Logs
Motor Information Enter the basic information of your motor      Speed in RPM     Speed in Hentz     T     Reaf Pais Correct     Reaf Pais Correct     Reaf Pais     Reaf Pais	~ 2	MPET Results BD/Covier BD/	<ul> <li>mV/Hz</li> <li></li> </ul>	12C Target Address (GU) s 1 1 12C Speed Command Parce 0% 25% 50% MOTOR STATUS Status Select Aggettim State MOTOR WHET_FAULT	Intel (%) T5% 100% Auto Read Motor Status C Disable VM Vottage 24.4629 V
<ul> <li>Spin Motor</li> <li>Move the sider to control the speed of the motor:</li> <li>IZC Speed Command Percentage (%)</li> <li>IZC Speed Command Percentage (%)</li> <li>IZC Speed Sp</li></ul>	Logs 14.36.41.5 14.36.38.9 14.36.38.60 14.36.38.60	15   Setting speed command to 0% 88   Default register settings loaded. 62   Fault detected : DRV_OFF 20   Fault detected : APP_RESET	0	Reterence for Speed Loop 8.000 Hz	Speed FDBK J337.487 Hz

#### 图 4-9. 电机最大速度



#### 备注

在没有电机数据表的情况下确定电机极数:

- 1. 使用实验室电源,并确保电流限制设置为低于电机额定电流。请勿打开电源。
- 2. 将电源的 V+ 连接到电机的 A 相,将电源的 V- 连接到 B 相。如果没有标记,则可以随机选择三相中的任意两相。
- 3. 打开电源。转子应在注入电流后稳定在一个位置。
- 4. 手动旋转转子,直到转子对齐到另一个稳定位置。一次机械循环将有多个稳定位置。
- 5. 对一次完整机械循环的稳定位置数进行计数,该数字即为极对数。乘以2后便可计算出极数。

注意电机内的传动系统。传动比将确定多少转子转数与轴的机械旋转相关联。

#### 4.1.7 运行 MPET 以识别电机参数

一旦设置了节 4.1 部分中介绍的所有其他设置,就可以使用 MCF8329A 中的 MPET 算法来测量使电机在闭环中 旋转所需的 BEMF 常数和速度环路增益。在运行 MPET 之前,请转至 MPET 页面,并检查是否按照节 4.1.3 中的 说明设置了 IPD 和开环电流限制。接下来,启用 Measure Motor BEMF Constant 和 Measure Motor Mechanical Parameter 开关,然后点击 Run MPET 按钮。电机应开始旋转。电机停止旋转后,MPET 已完成测量。点击 Write MPET Results To Shadow Registers 按钮,以使用由 MPET 测得的结果。

Motor Parameter Extraction Tool (MPET)			> Controls Faults	Charts Logs
Motor Parameters     Moseum Settings     Jeann Methods     Jeann Methods     J. Go to MPET Page     Metry flux     Metry flux     Metry flux     Metry flux     Metry flux     Metry flux	enformation MPET Results	Configured Values	I2C CONTROLS Speed Control via I2C I2C Target Address (GUI sid 0x0 I2C Speed Command Percent	Enabled     Ind Address     age (%)
20 %     20 %	vent Limits www.recoder.com work void void void void void void void void	Kp coefficient for speed loop	0% 25% 50% MOTOR STATUS Status Select Agosthm State MOTOR_IOLE	0.00         0           75%         100%           Auto Read Motor Status         Isable           VM Voltage         VM Voltage           0.000 V         VM Voltage
MPET Sol 3. Enable both Measurements Measure Motor IBSNF Measure Motor Measuremeter Measure Motor Measuremeter Measure Motor Measuremeter Measure Motor Measuremeter	Speed Loop K 0 000 5. Write MPET R Write MPET R Logs No Logs available	Ki coefficient for speed loop <b>T Results to Registers</b> suits To Shadow Registers	Reference to Speed Loop 0.0000 Hz	Speed FOIK 0.0000 Hz
» 9			EEPROM Controls	EEPROM •

图 4-10. 如何运行 MPET

备注

如果报告了故障或 MPET 无法测量 BEMF 常数,请转至节 6 以寻求帮助。

#### 4.1.7.1 跳过 MPET 测量

通过确保参数寄存器中填充非零值,并且禁用测量开关,可以跳过 BEMF 常数或速度环路增益的 MPET 测量。

使用以下步骤禁用 BEMF 常数测量:

- 1. 用非零值填充电机 BEMF 常量,最好使用电机数据表中的值或手测量值。
- 2. 禁用 Measure Motor BEMF Constant 开关。

执行以下步骤来禁用速度环路增益的测量:

- 1. 使用非零值填充速度环路的 Kp 和 Ki 系数。
- 2. 禁用"Measure Motor Mechanical Parameter"。

Motor Studio File Options Tools Help Documents				
a Motor Parameter Extraction Tool (MPET)			Controls Faults	Charts Logs
Motor Parameters     System Settings     System Settings     Moment Inter     Moment Inter     Moment Inter     Source Settings	Result Section	Configured Values	I2C CONTROLS Speed Control via I2C	Enabled
IPD Settings     MPET IPD Parameter select     Move of the select     Set of the select      Move of the select     Time	MPET motor BEMF constant 0.000 mV/Hz	otor BEMF Constant 0.000 0 mV/Hz	0x0 12C Speed Command Percenta 0% 25% 50%	ge (%) 75% 100%
Copen Loop Settings     Open Loop Settings     Points     Copen Loop Setting     Points     Co	S	coefficient for speed loop	MOTOR STATUS Status Select Algorithm State MOTOR_IDLE Reference for Speed Loop	Auto Read Motor Status C Disable
MPET Sel 2. Disable Measurement Measure Moor responses Measure Moor Beaution Measure Moor Mechanical Parameter Run MPET	0000 Write MPET Results To Sh	adow Registers	0.000 Hz	0.0000 Hz
69			EEPROM Controls	EEPROM •
	Measurements			

图 4-11. 如何跳过 MPET



### 4.2 测试是否成功启动至闭环

- 1. 使用 Quick Spin 页面的 *Spin Motor* 部分中的滑块或文本框应用非零速命令。提供速度命令后,电机应开始旋转并加速,直到电机达到目标速度。
- 2. 电机停止加速后,检查 Motor Status 部分下 Reference for Speed Loop 和 Speed FDBK 中的值是否接近同一 值。
- 3. 如果 Faults 选项卡显示红色圆圈,则检查是否存在任何故障。如果已报告故障,请转至节6并按照调试步骤 更正故障。
- 4. 一旦电机能够旋转进入闭环而不触发任何故障,请停止电机并通过依次点击 File -> Save Registers 将寄存器 配置保存到 json 文件中。在弹出的窗口中,选择 Json File 并点击 Save 按钮。
- 5. 为了在器件上电时对 MCF8329A 数据表第 7.7 节中介绍的寄存器进行配置,这些寄存器值可加载到 EEPROM 中。要将所配置的寄存器值写入 EEPROM,请点击位于 Motor Studio 右下角的 EEPROM 下拉菜 单,然后选择 Write to EEPROM 选项。在弹出的窗口中点击 Yes 按钮。

Motor Studio File Options Tools Help Documents				
命 6 A. Save Register Configuration 非 Optimization Wizards	🗣 Advanced Tuning	3. Check if Fault	has Occurred Faults	Charts Logs
Ouick Spin			I2C CONTROLS	^
計 Click the "Load Default Click the "Load Preset values" button to load the recommended default values.	Select Preset* MCF8329A_Default	Load Preset Values	Speed Control via I2C I2C Target Address (GUI side	Enabled
d Motor Information	MPET Results		0x0	Find Address
Enter the basic information of your motor		1. Enter Speed Command	12C Speed Command Percent	age (%)
EI: O Speed in RPM	BEMF Constant	▲ mV/Hz	0% 25% 50%	75% 100%
Rated Peak Current Max Speed			MOTOR STATUS	Auto Read Motor Status 🕥 Disable
60 % · 200.00 · 1	- SPD_LOOP_KP 0.00	\$	Status Select	~
Run MPET			Algorithm State	VM Voltage 0.0000 V
Executing the MPET command will enable Motor spinning	0.00	2. Check if Values are Close	Reference for Speed Loop 0.0000 Hz	Speed FDBK 0.0000 Hz
3 Spin Motor	Logs	0		
Move the slider to control the speed of the motor	12:40:35:462   : Default register settings loaded.			
I2C Speed Command Percentage (%)				
>> 0% 25% 50% 75% 100% 0.00 0			5. Save Confi	guration to EEPROM
69			EEPROM Controls	EEPROM -

图 4-12. 闭环旋转测试步骤



### 5 基本控制

本节提供了针对多种用例需求优化电机性能的调优指导。

**备注** 用户应跳过不适用于系统或终端设备的小节用例和情形。

### 5.1 速度输入模式

MCF8329A 提供四个用于控制电机转速的选项:PWM、频率、模拟和 I2C。可以通过更改 Advanced Tuning 页面上 SPEED\_MODE 寄存器的值来设置所需的速度模式。MCF8329A 无传感器场定向控制 (FOC) 三相 BLDC 栅极驱动器数据表的电机控制输入选项一节中提供了有关如何配置这些控制方法的说明。

Image: Control of Contro	
System Level Configuration - Gate Driver Settings     Driver Configuration-Gate Driver Fault Settings     Driver Configuration-Gate Driver Fault Settings     Driver Configuration - Gate Driver Fault Settings     Device and Pin Configuration     Setting Setting	Faults Charts Logs LS  12C  Disabled as (GUI side)
Driver Configuration-Gate Driver Settings     Driver Configuration-Gate Driver Fault Settings     Driver Configuration-Gate Driver Fault Settings     Driver Configuration     A Status Seteration	Find Address
Driver Configuration-Gate Driver Fault Settings * Device and Pin Configuration ^ Status Setect	and Percentage (%) 50% 75% 100% €
Device and Pin Configuration ^ Status Select	US Auto Read Motor Status 🜰 Disable
	~
- Bindly, The sender (BRAKE, NAVIT) - Sender, Control (Mole, Send) (Send) - Prived, Control (Mole, Send) (Send) - Prived, Control (Mole, Send) (Send) - Prived, Control (Mole, Send) (Send) - Aligorithm State Mandrag Mode · Pin BRAKE: A send (Send) (Send) - Pin Send (Send) (Send) - Pin Send (Send)	VM Voltage 00.0 V
0C save advest (DC_,RLvE_ADDR)         Steep Emy Time (BLEEP_ADTR)_TMR]         Dev Hole Steet (DEV_ADDR)         Reference for Spec 0 ab Viz           0         Steep entry when SPEED pin remains low for 5 v         Image: Standby Mode         Reference for Spec 0 ab Viz	ed Loop Speed FDBK
Min Regel: K.M.: Regel: 000000         Etitemel Check Configuration (ECT, CLX, DD)           - Colds States (Ext, SLS)         Etitemel Check Configuration (ECT, CLX, DD)           Interned Check States (ECT, CLX, CD)         Disable           Disable         Disable	
Dir_Pri_Covering (DR_, IPPUT)     Haddware Pin DIR     Covering (DR_, IPPUT)     Covering (	
Control Configuration-Reverse Drive Settings ~	
» Control Configuration-Pre-Startup v	
eo Control Configuration-Motor Stop	ntrols EEPROM +

图 5-1. 速度模式选择

如果选择了 I2C 速度输入,请将 SW1 切换到远离其他开关的位置(请参阅图 5-2),这将向 SPEED/WAKE 引脚 提供 WAKE 开关信号,以使 MCF8329A 退出休眠/待机模式。如果使用 I2C 以外的速度模式,请将开关反向切换 (如图 5-2 中所示),以将速度引脚连接到 J13。有关如何设置 J13 的信息,请参阅 MCF8329EVM 用户指南中的 MCF8329EVM 上用户可选设置(默认为粗体)的说明表。



图 5-2. I2C 速度模式的 SW1 位置

### 5.2 在启动期间防止转子回旋

### 选项1:初始位置检测(IPD):

- 1. 转至 Optimization Wizards 页面中的 Optimal Startup,选择"IPD",然后点击 Next 按钮以获取设置 IPD 启 动方法的说明。
- 2. 将 IPD 超前角度 [IPD\_ADV\_ANGLE] 设置为 90°,以获得最大启动扭矩。如果在启动过程中观察到急冲,则 建议将该角度减小到 60° 或 30°,以实现更平稳的启动。

#### 备注

如果电机具有非常高的电感,或者未连接电机,器件将会触发 IPD 超时故障 [IPD\_T1\_FAULT]。如果触发了此故障,建议检查电机是否连接到了器件。

如果 IPD 时钟频率设置得过高,器件会触发 IPD 频率故障 [IPD\_FREQ\_FAULT]。如果触发了此故障, 建议减小 IPD 时钟值 [IPD\_CLK\_FREQ]。



### 选项2:慢速首循环:

1. 进入 *Optimization Wizards* 页面中的 *Optimal Startup*,选择 "slow first cycle",然后点击 *Next* 按钮以获取 设置慢速首循环启动方法的说明。

Мс	tor Studio File Options Tools	Help Documents						
	OptimizationWizards > OptimalStartup OptimalStart-up This wizard helps you configure fast and robust r Pre-Startup Motor Startup Open Loop and Handoff	notor startup.	Motor Stop	Motor startup options [MTR_STARTUP] Align O Double Align	) 091 (	Controls Faults      I2C CONTROLS      Speed Control via I2C      I2C Target Address (GUI side      0      I2C Speed Command Percent      0% 25% 50%      MOTOR STATUS	Charts           Disabled           ) ()           age (%)           75%           100%	Logs
	IPD (Initial Position Detection) can be used in such applications therefore can allow for a faster motor start-up sequence. IPD w	where reverse rotation of orks by pulsing current in t Align	the motor is unacceptab to the motor and hence c Double Align	le. IPD does not wait for the motor to al an generate undesirable acoustics. Initial Position Detect	lign with the commutation and Slow First Cycle	Status Select Algorithm State MOTOR_IDLE Reference for Speed Loop	~	
	Reverse Rotation During Startup	Poor	Poor	Good	Average	00.0 Hz	00.0 Hz	
	Acoustic Noise	Good	Average	Poor	Good			
	Startup Torque	Good	Good	Good	Average			
	Startup Time	Average	Poor	Good	Average			
>>	DC Bus Spike	Good	Good	Average	Good			
Θ					Next	EEPROM Controls		EEPROM -

图 5-3. "Optimal Startup"页面

#### 5.3 缩短启动时间

#### 选项1:初始位置检测(IPD):

- 1. 转至 Optimization Wizards 页面中的 Optimal Startup,选择 IPD,然后点击 Next 按钮。
- 2. 将 IPD 电流阈值 (A) [IPD\_CURR\_THR] 提高到电机的额定电流。
- 3. 将 IPD 时钟值 [IPD\_CLK\_FREQ] 提高到更高的频率,在此值条件下,器件不会触发 IPD 频率故障。
- 4. 将 IPD 重复次数 [IPD\_REPEAT] 设为 1 次。
- 5. 将开环电流限制配置 [OL\_ILIMIT\_CONFIG] 设置为由 ILIMIT 定义的开环电流限制。
- 6. 增加开环加速系数 A1 [OL\_ACC\_A1] 和开环加速系数 A2 [OL\_ACC\_A2]。

#### 备注

可以增加 A1 和 A2,直到开环电流达到锁定检测电流阈值 [LOCK\_ILIMIT]。可以使用示波器来测量开环电流。

增加开环加速系数 A1 [OL\_ACC\_A1] 和开环加速系数 A2 [OL\_ACC\_A2] 可能触发 LOCK\_LIMIT 故障。 如果发生这种情况,请减小 A1 和 A2,直到不再触发 LOCK\_LIMIT 故障。

- 7. 对于超短启动时间(小于 100ms),建议按照以下步骤进行操作。
  - a. 禁用自动切换 [AUTO\_HANDOFF]。
  - b. 将开闭环切换阈值 [OPN\_CL\_HANDOFF\_THR] 配置为小于或等于 20Hz 的值。
- 8. 对于 100ms 以上的启动时间,建议按照以下步骤操作:
  - a. 启用自动切换 [AUTO\_HANDOFF]。



#### 备注

如果触发异常速度故障 [ABN\_SPEED],建议减小开环加速常量 [OL\_ACC\_A1] 和 [OL\_ACC\_A2],并通 过增加 IPD 电流阈值 [IPD\_CURR\_THR] 和 IPD 重复次数 [IPD\_REPEAT] 来重新调整 IPD。

9. 增加闭环加速率 [CL\_ACC]。

#### 备注

LOCK\_LIMIT 故障处理:

可以增加闭环加速率 [CL\_ACC],直到闭环电流达到锁定检测电流阈值 [LOCK\_ILIMIT]。可以使用示波器来测量闭环电流。增加闭环加速率 [CL\_ACC] 可能触发 LOCK\_LIMIT。如果发生这种情况,请减小闭环加速率 [CL\_ACC],直到不再触发。

#### 选项2:对齐

- 1. 进入 Optimization Wizards 页面中的 Optimal Startup,选择 "Align",然后点击 Next 按钮以获取设置对齐启 动方法的说明。
- 2. 将对齐时间 [ALIGN\_TIME] 配置为 10ms。
- 3. 按选项1中的第6步至第9步操作。

图 5-4 展示了 FG、相电流和电机电气速度波形。电机需要 50ms 才能从零达到目标速度。



图 5-4. 相电流、FG 和电机速度 - 更快的启动速度

备注

如果触发异常速度故障 [ABN\_SPEED] 或不同步 [LOSS\_OF\_SYNC] 故障,建议按照以下调试步骤进行 操作:

- 1. 在 [MTR\_STARTUP] 中选择 "Double align" 作为电机启动方法。
- 2. 增加对齐时间 [ALIGN\_TIME]。
- 3. 将对齐电流阈值 [ALIGN\_OR\_SLOW\_CURRENT\_ILIMIT] 配置为 ILIMIT 的 50%。
- 4. 将第一周期频率选择 [FIRST\_CYCLE\_FREQ\_SEL] 配置为 0。

### 5.4 改进速度调节

对于需要更好速度调节的应用,建议调优转速环路 PI 控制器 [SPD\_LOOP\_KP] 和 [SPD\_LOOP\_KI]。速度环路的 Kp 系数 [SPD\_LOOP\_KP] 控制稳定时间和速度过冲。速度环路的 Ki 系数 [SPD\_LOOP\_KI] 控制速度过冲,确保 将速度调节为设定值,并促使误差为零。速度环路 PI 控制器增益可以由 MCF8329A 自动调优,也可以手动调 优。

**自动调优:**当 [SPD\_LOOP\_KP] 和 [SPD\_LOOP\_KI] 设置为零时, MCF8329A 会自动计算速度环路 PI 控制器增益。

手动调优:按照下面的步骤手动调优速度环路 PI 控制器增益:

- 1. 将控制模式 [CTRL\_MODE] 设置为调制指数控制 (11b)。
- 2. 发出非零速命令,以启动电机(请参阅节4.2的第1步,了解如何发出非零速命令)。电机将在开环中旋转。
- 3. 让开环电流稳定,然后测量峰值开环电流。
- 4. 停止电机并将控制模式 [CTRL\_MODE] 设置为电流控制。
- 5. 缓慢增加速度命令,直到电机转速达到最大速度。记下 *IQ\_REF\_CLOSED\_LOOP* 寄存器中报告的 Iq\_ref 值。
- 6. 使用方程式 2 计算速度环路 Kp [SPD\_LOOP\_KP]。

Speed loop 
$$Kp = \frac{Iq \ reference \ at \ maximum \ speed}{Maximum \ Electrical \ Speed \ in \ Hz}$$

7. 使用方程式 3 计算速度环路 Ki [SPD\_LOOP\_KI]。

Speed loop  $Ki = 0.1 \times Speed \ loop \ Kp$ 

8. 停止电机并将控制模式 [CTRL\_MODE] 设置为速度控制。

备注

速度环路 Kp 和 Ki 的调优是试验性的。如果上述建议不起作用,则建议手动调优速度环路 Kp 和 Ki,直 到实现所需的结果。

(2)

(3)

### 5.5 限制和调节电源

MCF8329A 提供了限制和调节电源的选项。此功能可用于电池供电的电机驱动器应用,例如无绳吸尘器、电动工具等。

请按照以下步骤限制电源。在此模式下,电源仅限于参考功率,不主动调节。

- 1. 将 CTRL\_MODE 配置为功率控制 (1b)。
- 2. 配置 MAX\_POWER。这将设置 MCF8329A 在 100% 占空比命令下可以从直流输入电源获取的最大功率。例 如,如果 MAX\_POWER 配置为 25W, MCF8329A 将在 50% 占空比命令下从电源消耗 12.5W。
- 3. 电源控制环路使用与速度环路模式相同的 PI 控制器参数。Kp 和 Ki 系数通过 SPD\_POWER\_KP 和 SPD\_POWER\_KI 进行配置。调优 SPD\_POWER\_KP and SPD\_POWER\_KI 是试验性的。建议手动调优这 两个参数,直到获得所需的结果。

	$\wedge$		Show Advance Settings		> Controls Faults	Charts	Logs
re-Startup Motor Startup Open	Loop and Har	ndoff Closed Loop Motor Stop	Auto Read All Registers		I2C CONTROLS Speed Control via I2C C I2C Target Address (GUI side	Disabled	,
Control Configuration- Open Loo	c			~	0x0		Find Address
Control Configuration- Control Fa	ult Setting	js		~	I2C Speed Command Percentage (%)		
Control Configuration- Closed Lo	ор			^	0% 25% 50%	75% 100%	
Closed loop acceleration rate [CL_ACC]	~	Closed loop deceleration select (CL_DEC_CONFIG) Closed loop deceleration defined by CL_DEC	Closed loop deceleration rate [CL_DEC] 7.5	~	MOTOR STATUS Status Select	Auto Read Motor St	atus 🜑 Disabl
Kp coefficient for current lq and Id loop [CURR_LOOP_I 0.73	(P)	KI coefficient for current Iq and Id loop [CURR_LOOP_KI]	Kp coefficient for speed loop [SPD_LOOP_KP]	2	Algorithm State	VM Voltage	
Min Range: 0, Max Range: 255		Min Range: 0, Max Range: 255000	Min Range: 0, Max Range: 2.55	_	Reference for Speed Loop	Speed FDBK	
Ki coefficient for speed loop (SPD_LOOP_Ki) 10	\$	Reference for Torque PI Loop (A) [ILIMIT]	Flux Weakening Kp [FLUX_WEAKENING_KP]	0	00.0 Hz	00.0 Hz	
Min Range: 0, Max Range: 25:5			Min Range: 0, Max Range: 25.5				
Plux Weakening Ki (FLUX_WEAKENING_Ki) 0	•	Close loop acceleration when estimator is not yet fully aligned ( Hz / 0.1	Maximum Power [Maximum Power] 100	•			
Enable Maximum Torque Per Ampere Operation (MTPA)	EN]	Response_to_change_of_DIR_pin_status [DIR_CHANGE_MODE] Follow motor stop options and ISD routine on detecting DIR change	VIII Hange O, Max Range, 3070 FLUX WEAKENING REFERENCE [FLUX_WEAKENING_REF 70%	FERE			
- Control mode [CTRL_MODE]	~						

图 5-5. 功率控制设置



### 5.6 MTPA 调优

每安培最大扭矩 (MTPA) 是 MCF8329A 中的一项特性,用于尽可能提高凸极电机每安培电流产生的扭矩。要启用 MTPA,请将 MTPA\_EN 设置为 1b,并通过设置 Lq 和 Ld 值(如果器件特定数据表中提供了这两个值)将 SALIENCY\_PERCENTAGE 设置为非零值。

0		1 T				AA						Show Advance Settings Show Modified Registers Auto Read All Registers	
U		IVIOTOR						losed Loop	p Mo	tor Stop			
	Control Configur	ation-M	tor Param	eters									^
	Malas Dana Decisiona				La della				T at Sector			New PERF Commencement of Cardinal Street	
	0.88	MUTUR_NES		0	0.07			0	0.07		۵	35	0
	Min Range: 0, Max Range	20			Min Ra	nge: 0.016, Max Range: 20			Min Range: 0, Max Range: 20			Min Range: 0, Max Range: 2000	
	Mariana Parad Biby P	07701											
	397 83333333333333	3		•									
	Min Ranga: 0. Max Range Control Configur Control Configur	ration- O	oen Loop ontrol Faul	t Settings									~
	Min Rarge 0. Max Range Control Configur Control Configur	ation- O ation- C ation- C	pen Loop ontrol Faul osed Loop	t Settings									~
	Mn Rarger 0. Max Range Control Configur Control Configur Control Configur Closed loop acceleration 60	ation- O ation- C ation- C ation- C	oen Loop ontrol Faul osed Loop	t Settings	Closed	Isoo deceleration select [C Closed loop decel	L_DEC_CONFIG eration defined by CL	_DEC	Closed loop deceleration rate (C 7.5	L_DECI	~	Recentioner for current is and id table (CURR_LCOPP 0.73	~ ~ 
	Mn Rarger 0. Max Range Control Configur Control Configur Control Configur Control Configur	ation- O ation- C ation- C	pen Loop ontrol Faul osed Loop	t Settings	Closed	icco deceleration select (C Closed loop decele	L.DEC_CONFICI eration defined by CL	_DEC	Closed loop deceleration rate [0 7.5	L_DECI	~	No coefficient for current is and id lease (CURR_LCOP 073 Mon Respec 9, Max Range 235	~ ~ ~
	Min Range 0, Max Range Control Configur Control Configur Control Configur Control Configur	ation- O ation- C ation- C ation- C	ontrol Faul osed Loop	t Settings	Closed	loca deceleration select (C Closed loop decele Movert for cosed loop (SPD)	L_DEC_CONFIG  aration defined by CL	_DEC	Closed loop deceleration rate (C 7.5 ~ R coefficient for sceed loop 199	L_DEC)	~	No conflictent for current is and of boos (CURR_LLCOP 0.73 Min Brange & Mail Range 215 - Reference for Strange PL Loop (MULIUMT)	, , , , , , ,
	Min Rarget & Main Range Control Configure Control Configure Control Configure Control Configure Control Configure Control Configure 60	ation- O ration- C ration- C ration- C	pen Loop ontrol Faul osed Loop	t Settings	Closed Kp com 1.28	itoo deceleration select [C Closed loop decels ficient for speed loop (SPD	Loce_conFig pration defined by CL _Loce_KP	_DEC	Closed loop deceleration rate (C 7.5	L_DEC)	~	No conflorent for convert is per of level (CURR, LOOP, O.7.3)           Mr. Broger, R. Mair, Rouge 265           Reference for Stronge PL Loop (A) (SURT)           90 5%	
	Min Rarge & Mar Range Control Configur Control Configur Control Configur Control Configur Control Configur Control Configur Control Configur Control Configur	: 2730.5 ration- O ration- C ration- C ration- C	pen Loop ontrol Faul osed Loop	t Settings ~ ~	Closed Kp corr 1.28 Min Ra	Itoo deceleration select (C Closed loop decele ficient for speed loop (SPD rgs: 0, Max Range: 2.55	L_DED_CONFIG anation defined by CL _LOCP_XP]	_DEC	Closed loop docrimition rate (C 7.5 No coarticiant for speed loop (SP 10 Not Range 2, 5 Nax Range 25	L_DEC)	•	- 50 eachtraint to carrier 16 and 16 toog (CUMB_LOOP 073) Tell Ranging 15 tool Ranging 255 References for Toroug PTLoog (KU)(LMRT) 90 %	(%) (%) (%)
	Mm Rarget & Mar Ranget Control Configur	2738.5 ration- O ration- C ration- C	Den Loop Dontrol Faul osed Loop URR_LOOP_K(	t Settings	Closed E Kp cost 1.28 Min Ra C Flax W	lico deceleration select (C Closed loop docele ficient for speed loop (SPD nge: 0, Maic Range: 2.95 selecting to (PLLIX, VPEAK	L_DEC_CONFIG] pration defined by CL _LOC(P_KP)	_DEC	Closed loop decementary rate (C 75 10 10 10 10 10 10 10 10 10 10 10 10 10	L_DEC)	• )	Na conflictent for current is and to loss (CURR_LOOP 0.73) Min Single & Main Ringle 2015 Reference for thomas Pri Loog AV (201011 90 %) - Maansum Picare (Mainsum Picare)	(%) (%) (%)
	Min Range & Main Range Control Configur Control Configur Co	ation- C ation- C ation- C ation- C ation- C ation- C ation- C ation- C ation- C	pen Loop ontrol Faul osed Loop usr_Loop_ks	t Settings	Closed Kp coe 1.28 Min Ra Flac W 0	1000 decemention select (C Closed loop decell ficient for speed loop (SPD rgel 0, Max Rangel 2.55 eachemic (R (FLUX, WEAK)	L_DEC_CONFIG] aration defined by CL LOCP_XP]	_DEC	Closef loop provimition rate (C 7.5 No sufficient for streed loop (SP 10 Close accession of the streegy 25.5 Close Range 6.5 Note Range 25.5 0.1	L_DEC) O_LOOP_K() smatter is not yet fully abor	*) ed (Hz/sec	No confloent for somet is and stress pculies, score 0,73 Min Brayse R, Main Range 265 Reference for freque PF Lang AU (SLIMT) 00 % Macman Prover (Marman Prover) 100	
	Min Range & Mais Range Control Configur Control Configur Conf	2730.5 ation- O ation- C ation- C ation	pen Loop ontrol Faul osed Loop use_Loop_ks	t Settings	Closed Control 1.28 Min Ra C Fluc W O Min Ra	Tood deceleration satisfy (C Closed Toop deceler Rotert for speed toop 19PD rgst 0, Marc Ranger 2.95 selerang K0 PLUX_VEAKI rgst 0, Marc Ranger 2550	L_DEC_CONFIGI anation defined by CL _LOCP_JKP	_DEC	Closed loop docrimition rate (C 7.5 No coefficient for speed loop (DP Non Regist 2, Main Regist 2, Solar Regis	L_DEC) D_LOOP_K() amater is not yet fully align	*) (5) ef(ht/sec. *)	40 southcast for oursel is and M loss (CURR_LOCP 0.73 More Range 1: Max Range 2:05 Reference for Tyrous PL Loss (AULANT) 90 %     40 more Plan PL Loss (AULANT) 100 March 1: Max Range 3:01	v v 197 207 207 207 207 207 207 207 207 207 20
	Min Range & Main Range Control Configure Control Configure Confi	2738.5 ation- O ation- C ation- C ation	Den Loop ontrol Faul osed Loop UBR_LOOP_K() -	t Settings	Closed The corr 1.28 Min Ra Plact W 0 Min Ra Response	Toor development which to Closed loop develo	L,DEC, CONNOL Intellin defined by CL LOCE_NPT DINNO_NT JUNE (DR_COMNOL_NC	_DEC	Closed loop decisivestion rate (C           7.5           10           10           10           10           10           10           10           10           10           10           10           10           10           10           10           10           10           10           10	21 (FLAC/VEARDING)	* * * * * *	50 sanflowt for current is and all toos (CURR_LOOP 0.73         100           60 Statistics         500         100         100           60 Statistics         500         100         100         100           60 Statistics         500         100         100         100         100           60 Statistics         500         500         100 <td>• • • •</td>	• • • •

备注

如果电机 Ld 或凸极百分比未知,则可以按照以下步骤确定近似 SALIENCY\_PERCENTAGE:

- 1. 将 SALIENCY\_PERCENTAGE 设置为 0x1h
- 2. 将 CTRL MODE 设置为电流控制模式
- 3. 提供速度命令。
- 4. 在电机旋转时,将 SALIENCY\_PERCENTAGE 值增加 1h,直到电机转速开始降低。

Mo	tor Studio File Options	Tools Help Documents				
ŵ	Search registers by name,address or bitfield	name Q Show bits		Registers +	Controls Faults	Charts Logs
0	Register Name	Address	Value	Field View	I2C CONTROLS	^
ф 11	Algorithm Configuration		~		Speed Control via I2C  I2C Target Address (GUI side)	Disabled
;:]	Fault Configuration		~		0x0	Find Address
۰,	Internal Algorithm Configuration		~	CTRL_MODE Power Control +	0% 25% 50%	75% 100%
	Hardware Configuration		^	FLUX_WEAKENING_REFERENCE	MOTOR STATUS	Auto Read Motor Status 🜑 Disable
	PIN_CONFIG	0x000000A4	0x00032000	70%	Status Select	~
	DEVICE_CONFIG1	0x000000A6	0x00000000	RESERVED	Algorithm State MOTOR_IDLE	VM Voltage 00.0 V
	DEVICE_CONFIG2	0x000000A8	0x00000000	SPD_RANGE_SELECT	Reference for Speed Loop 00.0 Hz	Speed FDBK 00.0 Hz
	PERI_CONFIG1	0x000000AA	0x00000010	ACTIVE_BRAKE_MOD_INDEX_LIMIT		
	GD_CONFIG1	0x00000AC	0x000600FC	0% *		
	GD_CONFIG2	0x000000AE	Dx00000000	ACTIVE_BRAKE_SPEED_DELTA_LIM 2.5% *		
	Fault Status		~	SELF_TEST_ENABLE		
>>	System Status		~	DIR_CHANGE_MODE		
ශ	Device Control		v	Follow motor stop options and IS * DIR_INPUT	EEPROM Controls	EEPROM ·

图 5-7. 凸极寄存器



# 5.7 Motor Studio 优化向导

有关配置 MCF8329A 以了解其他用例和优化功能的分步指导,请参阅 Motor Studio 上的 Optimization Wizards 页面。

Motor Studio File Options Tools Help Docum	ents	
Motor Pre-startup	p and Handoff Closed Loop Motor Stop	Controls Faults Charts Logs I2C CONTROLS Speed Control via I2C Disabled I2C Target Address (GUI side) 0 Find Address
Initial Speed Detection     This wizard helps Initial speed detection of motor reliable motor     resynchronization.	Unidirectional motor drive detecting           This wizard helps you in Unidirectional motor drive detecting backward spin	I2C Speed Command Percentage (%)     0.00 €       0%     25%     50%     75%     100%       MOTOR STATUS     Auto Read Motor Status To Disable
Direction and Brake pin override		Status Select         V           Algorithm State         VM Voltage           MOTOR_IDLE         90.0 V           Reference for Sneed Loop         Sneed EDBK
Motor Startup		00.0 Hz 00.0 Hz
Optimal Startup           This wizard helps you configure fast and robust motor startup.		
Open Loop and Handoff		
Gradual and smooth start up motion           This wizard helps for applications thatrequire slow and gradual startup.		
e		EEPROM Controls





### 6 故障处理

要查看 MCF8329A 报告了哪个故障,请转至 *Faults* 选项卡,并检查是否存在任何带有红色圆圈的故障。如果此 选项卡中显示了故障,请参阅下面标题类似于所报告故障的部分。

Мо	tor Studio File Options Tools Help Documents					
	Pre-Startup Motor Startup Open Loop and Handoff Closed Loop Motor Stap	2	Controls Auto Read Fault St Read Faults Cit	Faults   tatus ear Faults Cont	Charts	Logs Show Faults List
	System Level Configuration	~	CONTROLLE ABN BEMF	ER_FAULT		
٥,	Driver Configuration-Gate Driver Settings	~	-			
	Driver Configuration-Gate Driver Fault Settings	~				
	Device and Pin Configuration	~				
	Control Configuration-Reverse Drive Settings	~				
	Control Configuration-Pre-Startup	*				
	Control Configuration-Motor Stop	~				
	Control Configuration-Motor Startup Stationary	*				
	Control Configuration-Motor Parameters Extraction Tool(MPET)	~				
	Control Configuration-Motor Parameters	×				
	Control Configuration- Open Loop	~				
>>	Control Configuration- Control Fault Settings	~				
Θ	Control Configuration- Closed Loop	× 1				

图 6-1. "故障" 选项卡

### 6.1 MPET BEMF 故障 [MPET\_BEMF\_FAULT]

当测得的 BEMF 小于 STAT\_DETECT\_THR 中设置的阈值时,会报告 MPET\_BEMF\_FAULT。如果触发了此故障,请转至 Motor Studio 中的 *MPET*页面,并遵循以下建议:

- 1. 启用 MPET Open Loop Parameter Resistance。
- 2. 增大 Open Loop Current Reference 值。
- 3. 减小 Open Loop Slew Rate for MPET 值。
- 4. 如果故障仍然存在,请参阅电机参数常见问题解答,了解有关如何通过电机数据表或通过手动测量获取电机 BEMF常数的说明。找到电机的 BEMF常数值后,在 MPET页面上 Configured Values 部分的 Motor BEMF Constant 框中输入 BEMF常数值。

ଳ Motor Parameter Extr	action Tool (MPET)				>	Controls	Faults	Charts	Logs
Motor Parameters     System Settings     Accorner Speed     200.000	taximum Bus Vota 60 V	e Configuration	sult Section MPET Results	Configured Values		I2C CONTR Speed Control o I2C Target Add	OLS via 12C a ress (GUI side)	D Enabled	Circl Address
IPD Settings     IPD Current Threshold (A)     20 %     Open Loop Settings	MPET IPI Number of times IPD 1 time MPET open loop pa	ameter resistance	ET motor BEMF constant	Motor BEMF Constant	4	12C Speed Con 0% 25%	50%	ge (%) 75% 1009	0.00 Clouble
2 30% 3 User Loop Settings Closed Loop Settings Endergree for Zoniu P1 pop (4)	25%	× Sp	eed Loop Kp	Kp coefficient for speed loop		Status Select Algorithm State MOTOR_IDLE		VM Voltage 0.0000 V	·
60 % MPET Select Measure Motor Resistance Measure Motor BEMF	Measure Motor Inducta Measure Motor Mechan	Sp (C ice CD) ical CD	Write MPET R	Ki coefficient for speed loop		Reference for S	peed Loop	Speed FDBK 0.0000 Hz	
Constant Run MPET	Parameter	Log No I	s ogs available		0				
Ð									[]

图 6-2. MPET\_BEMF\_FAULT

### 6.2 异常 BEMF 故障 [ABN\_BEMF]

当估算的 BEMF 电压之间的差值超过 ABNORMAL\_BEMF\_THR 设置的阈值时,会触发此故障。如果触发了此故障,请转到 Motor Studio 中 Advanced Tuning 页面内的 Control Fault Settings 选项卡,并遵循以下建议:

- 1. 对于具有负载动态特性 (负载突然变化)的应用,建议将异常 BEMF 阈值设置为 70%,以避免触发此故障。
- 2. 如果编程的 BEMF 常数不准确,可能会触发此故障。请按照节 6.1 第 4 步中建议的步骤操作,以获得准确的 BEMF 常数。

Motor Studio File Options Tools	Help Documents		
	mdott Clased Leep Motor Stop	Show Advance Settings Show Modified Registers Auto Read All Registers	Controls Faults Charts Logs I2C CONTROLS Speed Control via I2C C Enabled I2C Target Address (GUI side)
control Configuration- Open Loop		~	0 Find Address
Control Configuration- Control Fault Setting     Hardware Lock detection current limit (A) [MV]_LOCK_JUMIT]     80 %     V	gs Look detection current threshold (A) [LOCK_ULMIT] 75 %	Lock current Limit Mode [LOCK_JLIMIT_MODE]     Fault automatically cleared after LCK_RETRY t	12C Speed Command Percentage (%)         0.00           0%         25%         50%         75%         100%           MOTOR STATUS         Auto Read Meter Status Con Disa         Disa         Disa
Lock Detection current limit deglitch time [LOCK_ILIMIT_DEG]     S ms	Lock detection retry time [LCK_RETRY]	Motor Lock Mode [MTR_LOK_MODE] Fault automatically cleared after LCK_RETRY t Y	Status Select
IPD timeout fault Enable (IPD_TIMEOUT_FAULT_EN)  Enable	IPD frequency fault Enable [IPD_FREQ_FAULT_EN]  Enable	Lock 1 (Abnormal Speed) Enable [LOCK1_EN]	Algorithm State VM Voltage 0.0000 V
Lock 2 (Abnormal BEMF) Enable [LOCK2_EN] Enable	Lock 3 (No Motor) Enable [LOCK3_EN] CDEnable	Calculated Abnormal Speed Lock Threshold (Hz) 0.00	Reference for Speed Loop Speed FDBK 0.0000 Hz 0.0000 Hz
Abnormal speed lock threshold [LOCK_ABN_SPEED]	- Abnormal BEMF lock threshold (% of expected BEMF) (ABNORMA 70%	No motor lock threshold (A) [NO_MTR_THR]	
Hardware Lock Detection current limit mode [HW_LOCK_ILIMIT_M Fault automatically cleared after LCK_RETRY t V	Hardware Lock Detection current limit degitch time [HW_LOCK_IU 2 us	[VM_UV_OV_HYS] 1V for UV and 2V for OV	
Undervoltage Fault Recovery Mode (MIN_VM_MODE) Automatic clear if voltage in bounds	Overvoitage Fault Recovery Mede (MAX_VM_MODE) Automatic clear if voltage in bounds	Automatic retry attempts (AUTO_RETRY_TIMES)	
» Control Configuration- Closed Loop		~	
Algorithm Configuration- Reference Profile	•	~	EEPROM Controls

图 6-3. ABNORMAL\_BEMF\_THR



# 6.3 锁定电流限制 [LOCK\_LIMIT]

当相电流超过 LOCK\_ILIMIT 阈值时, 会触发此故障。如果触发了此故障,请查看电机数据表中的失速扭矩,并使电机负载低于数据表中指定的失速扭矩。如果负载扭矩仍在失速扭矩范围内,请转到 Advanced Tuning 页面中的 Control Fault Settings 选项卡,并增加 LOCK\_ILIMIT 的值。

Мс	tor Studio	File Options	Tools	Help	Documents			
③ ☆ ⊗ ☆	Pre-Startup Motor	r Startup Open	Loop and Ha	ndoff	Closed Loop: Motor Stop	Show Advance Settings Show Modified Registers Auto Read All Registers	Controls F I2C CONTROLS Speed Control via I2C I2C Target Address (	Faults Charts Logs
i.	Control Configur	ation- Open Loo	р			~	0	Find Address
۰.	Control Configur	ation- Control Fa	ault Setting	gs		^	I2C Speed Command	Percentage (%)
	<ul> <li>Hardware Lock detection of 80 %</li> </ul>	current limit (A) [HW_LOCK_I	LIMIT]	- Lock dete 75 %	ction current threshold (A) [LOCK_ILIMIT]	Fault automatically cleared after LCK_RETRY t V	0% 25%	50% 75% 100% Auto Read Motor Status Disable
	Lock Detection current limit 5 ms	it degiltch time [LOCK_ILIMIT	_DEG]	Lock dete	ction retry time [LCK_RETRY]	Motor Leck Mode [MTR_LCK_MODE] Fault automatically cleared after LCK_RETRY t V	Status Select	×
	IPD timeout fault Enable (II	PD_TIMEOUT_FAULT_EN]		IPD frequ	ency fault Enable [IPD_FREQ_FAULT_EN] Enable	Lock 1 (Abnormal Speed) Enable [LOCK1_EN] Description	Algorithm State MOTOR_IDLE	VM Voltage 0.0000 V
	Lock 2 (Abnormal BEMF) I Enable	Enable [LOCK2_EN]		Lock 3 (M	o Motor) Enable [LOCK3_EN] Enable	Calculated Abnormal Speed Lock Threshold (Hz) 0.00	Reference for Speed L 0.0000 Hz	.00p Speed FDBK 0.0000 Hz
	Abnornal speed lock thresh 130%	hold [LOCK_ABN_SPEED] -	~	Abnornal 70%	BEMF lock threshold (% of expected BEMF) (ABNORMA	No motor lock threshold (A) [NO_MTR_THR]		
	Fault automatically of	current limit mode (HW_LOCI cleared after LCK_RE	K_IUMIT_M TRY t ❤	Hardware 2 us	Lock Detection current limit degitch time [HW_LOCK_IU ~	[VM_UV_OV_HYS] TV for UV and 2V for OV		
	Undervoitage Fault Recovered Automatic Cl	ery Mode [MIN_VM_MODE] ear if voltage in bound	is	Overvolta	ge Fault Recovery Mode [MAX_VM_MODE] Automatic clear if voltage in bounds	Automatic retry attempts (AUTO_RETRY_TIMES)		
»	Control Configur	ation- Closed Lo	юр			~		
Θ	Algorithm Config	uration- Referer	nce Profile			~	EEPROM Contr	ols EEPROM •

图 6-4. LOCK\_ILIMIT

### 6.4 硬件锁定电流限制 [HW\_LOCK\_LIMIT]

当相电流超过 HW\_LOCK\_ILIMIT 阈值时, 会触发此故障。如果触发了此故障,请遵循以下建议:

- 1. 使用图 6-5 中圈出的字段,将 SPD\_LOOP\_KP、SPD\_LOOP\_KI、CURR\_LOOP\_KP 和 CURR\_LOOP\_KI 设置为零。这使 MCF8329A 能够自动计算速度环路和电流环路 PI 控制器增益。
- 2. 如果故障仍然存在,请检查相间、相位与 GND 间以及 PVDD 与 GND 间的连通性,以确保这些端子之间未短 接。

or Studio File Option	is tools	Help Documents						
re-Startup Motor Startup Op	en Loop and Ha	Indott Closed Loop Michael	Show Advance Settings Show Modified Registers Auto Read All Registers	>	Controls Auto Read Fau Read Faults	Faults	Charts	Logs ow Faults L
Control Configuration-Motor Pa	rameters	~						
Control Configuration- Open Lo	оор			*				
Control Configuration- Control	Fault Settin	gs		~				
Control Configuration- Closed Closed loop acceleration rate [CL_ACC] 500	_oop ~	Closed loop deceleration select [CL_DEC_CONFIG] Closed loop deceleration defined by CL_A	CC Closed toop deceleration rate (CL_DEC) ~			8		
Kp coefficient for current in and id loop [CURR_LOO     Min Range: 0, Max Range: 255	(P_KP]	Ki coefficient for current lq and (d loop (CURR_LOOP_K)     O     Min Range: 0, Max Range: 255000	Ko coefficient for speed loop (SPD_LOOP_KP)     O     Min Range: 0, Max Range: 255			8=	- 1	
- Ki coefficient for speed loop (SPD_LOOP_Ki)	:	- Reference for Torque Pi Loop (A) (ILIMIT)	Plux Weskening Kp [FLUX_WEAKENING_KP]     1.6			No Fault	s Detected	
Min Range: 0, Max Range: 25.5			Min Range: 0, Max Range: 25 5					
Flux Westening KI [FLUX_WEAKENING_KI]	3	<ul> <li>Close loop acceleration when estimator is not yet fully aligned ( Ho 200</li> </ul>	✓ Maximum Power (Maximum Power)					
Min Range: 0, Max Range: 2550 Enable Maximum Torque Per Ampere Operation [M MTPA disabled	PA_EN]	Response_to_change_of_DIR_pin_status [DIR_CHANGE_MODE Change the direction through Reverse Dri while continuously driving the motor	Min Ranger 0, Main Ranger 2070 1 - FLUX WEAKENING REFERENCE (FLUX_WEAKENING_REFERE	]				
- Control mode [CTRL_MODE]								

图 6-5. HW\_LOCK\_LIMIT



### 6.5 无电机故障 [NO\_MTR]

当相电流在开环期间低于无电机锁定阈值的时间达到 500ms 时,会触发此故障。触发此故障时,请遵循以下建议:

- 1. 确保电机相位牢固地连接到 OUTA、OUTB 和 OUTC 测试点或连接器块 J11。
- 2. 如果故障仍然存在,请将无电机锁定电流阈值 [NO\_MTR\_THR] 设置为 5%。
- 3. 对于低电感电机,增加 PWM 开关频率 [PWM\_FREQ\_OUT]。

		Show Advance Settings	> Controls	Faults	Charts Logs
Pre-Startup Motor Startup Open Loop and Ha	ndoff Closed Loop. Motor Stor	Show Modified Registers Auto Read All Registers	Auto Read Fau Read Faults	It Status	Show Faults I
Control Configuration- Open Loop		v			
Control Configuration- Control Fault Setting	gs	~			
Hardware Lock detection current limit (A) [HW_LOCK_ILIMIT]	Lock detection current threshold (Å) [LOCK_ILIMIT]	Lock current Limit Mode [LOCK_JLIMIT_MODE]			
Lock Detection current limit deglitch time [LOCK_ILIMIT_DEG]	Lock detection retry time [LCK_RETRY]	Fault automatically cleared after LCK_RETRY t Y			
IPD timeout fault Enable [IPD_TIMEOUT_FAULT_EN]  Enable	IPD frequency fault Enable [IPD_FREQ_FAULT_EN] Enable	Lock 1 (Abnormal Speed) Enable [LOCK1_EN] Enable		8	
Lock 2 (Abnormal BEMF) Enable [LOCK2_EN] Cnable	Lock 3 (No Motor) Enable [LOCK3_EN] Cnable	Calculated Abnormal Speed Lock Threshold (Hz) 0,00		8=	
Abnornal speed lock threshold [LOCK_ABN_SPEED]	Abnormal BEMF lock threshold (% of expected BEMF) [ABNORMA 70%	- No motor lock threshold (A) [NO_MTR_THR]		No Fault	s Detected
Hardware Lock Detection current limit mode [HW_LOCK_ILIMIT_M Fault automatically cleared after LCK_RETRY t ~	Hardware Lock Detection current limit deglitch time [HW_LOCK_IL 2 us	[VM_UV_OV_HYS] 1V for UV and 2V for OV			
Undervoltage Fault Recovery Mode [MIN_VM_MODE]  Automatic clear if voltage in bounds	Overvoltage Fault Recovery Mode [MAX_VM_MODE] Automatic clear if voltage in bounds	Automatic retry attempts (AUTO_RETRY_TIMES)			
Control Configuration- Closed Loop		~			
Algorithm Configuration- Reference Profile					

图 6-6. NO\_MTR

**备注** 当电机旋转时,如果电机相位断开,MCF8329A可能会触发不同步 [LOSS\_OF\_SYNC]。



### 6.6 异常速度 [ABN\_SPEED]

当电机速度超过异常速度阈值 [LOCK\_ABN\_SPEED] 时,会触发此故障。触发此故障时,请遵循以下建议:

- 1. 根据所选的启动模式,增加对齐时间 [ALIGN\_TIME]、减小慢速首循环频率 [SLOW\_FIRST\_CYC\_FREQ] 或 增加 IPD 电流阈值 [IPD\_CURR\_THR] 和 IPD 重复时间 [IPD\_REPEAT]。
- 2. 减小开环加速 A1 [OL\_ACC\_A1] 和开环加速 A2 [OL\_ACC\_A2]。
- 3. 减小闭环加速 [CL\_ACC]。

Noto	or Studio	File	Options	Tools	Help	Documents							
а Э # Р	Pre-Startup	or Startup	Open La	Dop and Han	doff	Closed Loop.	Motor Stop	Show Advance Settings Show Modified Registers Auto Read All Registers	×)	Controls Auto Read Fau Read Faults	Faults	Charts I	Logs
©` 	Motor startup options (M	<b>ITATION-N</b>	otor Startu	ip Station	Align or si	ow first cycle current ramp rate [Ab	LIGN_SLOW_RAMP_R	- Align time (ALIGN_TIME)	Î				
	Align or slow first cycle o 20 %	current limit (A)	(ALIGN_OR_SLO)	V_CURR	IPD Clock 100 Hz	Frequency [IPD_CLK_FREQ]	*	IPD Current Threshold (A) [IPD_CURR_THR]					
	IPD release mode (IPD_ Disable	RLS_MODE]			PD advar	ce angle [IPD_ADV_ANGLE]	~	Number of times IPD is executed [IPD_REPEAT]					
	Align Time [ALIGN_ANG 0 deg	GLE]		~	Calculated F 0.00	requency of First Cycle (Hz)		<ul> <li>Frequency of first cycle in close loop startup (% of MAX_SPEED) [</li></ul>			8		
	Starting frequency of firs	st cycle (FIRST	CYCLE_FREQ_S	EL]	IPD high i	esolution enable [IPD_HIGH_RES Enable	OLUTION_EN]						
0	Control Configu	uration-M	otor Parar	neters Ex	Extraction Tool(MPET) ~						s Detected	ted	
L	Control Configu	uration-M	otor Parar	neters					~				
	Control Configu	uration- C	Open Loop						~				
»	Control Configuration- Control Fault Settings v												
2	Control Configuration- Closed Loop ~												
	Algorithm Confi	iguration	- Referenc	e Profile					~				

图 6-7. ABN\_SPEED

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