# 主題: **HDT** 驅動器的電子凸輪應用, 其中的 **CAM Engagement** 設定

Date: May 27th, 2021, Friday

本文針對 **HDT TOMCAT** 驅動器的電子凸輪 **Electric CAM** 應用, 其中的 **CAM Engagement** 設定, 說明設定方法及物理義意, 在各式需要電子凸輪, 如飛剪~**FLY CUT** 應用, 提供 **HDT TOMCAT** 驅動器的設定流程.

PS: HDT 電子凸輪及 Fly Cut 等相關應用, 請參閱文檔: 5f, 5G, 5H, 5J, 及 HDT Modbus Manual 等說明.

HDT TOMCAT 驅動器的電子凸輪 **Electric CAM** 共有 **3** 個階段或過程,

(1) **CAM engagement,**

(2) **Cam execution,**

(3) **CAM disengagement,**

上述的 **Electric CAM** 的 **3** 個階段過程, 請參閱 **HDT Modbus Manual, page 101, 3.14.2** 的說明.
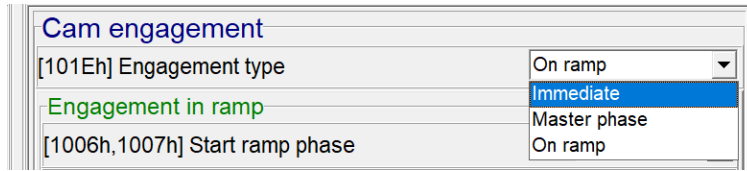
**3.14.2** 的文字結錄如下所示.

## 3.14.2 Electronic cam parameters

Essentially, the *Electronic cam* functioning can be divided in 3 phases:

1. *Cam engagement*: during this phase the slave speeds up until it reaches the speed of the master reference, and after that it could start excecuting the electronic cam;

2. *Cam execution*: during this phase the slave executes the position profile obtained by points set on the cam table. This table maps the reference position received by the master with the target position that the slave must reach. By putting several points together, the profile of the cam is drawn. The electronic cam could be executed in one of the following ways:

   - *"Cyclic"*: the electronic cam will be endlessly repeated, to stop it the bit 5 of the status word has to be lowered to 0. After the stop the disengagement phase starts, the axis will be stopped with the method set on the parameter *"Cyclic disengage mode"*.

   - *"Acyclic"*: in this mode the electronic cam will be repeated only for the number of cycles set on the parameter *"Num cams"*. After the end of the last cam, the disengagement phase starts automatically in the way set on the parameter *"Acyclic disengage mode"*. To make the slave start again you have to switch the bit 5 of the *Status word* to 0 and then switch it again to 1.

3. *Cam disengagement*: during this phase the slave is disengaged from the master reference and is stopped with the mode set on the parameters previously cited.

With the *electronic cam* mode you can also perform the functions of *Home position* and *Jog*, in order to repostion the slave axis. This table lists the parameters used to command the motor in the *Electronic Cam* mode.

本文說明 **CAM engagement** 的設定方法及相關的物理義意, 共有 **Immediately, Master phase, On ramp** 等 **3** 個方法.

其中 **immediately** 容易引起機台振動, 除非 **Master** 和 **Slave** 一定一起從靜止開始運動, 否則均可以用其他 **2** 種方式來做 **CAM engagement.**

Cam engagement
| [101Eh] Engagement type | On ramp ▼ |
| --- | --- |
| Engagement in ramp | Immediate |
| | Master phase |
| [1006h,1007h] Start ramp phase | On ramp |

1. HDT 驅動器 Slave 的硬體接線及訊號型式, J4 的 pins 11~14, 請參閱 HDT TOMCAT Manual, page 36 說明, 如下所示:

## 5.11 Frequency optoinsulated digital input

The drive allows an optoinsulated connection for frequency speed reference input:

1. DIRECTION / CHA / CCW data input.
2. PULSE / CHB / CW data input.

LINE DRIVER connection is available upt to +5V; for NPN and PNP connection, signal voltage must be lower than +30V, or equals.

In some condition, an external resistor is needed for the connection (it's recommended to position it on drive size, as shown in picture below). Anyway, do not exceed input voltage threshold (+30V).

**Failure to observe this note could lead to drive damage.**

In order to prevent high frequency noise, earth connected shielded cables are recommended; connect shield to Power Earth both on drive side and source side.

Different connection topologies about **frequency speed reference input** are shown below:



External resistor selection ($R_{ext}$) is in function of Vcc supply voltage value. Refer to following table:

| | Logic Supply Vcc | | |
| --- | --- | --- | --- |
| | +12V | +24V | +5V |
| **Rext** | 680Ω - ¼ Watt | 1.8kΩ - ½ Watt | 0Ω |
| **Line Driver** | Not available | Not available | √ |

**Electric CAM** 有 **3** 個階段過程**, CAM engagement, Cam execution, CAM disengagement,** 如 **HDT Modbus Manual page 101** 的說明**,** 如下所示**.** 本文說明 **CAM engagement** 的設定方法及相關的物理義意**.**

### 3.14.2 Electronic cam parameters

Essentially, the **Electronic cam** functioning can be divided in 3 phases:

1. **Cam engagement**: during this phase the slave speeds up until it reaches the speed of the master reference, and after that it could start excecuting the electronic cam;

2. **Cam execution**: during this phase the slave executes the position profile obtained by points set on the cam table. This table maps the reference position received by the master with the target position that the slave must reach. By putting several points together, the profile of the cam is drawn. The electronic cam could be executed in one of the following ways:

   - "**Cyclic**": the electronic cam will be endlessly repeated, to stop it the bit 5 of the status word has to be lowered to 0. After the stop the disengagement phase starts, the axis will be stopped with the method set on the parameter "**Cyclic disengage mode**".

   - "**Acyclic**": in this mode the electronic cam will be repeated only for the number of cycles set on the parameter "**Num cams**". After the end of the last cam, the disengagement phase starts automatically in the way set on the parameter "**Acyclic disengage mode**". To make the slave start again you have to switch the bit 5 of the *Status word* to 0 and then switch it again to 1.

3. **Cam disengagement**: during this phase the slave is disengaged from the master reference and is stopped with the mode set on the parameters previously cited.
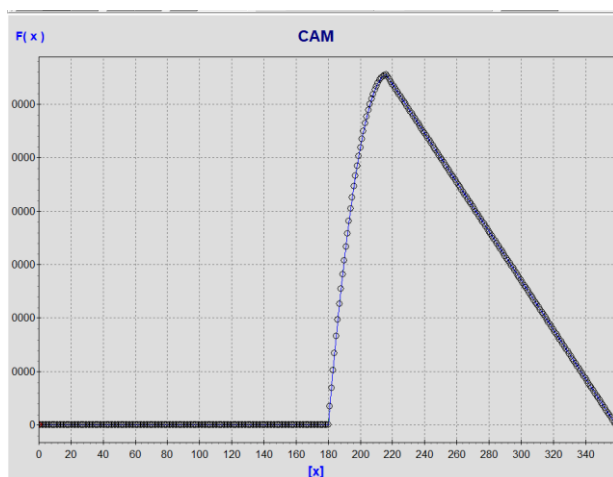
With the **electronic cam** mode you can also perform the functions of **Home position** and **Jog**, in order to repostion the slave axis. This table lists the parameters used to command the motor in the **Electronic Cam** mode.

2. 執行 CAM Engagement 前, 要注意 2 件事:

**(1)** **Salve** 要歸 **home,** 這樣才看得出 **Slave** 的實際移動的起始位置

**(2)** **[28] INPUT Slave Syn.** 的 **[101Ch] Correc. Slave mod.** 要關掉(不啟動)**,** 避免 **Slave module meas.** 量測到錯誤的 **increments,** 造成誤判**.**

**PS: HDT** 電子凸輪及 **Fly Cut** 等相關應用**,** 請參閱文檔**: 5G, 5H, 5J,** 及 **HDT Modbus Manual** 等說明**.**



Cam Profile

本文說明**CAM engagement**的設定方法及相關的物理義意，共有**Immediately, Master phase, On ramp**等**3**個方法.
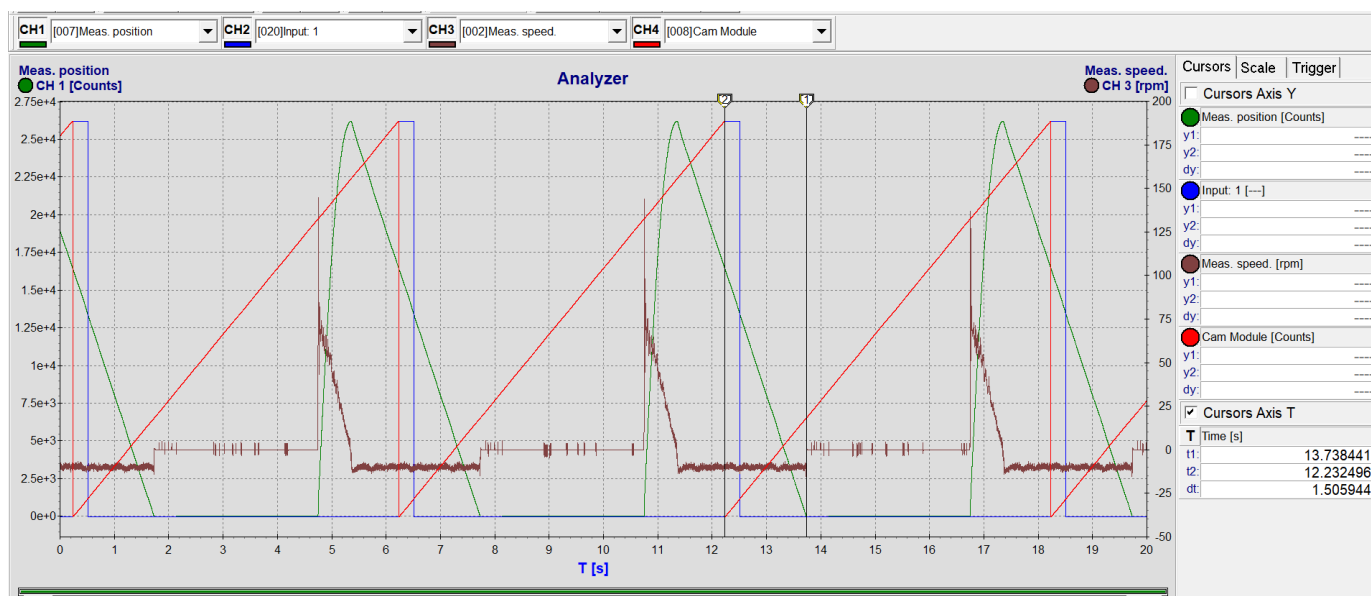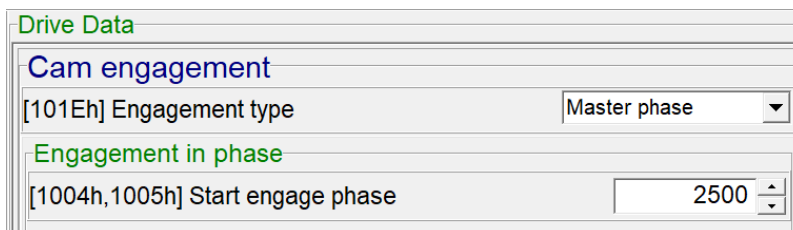
　　　　其中**immediately** 容易引起機台振動，除非**Master**和**Slave**一定一起從靜止開始運動，否則均可以用其他**2**種方式來做**CAM engagement.**
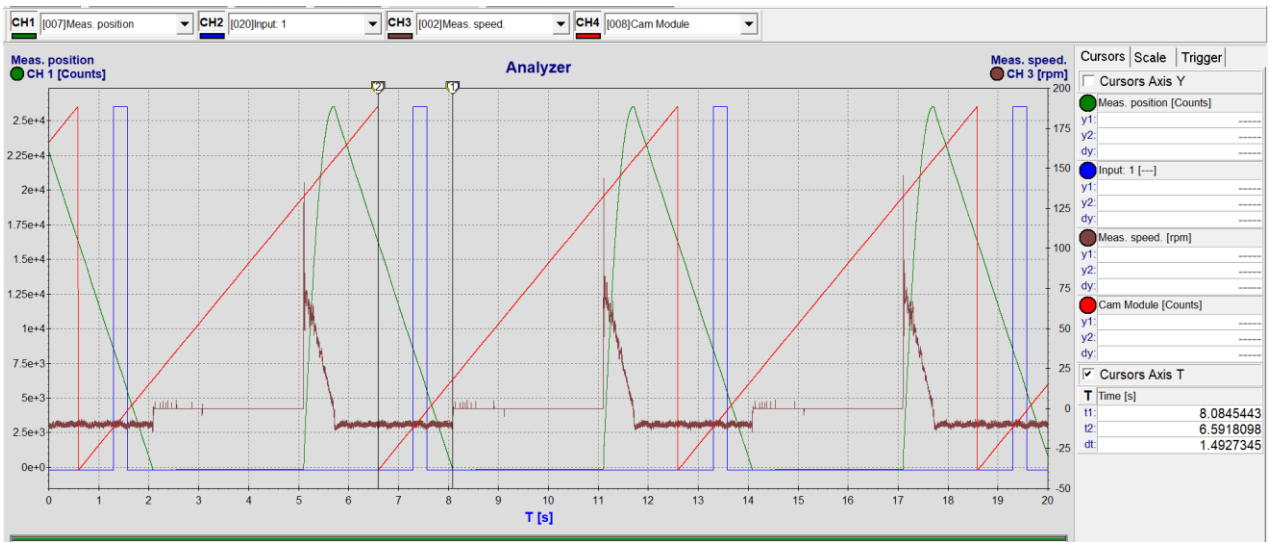
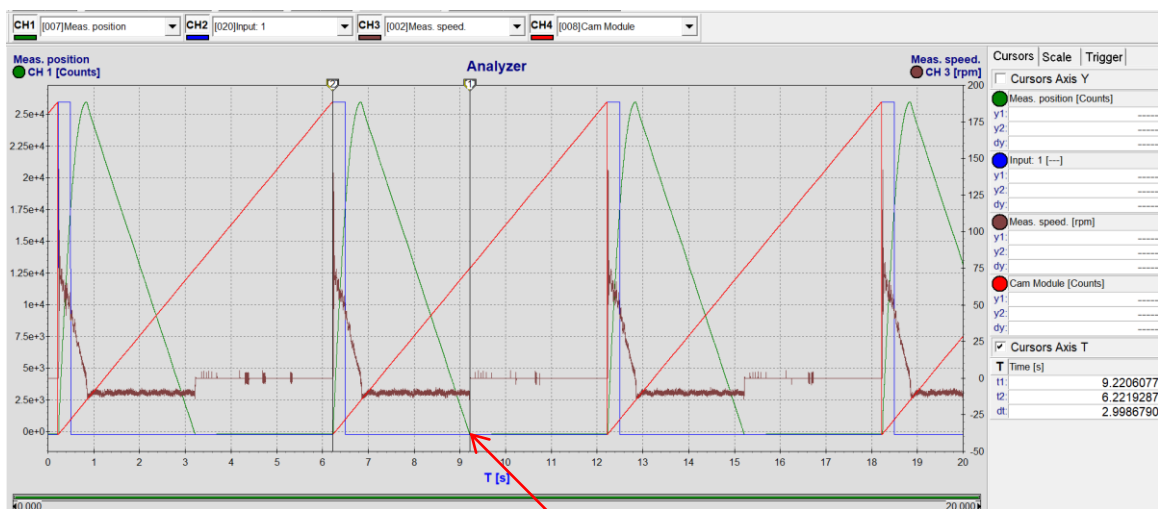## 3. [101Eh] Engagement type = Master phase

(1) [1004h, 1005h] Start engage phase = 2500

PS: [101Ch] Enable Synchronism 開不開都樣，<u>是依 **CAM profile** 工作</u>，其中<u>單位是 **counts, 1ppr=4 counts**</u>

開[101Ch]比較好辨識.

2500 counts = 625 pulse

一個週期是 360 度, 6 sec.

625/2500 = 1/4

6/4 = 1.5 sec, 約 90 度時➔ Master phase = 90 度時, 做 Engagement (紅線是 Master)

所以, 也可以做 shift 來使用


**(2) [101Eh] Engagement type = Master phase**

**[1004h, 1005h] Start engage phase = 5000**

PS: [101Ch] Enable Synchronism 開不開都樣, 是依 **CAM profile 工作, 其中單位是 counts,** 1ppr=4 counts

開[101Ch]比較好辨識.




5000 counts = 1250 pulse

一個週期是 360 度, 6 sec.

1250/2500 = 1/2

6/2 = 3 sec, 約 180 度時➔ Master phase = 180 度時, 做 Engagement (紅線是 Master 的 CAM profile)

所以, 也可以做 shift 來使用

## 4. [101Eh] Engagement type = On ramp

**(1) Case 1:**

**[1006h, 1007h] Start ramp phase = 5000**

➔ Slave 開始加速時, master 的位置. 就是先走一段距離後, 再開始加速. 單位是 count. 1 pulse per round (ppr)= 4 counts.

⇨ 5000/4 = 1250, 所以就是 master 走半圈.

**[1008h, 1009h] Master space = 2500**

➔ Slave 加速段時 master 的距離. Slave 在此 master 距離完成加速, 並且完成 Engagement, 此時 master 的位置, 要開始進入 Cam profile. 單位是 count. 1 pulse per round (ppr)= 4 counts.

⇨ 2500/4 = 625, 所以就是 master 再走 1/4 圈, 這 1/4 圈是加速並且 engagement, **master 再走完這 1/4 圈後**, 就進入 CAM Profile.

**[100Ah, 100Bh] Slave space = 26214**

➔ Slave 加速段時, Slave 自己移動的距離. 看來可以用來 shift Slave 的位移. 單位是 increment. 65536 increments = 1 turn of motor.
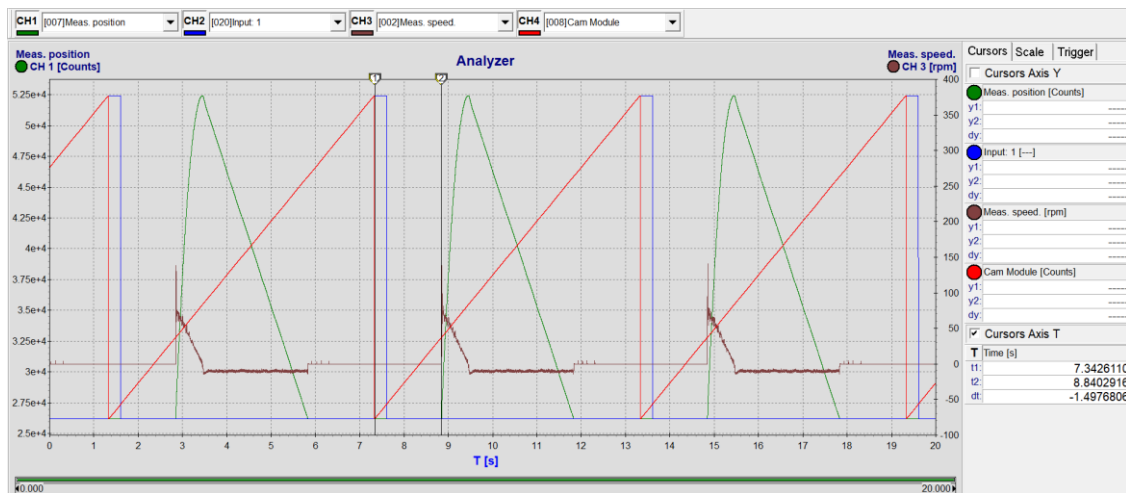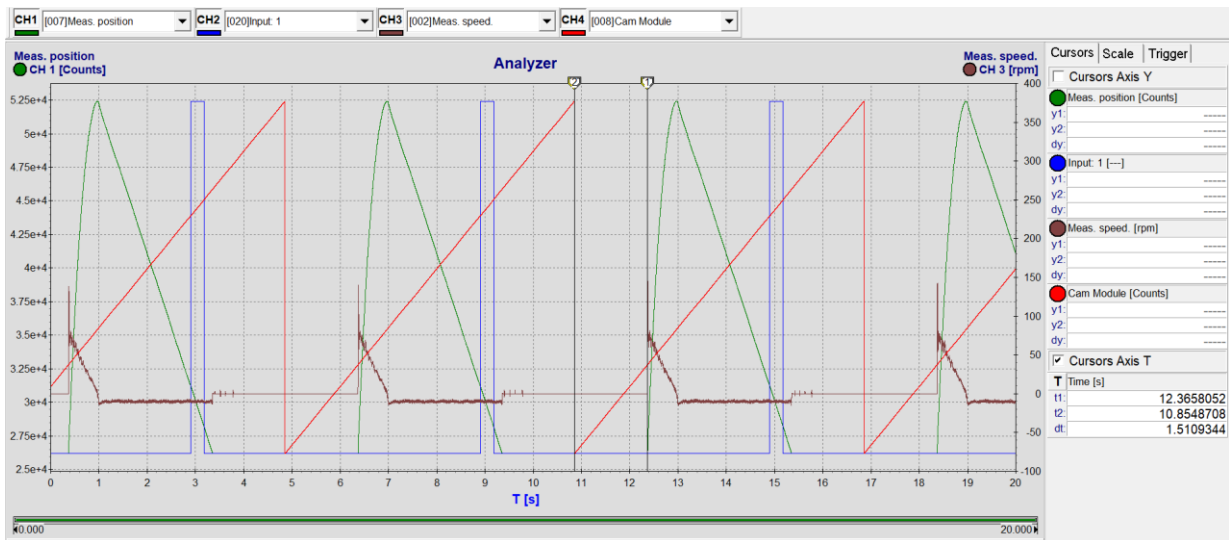
⇨ (26214/65536)*360 = 144 度, 就是在加速段, Slave 自己 shift 144 度後, 再進入 Cam profile



PS: [101Ch] Enable Synchronism 開不開都樣, **是依 CAM profile 工作**, 開[101Ch]比較好辨識.



Engagement 結束, 進入 CAM Profile

## (2) Case 2
### [101Eh] Engagement type = On ramp

**[1006h, 1007h] Start ramp phase = 2500**

➔ Slave 開始加速時, master 的位置. 就是先走一段距離後, 再開始加速. 單位是 count. 1 pulse per round (ppr)= 4 counts.

⇨ 2500/4 = 625, 所以就是 master 走 **90 度, 1/4 圈**.
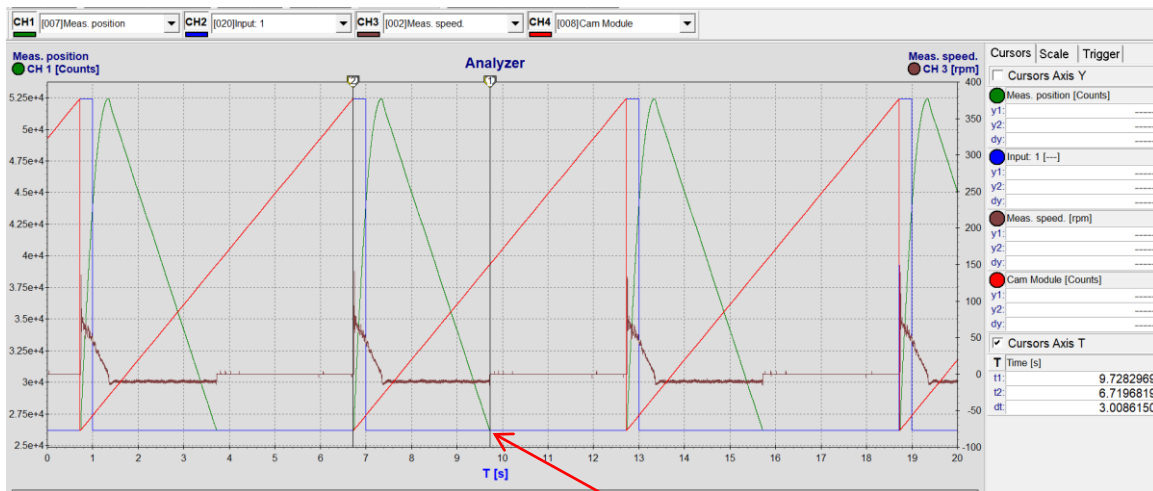
**[1008h, 1009h] Master space = 2500**

➔ Slave 加速段時 master 的距離. Slave 在此 master 距離完成加速, 並且完成 Engagement, 此時 master 的位置, 要開始進入 Cam profile. 單位是 count. 1 pulse per round (ppr)= 4 counts.

⇨ 2500/4 = 625, 所以就是 master 再走 1/4 圈, 這 1/4 圈是加速並且 engagement, **master 再走完這 1/4 圈後**, 就進入 CAM Profile.
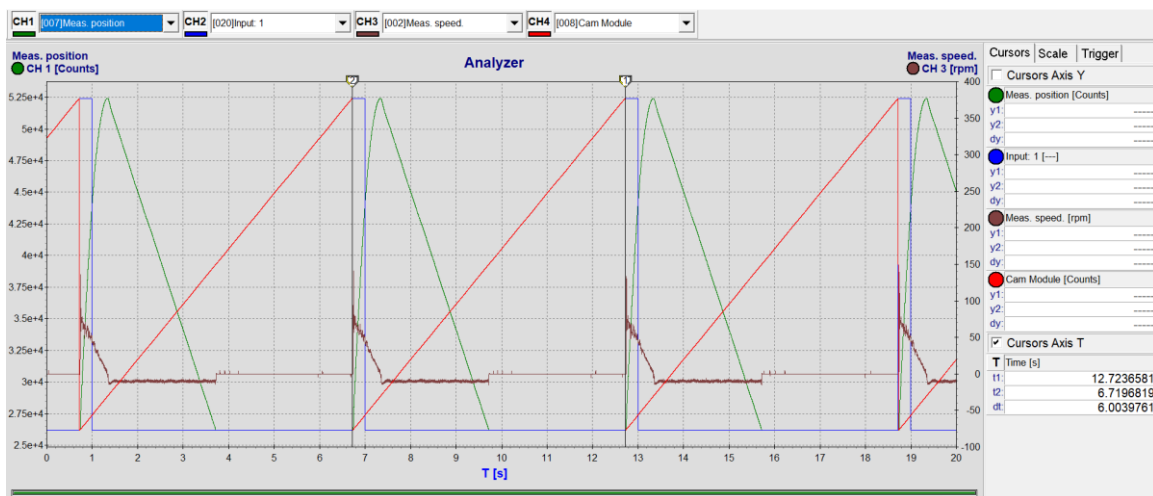
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➔ Slave 加速段時, Slave 自己移動的距離. 看來可以用來 shift Slave 的位移. 單位是 increment. 65536 increments = 1 turn of motor.

⇨ (26214/65536)*360 = 144 度, 就是在加速段, Slave 自己 shift 144 度後, 再進入 Cam profile

Engagement 結束, 進入 CAM Profile



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謝謝您的選用

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