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Computer Interface for MK2 Chopper Electronics

Communication Specification and Command Reference.

1. Communication Settings and RS232 connections.

1.1. All data transfer is done asynchronously in ASCII code over a RS232 link. Each character consists of 7 bits of upper case ASCII data, 1 Start bit, 1 Parity bit, and 1 Stop bit. RS-232 connection details are shown below:-

D-Type 9 Pole Socket.	Description.
Pin 2	Computer Interface Transmit.
Pin 3	Computer Interface Receive.
Pin 5	Signal Ground.

1.2. The parity bit and baud rates can be set up via SW1 DIL switch as detailed below:-

Baud Rate	SW1-1	SW1-2
1200	OFF	OFF
2400	OFF	ON
4800	ON	OFF
9600	ON	ON

PARITY	SW1-3
EVEN	ON
ODD	OFF

2. Command Reference.

2.1. Write Commands general format and listing.

These are used to change various chopper settings.
Each Write Command consists of two upper case alphabetical characters and up to 5 numerical characters for chopper data. The first character is always a 'W' to signify a WRITE operation. Finally a carriage return <CR> is used to terminate the command. Examples are:-

WM50<CR> -set chopper rotor frequency to 50Hz.
WP12345<CR> -set chopper phase delay to 12345uS

Placing zeros in front of the data characters is optional, providing the data field does not exceed the maximum of 5 ASCII digits. See below for examples and command listing.

Write Commands and Examples.	Description.
WM12, WM012, WM0012, WM00012	Set Rotor Frequency to 12.5Hz.
WP8, WP08, WP008, WP0008,WP00008	Set Phase Delay to 8uS.
WR9, WR09,WR009,WR0009,WR00009	Set Rotor Position Phase Error Window to 9uS.
WS1, WS01, WS001, WS0001,WS00001	Start Chopper.
WS2, WS02, WS002, WS0002, WS00002	Stop Chopper.

NOTE: Decimal Speed data (e.g. 12.5Hz,16.67Hz) needs to be rounded down to the nearest whole number as shown in the first example above. Carriage returns are not shown in above examples.

2.2. Read Commands General Format and Listing.

These are used to read back various chopper parameters. Each Read Command consists of two ASCII upper case letters where the first letter is always a 'R' to indicate a READ operation. Finally a carriage return **<CR>** is used to terminate the command. Data returned echoes back the Read Command letters followed by the requested data and terminates with a carriage return. All read commands can be executed separately or all in one go using the Read All command (RA). Also, some Read Commands are paired with their complementing Write Commands which means they are executed automatically after a successful write command to confirm positively any chopper setting changes made.

Read Command.	Description.	Returned Data.
RF<CR>	True Rotor Frequency	RF<DDD><CR>
RG<CR>	Demanded Rotor Frequency	RG<DDD><CR>
RP<CR>	True Phase Delay	RP<DDDDD><CR>
RQ<CR>	Demanded Phase Delay	RQ<DDDDD><CR>
RE<CR>	True Rotor Phase Error	RE<DDD><CR>
RW<CR>	Demanded Rotor Phase Error Window	RW<DDD><CR>
RC<CR>	Chopper Interlocks	RC<DDDDDDDD><CR>
RS<CR>	Spectral Interlocks	RS<DDDDDDDD><CR>
RX<CR>	Error Flags	RX<DDDDDDDD><CR>
RA<CR>	Read All parameters.	All of the above.

Data field lengths shown above will be maintained by automatic insertion of leading zeros as required.

2.3. Detailed Descriptions of each command.

2.31. WM command (Write Demanded Rotor Frequency).

On 50Hz systems, the first 2 least significant data characters are taken as the demanded chopper speed. Any other digits, except leading zeros, will cause an error message to be generated. Also, non-existent chopper speeds will generate an error message. Valid chopper speeds on 50Hz systems are:- 5, 10, 12.5(12), 16.67(16), 25 and 50Hz. Valid chopper speeds on 100Hz systems are:- 12.5(12), 25, 50 and 100Hz. After successful execution of the WM command a confirmation message will returned by automatic execution of WM's complementary Read Command **RG** (Read Demanded Rotor Frequency).

2.32. RG command (Read Demanded Rotor Frequency).

This command can be executed individually, or as part of Read All (RA) or as a reply from a WM command. The format of returned data is:-

RG<DDD><CR>

Where DDD is 3 digits of Numerical ASCII data referring to the demanded rotor frequency. If the data read back from the chopper controller does not match a valid frequency code the following error message will be returned:-

RG<ERR><CR>

2.33. WP command (Write Demanded Chopper Phase Delay).

All five ASCII data digits are taken as the demanded Chopper Phase Delay setting. If leading zeros are needed to make up 5 digits, they will be added automatically. Any non-numerical characters found in the data field will generate an error message. Therefore the maximum theoretical delay is 99999uS, although in practice this is dependent on the Rotor Speed, as shown below.

Rotor Frequency (Hz)	Maximum Phase Delay (us)
5	99995
10	99995

12.5	79995
16.67	59995
25	39995
50	19995
100	09995

Invalid delay settings are **not** checked at this level by the Computer Interface processor and so, will be wrote to the chopper control electronics which will ignore them and set the Phase Delay Error Flag -see Read Error Flags Command(RX). Therefore the last valid delay setting received for the current motor speed will be preserved.
Finally the WP confirmation message will be returned by automatic execution of **RQ** (Read Demanded Phase Delay). If invalid phase delay data for the current motor speed has been sent then WP and **RQ** data will not match upon inspection.

2.34. RQ Command (Read Demanded Phase Delay).

This command can be executed individually, or as part of Read All (RA) or as a reply from a WP command. The format of returned data is:-

RQ<DDDDD><CR>

Where DDDDD is 5 digits of Numerical ASCII data referring to the demanded Phase Delay in microseconds.

2.35. WR Command (Write Demanded Rotor Position Phase Error Window).

The first 3 least significant data digits are taken as the Demanded Rotor Position Error Window setting in microseconds. Any other digits, except leading zeros, will generate an error message. Also, any non-numerical characters found in the data field will generate an error message. After successful execution of the WR Command a confirmation message will be returned by automatic execution of WRs complementary Read command **RW.** Any deviations of the rotor position which fall outside the Rotor Position Phase Error Window value will dynamically set the Phase Accuracy Window Error flag. See RX (Read Error Flags) command.

2.36. RW Command (Read Demanded Rotor Phase Error Window).

This command can be executed individually, or as part of Read All (RA) or as a reply from a WR command. The format of returned data is:-

RW<DDD><CR>

Where DDD is 3 digits of Numerical ASCII data referring to the Demanded Rotor Phase Error Window in microseconds.

2.36. WS Command (Stop/Start Chopper).

To Start the Chopper use WS1<CR>
To Stop the Chopper use WS2<CR>

Note: No positive confirmation of this commands successful operation can be provided as the chopper run down time could be as long a five minutes whilst the run up time takes about 30 seconds.
A false echo back of this command has not been provided for reasons of safety. Therefore if no error message is returned it can be assumed that the message has at least been understood by the Computer Interface Processor. If confirmation of chopper rotation status is required the RF (Read True Rotor Frequency) command is recommended.

Using the Start Command (WS1) with Write Demanded Rotor Speed Command (WM<DDD>).

With the chopper already running it is possible to issue a Write Demanded Rotor Frequency change command which will:-

A. Load the new frequency data into the buffer store.
B. Read this frequency data back to the terminal with a RG command.
C. Stop the chopper automatically. (Takes about 5 minutes).
D. Change Demanded Rotor Frequency setting.
E. Finish with chopper stopped.

To protect the motor drive from overloading, any Start Command (**WS1**) sent while the chopper is running (5 minute run down time in this case) will be ignored. Also, the system would not have reached step **D** which performs the actual speed change. So how do we know when to send a start command? One method would be to monitor the True Rotor Frequency using the **RF** command (see section 11) until a value of zero is returned and then send the Start Command (**WS1**). A much more efficient alternative is to use the automatic start feature which will re-start the chopper with the new speed selected when step **E** above is reached. This is achieved by sending a Start Command no later than 1 second after receiving the RG<DDD> which occurs in step **B** (see above). This stores the Start Command which is then used to re-start the chopper automatically when step **E** is reached.

The sequence of commands for a speed change with an automatic re-start will therefore be:-

1. Send **WM<DDD>** to demand new motor speed.
2. Receive **RG<DDD>** (This will happen automatically, see **2.31** and **2.32**).
3. Send **WS1** within 1 second of receiving **RG<DDD>** above.

2.37. RF (Read True Rotor Frequency).

This command can be executed individually or as part of Read All (RA) command. The format of returned data is:-

RF<DDD><CR>

Where DDD is 3 digits of Numerical ASCII data referring to the actual or instantaneous running speed of the Chopper in Hz.

2.38. RP (Read True Phase Delay).

This command can be executed individually or as part of Read All (RA) command. The format of returned data is:-

RF<DDDDD><CR>

Where DDDDD are 5 digits of Numerical ASCII data referring to the actual or instantaneous Phase Delay of the Chopper in microseconds. Any new delay setting demanded by the WP (Write Demanded Phase Delay) command will take some time to be reached as the actual phase delay is incremented or decremented slowly until the Demanded Phase Delay is reached. Therefore the RP command can be used to monitor how far the actual or true phase delay has progressed towards the demanded phase delay at any given time.

2.39. RE (Read True Rotor Phase Error).

This command can be executed individually or as part of Read All (RA) command. The format of returned data is:-

RE<DDD><CR>

Where DDD refers chopper phase error in microseconds.

2.40. RC (Read Chopper Interlocks Status).

This command can be executed individually or as part of Read All (RA) command. The format of returned data is:-

RC<BBBBBBBB><CR>

Where <BBBBBBBB> are ASCII ones and noughts which represent the following interlock conditions:-

B0- Indicates the type of chopper system, 1=50Hz, 0=100Hz.
B1- Indicates Main Clock loss, 1=CLK loss, 0=OK.
B2- Indicates Bearing Temp.1, 1=Overheat, 0=OK.
B3- Indicates Bearing Temp.2, 1=Overheat, 0=OK.
B4- Indicates Motor Temperature, 1=Overheat, 0=OK.
B5- Indicates Chopper Overspeed, 1=Overspeed, 0=OK.
B6- Not Used.
B7- Not Used.

2.41. RS (Read Spectral Drive/Indramat Drive/Cortina Drive Interlocks Status).

This command can be executed individually or as part of Read All (RA) command. The format of returned data is:-

RS<BBBBBBBB><CR>

Where <BBBBBBBB> are ASCII ones and noughts which represent the following interlock conditions:-

B0- Indicates Inverter Ready, 1=Ready, 0=Not ready (Cortina Drive).
B0- Indicates Drive Running 1=Running, 0=Not Running (Indramat Drive).
B1- Indicates Motor running, 1=Motor running, 0=Motor not running. (Cortina Drive).
B1- Indicates Reg. Mode, 1=Reg. Mode. (Indramat Drive).
B2- Indicates External Fault 1=Fault, 0=OK. (Spectral Drive).
B2- Indicates "In Sync." 1=Sync. (Cortina/Indramat Drives)
B3- Not Used.
B4- Not Used.
B5- Not Used.
B6- Not Used.
B7- Not Used.

2.42. RX (Read Error Flags).

This command can be executed individually or as part of Read All (RA) command. The format of returned data is:-

RX<BBBBBBBB><CR>

Where <BBBBBBBB> are ASCII ones and noughts which represent the following error flags:-

B0- Indicates Phase Delay Error, 1=Wrong Delay for current Rotor Speed Setting.
B1- Indicates Phase Delay Correction Error, 1=Delay value not reached yet.
B2- Indicates Phase Accuracy Window Error, 1=Phase Error outside Accuracy Window.
B3- Not Used.
B4- Not Used.
B5- Not Used.
B6- Not Used.
B7- Not Used.

2.43 T1 (Test Mode) Command.

In this mode all commands are echoed back to the terminal with full descriptions of

actions taken and values read back. This should only be used for diagnostic purposes. Also, typing **??<CR>** in this mode will send back a help screen. Use T1 to toggle this mode ON or OFF.

2.44 RA (Read All) Command.

This performs all read commands at once. This could possibly be used to update a dashboard type display.

3. Error Codes.

A brief description of the error codes is given below.

Computer Interface Error Codes				
Error Description.	**Returned Error Code.**	**Error LED Code on front panel.**		
		D6	**D7**	**D8**
Wrong Parity.	**NONE**	**ON**	**OFF**	**OFF**
Stop bit Missing.	**NONE**	**OFF**	**ON**	**OFF**
Command too long.	**ER1**	**ON**	**ON**	**OFF**
Command too short.	**ER2**	**OFF**	**OFF**	**ON**
Data not recognised	**ER3**	**ON**	**OFF**	**ON**
Bad Command/Missing Data	**ER4**	**OFF**	**ON**	**ON**