MYOSTAT MOTION CONTROL INC.

CM2 – 600W
V3.20 X007-3 Firmware
CM2 – 400W
V3.12f X007-3 Firmware

Expanded MODBUS RTU Functionality Guide

Version 1.7

December 19th, 2011

Introduction

This document provides an overview of the expanded MODBUS RTU functionality included in the Cool Muscle 2 firmware release 3.12f X007-3. This document assumes the reader is familiar with the MODBUS communications protocol specification as defined by the Modbus Organization, Inc. (www.modbus-ida.org). The X007 firmware provides the MODBUS functionality described here as well as that documented in Section 5.6 of the CM2 CML User's Guide. Note the Cool Muscle 2 firmware release X007-3 is only available and supported for use in applications directly authorized by Myostat Motion Control Inc. staff.

Expanded Read/Write Access

The principal update included in the X007 firmware release is the addition of read and write access to a variety of motor parameters via MODBUS registers. Specifically the motor parameters are available as signed 32-bit MODBUS holding registers. Note the X007 firmware release does not provide support for read or write requests to 16-bit holding registers. [The X007 firmware does not allow single point read/write access to the upper or lower word of the aforementioned 32-bit holding registers.]

Two Channel MODBUS RTU Slave Support

The X007 firmware updates allows for simultaneous MODBUS RTU connectivity on each of the Cool Muscle 2 serial communications channels (UART0, UART1). As such the Cool Muscle 2 can serve as a slave device to two separate MODBUS RTU master devices and even serve as a bridge between the two networks. The relevant configuration parameters included in the X007 firmware is included in the table below.

Parameter	Description	Range
K81	UART0 MODBUS Address	0 … 255
K84 (3.12f X007-3) K83 (3.20 X007-3)	UART1 MODBUS Address	-255 … 255

Note: Setting K84 to a negative value will disable MODBUS Slave communications on UART1.
Note: Setting K84 to zero will enable MODBUS Master communications on UART1.
Note: Setting K81 to zero will disable MODBUS Slave communications on UART0 **and** UART1.
Note: Parameter K84 cannot be written to via MODBUS on UART1.

Flexible Data Encoding

The MODBUS protocol clearly defines that all 16-bit register contents be transmitted in "Big-Endian" format. The "Big-Endian" convention states that when a numerical quantity larger than a single byte is transmitted, the most significant byte is sent first. However the MODBUS protocol does not establish a data encoding standard for transmission the pair of 16-bit words which comprise a 32-bit holding register. As such the X007-2 provides flexible options for data encoding via the motor parameter K85 and X007-3 through K87.

K85 (3.12f X007-3) K87 (3.20 X007-3) Parameter Setting	UART0	UART1
0	Big Endian	Big Endian

1	Little Endian	Big Endian
2	Big Endian	Little Endian
3	Little Endian	Little Endian

Broadcast Write Support

The X007 firmware release includes support for processing MODBUS broadcast mode request messages. Broadcast mode request messages allow the MODBUS master to send a request to all MODBUS slave devices. The broadcast requests are write commands which contain a MODBUS address of 0.

Reserved 16-bit "Ping" Address

Some MODBUS master devices employ a read request message to verify slave device connectivity at power on. Typically the master device requests ("Ping") the contents of a single 16-bit holding register for this purpose. The X007 firmware release will provide a valid response to a single point (16-bit) MODBUS read request at holding register address ([K78] + 1). This is the only single point (16-bit) read request the motor will process.

Write Access to Analog Output

The X007 provides write access to the analog output built into the Cool Muscle 2 series motors. The analog output set point can be written to via the MODBUS communications interface or via CML variable assignment. The analog output range of 1 – 4 VDC is linearly mapped to the set point range of {0 … 255}. Set point values beyond the aforementioned range are ignored.

The table included below provides details regarding MODBUS holding register access to the analog output.

Holding Register Address	Motor Parameter	Read Access	Write Access	Valid Range
[K78] + 55	Analog Output	Yes	Yes	0 … 255

For write access via CML variable assignment the analog output set point variable is defined as "ADO". Included below is a simple CML example which will set the analog output to ~ 2.5 VDC on execution of Program Bank 1.

V1.1="ADO"
V2.1=128

B1.1
V1.1=V2.1
END.1

Read/Write Access Table

Included below is a table which details the location and significance of motor-side MODBUS registers.

Note the addresses included below are referenced to the MODBUS data model. [1 … n]

The MODBUS PDU address is obtained by subtracting 1 from the MODBUS data model address. [0 … (n-1)]

Holding Register Address	Motor Parameter	Read Access	Write Access
[K78] + 1	Position Error (?95)	Yes	No
[K78] + 3	Motor Position (?96)	Yes	No
[K78] + 5	Motor Speed (?97)	Yes	No
[K78] + 7	Motor Torque (?98)	Yes	No
[K78] + 9	Motor Status (?99)	Yes	No
[K78] + 11	V0	Yes	Yes
[K78] + 13	V1	Yes	Yes
[K78] + 15	V2	Yes	Yes
[K78] + 17	V3	Yes	Yes
[K78] + 19	V4	Yes	Yes
[K78] + 21	V5	Yes	Yes
[K78] + 23	V6	Yes	Yes
[K78] + 25	V7	Yes	Yes
[K78] + 27	V8	Yes	Yes
[K78] + 29	V9	Yes	Yes
[K78] + 31	V10	Yes	Yes
[K78] + 33	V11	Yes	Yes
[K78] + 35	V12	Yes	Yes
[K78] + 37	V13	Yes	Yes
[K78] + 39	V14	Yes	Yes
[K78] + 41	V15	Yes	Yes
[K78] + 43	P1	Yes	Yes
[K78] + 45	P2	Yes	Yes
[K78] + 47	S1	Yes	Yes
[K78] + 49	S2	Yes	Yes
[K78] + 51	A1	Yes	Yes
[K78] + 53	A2	Yes	Yes
[K78] + 55	Analog Output	Yes	Yes
[K78] + 57	Input Status (?70)	Yes	No
[K78] + 59	Output Status (?50)	Yes	No
[K78] + 61	UART1 Node ID	Yes	Yes
[K78] + 101	CML Port [HEX]	No	Yes
[K78] + 103	CML Port [ASCII]	No	Yes
[K78] + 201	P0	Yes	Yes
[K78] + 203	P1	Yes	Yes
[K78] + 205	P2	Yes	Yes
[K78] + 207	P3	Yes	Yes
[K78] + 209	P4	Yes	Yes

Holding Register Address	Motor Parameter	Read Access	Write Access
[K78] + 211	P5	Yes	Yes
[K78] + 213	P6	Yes	Yes
[K78] + 215	P7	Yes	Yes
[K78] + 217	P8	Yes	Yes
[K78] + 219	P9	Yes	Yes
[K78] + 221	P10	Yes	Yes
[K78] + 223	P11	Yes	Yes
[K78] + 225	P12	Yes	Yes
[K78] + 227	P13	Yes	Yes
[K78] + 229	P14	Yes	Yes
[K78] + 231	P15	Yes	Yes
[K78] + 233	P16	Yes	Yes
[K78] + 235	P17	Yes	Yes
[K78] + 237	P18	Yes	Yes
[K78] + 239	P19	Yes	Yes
[K78] + 241	P20	Yes	Yes
[K78] + 243	P21	Yes	Yes
[K78] + 245	P22	Yes	Yes
[K78] + 247	P23	Yes	Yes
[K78] + 249	P24	Yes	Yes
[K78] + 251	P25	Yes	Yes
[K78] + 253	P26	Yes	Yes
[K78] + 255	P27	Yes	Yes
[K78] + 257	P28	Yes	Yes
[K78] + 259	P29	Yes	Yes
[K78] + 261	P30	Yes	Yes
[K78] + 263	P31	Yes	Yes
[K78] + 265	P32	Yes	Yes
[K78] + 267	P33	Yes	Yes
[K78] + 269	P34	Yes	Yes
[K78] + 271	P35	Yes	Yes
[K78] + 273	P36	Yes	Yes
[K78] + 275	P37	Yes	Yes
[K78] + 277	P38	Yes	Yes
[K78] + 279	P39	Yes	Yes
[K78] + 281	P40	Yes	Yes
[K78] + 283	P41	Yes	Yes
[K78] + 285	P42	Yes	Yes
[K78] + 287	P42	Yes	Yes

Holding Register Address	Motor Parameter	Read Access	Write Access
[K78] + 289	P44	Yes	Yes
[K78] + 291	P45	Yes	Yes
[K78] + 293	P46	Yes	Yes
[K78] + 295	P47	Yes	Yes
[K78] + 297	P48	Yes	Yes
[K78] + 299	P49	Yes	Yes
[K78] + 301	P50	Yes	Yes
[K78] + 303	P51	Yes	Yes
[K78] + 305	P52	Yes	Yes
[K78] + 307	P53	Yes	Yes
[K78] + 309	P54	Yes	Yes
[K78] + 311	P55	Yes	Yes
[K78] + 313	P56	Yes	Yes
[K78] + 315	P57	Yes	Yes
[K78] + 317	P58	Yes	Yes
[K78] + 319	P59	Yes	Yes
[K78] + 321	P60	Yes	Yes
[K78] + 323	P61	Yes	Yes
[K78] + 325	P62	Yes	Yes
[K78] + 327	P63	Yes	Yes
[K78] + 329	P64	Yes	Yes
[K78] + 331	P65	Yes	Yes
[K78] + 333	P66	Yes	Yes
[K78] + 335	P67	Yes	Yes
[K78] + 337	P68	Yes	Yes
[K78] + 339	P69	Yes	Yes
[K78] + 341	P70	Yes	Yes
[K78] + 343	P71	Yes	Yes
[K78] + 345	P72	Yes	Yes
[K78] + 347	P73	Yes	Yes
[K78] + 349	P74	Yes	Yes
[K78] + 351	P75	Yes	Yes
[K78] + 353	P76	Yes	Yes
[K78] + 355	P77	Yes	Yes
[K78] + 357	P78	Yes	Yes
[K78] + 359	P79	Yes	Yes
[K78] + 361	P80	Yes	Yes
[K78] + 363	P81	Yes	Yes
[K78] + 365	P82	Yes	Yes

Holding Register Address	Motor Parameter	Read Access	Write Access
[K78] + 367	P83	Yes	Yes
[K78] + 369	P84	Yes	Yes
[K78] + 371	P85	Yes	Yes
[K78] + 373	P86	Yes	Yes
[K78] + 375	P87	Yes	Yes
[K78] + 377	P88	Yes	Yes
[K78] + 379	P89	Yes	Yes
[K78] + 381	P90	Yes	Yes
[K78] + 383	P91	Yes	Yes
[K78] + 385	P92	Yes	Yes
[K78] + 387	P93	Yes	Yes
[K78] + 389	P94	Yes	Yes
[K78] + 391	P95	Yes	Yes
[K78] + 393	P96	Yes	Yes
[K78] + 395	P97	Yes	Yes
[K78] + 397	P98	Yes	Yes
[K78] + 399	P99	Yes	Yes
[K78] + 401	P100	Yes	Yes
[K78] + 403	P101	Yes	Yes
[K78] + 405	P102	Yes	Yes
[K78] + 407	P103	Yes	Yes
[K78] + 409	P104	Yes	Yes
[K78] + 411	P105	Yes	Yes
[K78] + 413	P106	Yes	Yes
[K78] + 415	P107	Yes	Yes
[K78] + 417	P108	Yes	Yes
[K78] + 419	P109	Yes	Yes
[K78] + 421	P110	Yes	Yes
[K78] + 423	P111	Yes	Yes
[K78] + 425	P112	Yes	Yes
[K78] + 427	P113	Yes	Yes
[K78] + 429	P114	Yes	Yes
[K78] + 431	P115	Yes	Yes
[K78] + 433	P116	Yes	Yes
[K78] + 435	P117	Yes	Yes
[K78] + 437	P118	Yes	Yes
[K78] + 439	P119	Yes	Yes
[K78] + 441	P120	Yes	Yes
[K78] + 443	P121	Yes	Yes

Holding Register Address	Motor Parameter	Read Access	Write Access
[K78] + 445	P122	Yes	Yes
[K78] + 447	P123	Yes	Yes
[K78] + 449	P124	Yes	Yes
[K78] + 451	P125	Yes	Yes
[K78] + 453	P126	Yes	Yes
[K78] + 455	P127	Yes	Yes
[K78] + 457	P128	Yes	Yes
[K78] + 459	P129	Yes	Yes
[K78] + 461	P130	Yes	Yes
[K78] + 463	P131	Yes	Yes
[K78] + 465	P132	Yes	Yes
[K78] + 467	P133	Yes	Yes
[K78] + 469	P134	Yes	Yes
[K78] + 471	P135	Yes	Yes
[K78] + 473	P136	Yes	Yes
[K78] + 475	P137	Yes	Yes
[K78] + 477	P138	Yes	Yes
[K78] + 479	P139	Yes	Yes
[K78] + 481	P140	Yes	Yes
[K78] + 483	P141	Yes	Yes
[K78] + 485	P142	Yes	Yes
[K78] + 487	P143	Yes	Yes
[K78] + 489	P144	Yes	Yes
[K78] + 491	P145	Yes	Yes
[K78] + 493	P146	Yes	Yes
[K78] + 495	P147	Yes	Yes
[K78] + 497	P148	Yes	Yes
[K78] + 499	P149	Yes	Yes
[K78] + 501	P150	Yes	Yes
[K78] + 503	P151	Yes	Yes
[K78] + 505	P152	Yes	Yes
[K78] + 507	P153	Yes	Yes
[K78] + 509	P154	Yes	Yes
[K78] + 511	P155	Yes	Yes
[K78] + 513	P156	Yes	Yes
[K78] + 515	P157	Yes	Yes
[K78] + 517	P158	Yes	Yes
[K78] + 519	P159	Yes	Yes
[K78] + 521	P160	Yes	Yes

Holding Register Address	Motor Parameter	Read Access	Write Access
[K78] + 523	P161	Yes	Yes
[K78] + 525	P162	Yes	Yes
[K78] + 527	P163	Yes	Yes
[K78] + 529	P164	Yes	Yes
[K78] + 531	P165	Yes	Yes
[K78] + 533	P166	Yes	Yes
[K78] + 535	P167	Yes	Yes
[K78] + 537	P168	Yes	Yes
[K78] + 539	P169	Yes	Yes
[K78] + 541	P170	Yes	Yes
[K78] + 543	P171	Yes	Yes
[K78] + 545	P172	Yes	Yes
[K78] + 547	P173	Yes	Yes
[K78] + 549	P174	Yes	Yes
[K78] + 551	P175	Yes	Yes
[K78] + 553	P176	Yes	Yes
[K78] + 555	P177	Yes	Yes
[K78] + 557	P178	Yes	Yes
[K78] + 559	P179	Yes	Yes
[K78] + 561	P180	Yes	Yes
[K78] + 563	P181	Yes	Yes
[K78] + 565	P182	Yes	Yes
[K78] + 567	P183	Yes	Yes
[K78] + 569	P184	Yes	Yes
[K78] + 571	P185	Yes	Yes
[K78] + 573	P186	Yes	Yes
[K78] + 575	P187	Yes	Yes
[K78] + 577	P188	Yes	Yes
[K78] + 579	P189	Yes	Yes
[K78] + 581	P190	Yes	Yes
[K78] + 583	P191	Yes	Yes
[K78] + 585	P192	Yes	Yes
[K78] + 587	P193	Yes	Yes
[K78] + 589	P194	Yes	Yes
[K78] + 591	P195	Yes	Yes
[K78] + 593	P196	Yes	Yes
[K78] + 595	P197	Yes	Yes
[K78] + 597	P198	Yes	Yes
[K78] + 599	P199	Yes	Yes

Holding Register Address	Motor Parameter	Read Access	Write Access
[K78] + 601	P200	Yes	Yes
[K78] + 603	S0	Yes	Yes
[K78] + 605	S1	Yes	Yes
[K78] + 607	S2	Yes	Yes
[K78] + 609	S3	Yes	Yes
[K78] + 611	S4	Yes	Yes
[K78] + 613	S5	Yes	Yes
[K78] + 615	S6	Yes	Yes
[K78] + 617	S7	Yes	Yes
[K78] + 619	S8	Yes	Yes
[K78] + 621	S9	Yes	Yes
[K78] + 623	S10	Yes	Yes
[K78] + 625	S11	Yes	Yes
[K78] + 627	S12	Yes	Yes
[K78] + 629	S13	Yes	Yes
[K78] + 631	S14	Yes	Yes
[K78] + 633	S15	Yes	Yes
[K78] + 635	A0	Yes	Yes
[K78] + 637	A1	Yes	Yes
[K78] + 639	A2	Yes	Yes
[K78] + 641	A3	Yes	Yes
[K78] + 643	A4	Yes	Yes
[K78] + 645	A5	Yes	Yes
[K78] + 647	A6	Yes	Yes
[K78] + 649	A7	Yes	Yes
[K78] + 651	A8	Yes	Yes
[K78] + 653	M0	Yes	Yes
[K78] + 655	M1	Yes	Yes
[K78] + 657	M2	Yes	Yes
[K78] + 659	M3	Yes	Yes
[K78] + 661	M4	Yes	Yes
[K78] + 663	M5	Yes	Yes
[K78] + 665	M6	Yes	Yes
[K78] + 667	M7	Yes	Yes
[K78] + 669	M8	Yes	Yes
[K78] + 671	K0	Yes	Yes
[K78] + 673	K1	Yes	Yes
[K78] + 675	K2	Yes	Yes
[K78] + 677	K3	Yes	Yes

Holding Register Address	Motor Parameter	Read Access	Write Access
[K78] + 679	K4	Yes	Yes
[K78] + 681	K5	Yes	Yes
[K78] + 683	K6	Yes	Yes
[K78] + 685	K7	Yes	Yes
[K78] + 687	K8	Yes	Yes
[K78] + 689	K9	Yes	Yes
[K78] + 691	K10	Yes	Yes
[K78] + 693	K11	Yes	Yes
[K78] + 695	K12	Yes	Yes
[K78] + 697	K13	Yes	Yes
[K78] + 699	K14	Yes	Yes
[K78] + 701	K15	Yes	Yes
[K78] + 703	K16	Yes	Yes
[K78] + 705	K17	Yes	Yes
[K78] + 707	K18	Yes	Yes
[K78] + 709	K19	Yes	Yes
[K78] + 711	K20	Yes	Yes
[K78] + 713	K21	Yes	Yes
[K78] + 715	K22	Yes	Yes
[K78] + 717	K23	Yes	Yes
[K78] + 719	K24	Yes	Yes
[K78] + 721	K25	Yes	Yes
[K78] + 723	K26	Yes	Yes
[K78] + 725	K27	Yes	Yes
[K78] + 727	K28	Yes	Yes
[K78] + 729	K29	Yes	Yes
[K78] + 731	K30	Yes	Yes
[K78] + 733	K31	Yes	Yes
[K78] + 735	K32	Yes	Yes
[K78] + 737	K33	Yes	Yes
[K78] + 739	K34	Yes	Yes
[K78] + 741	K35	Yes	Yes
[K78] + 743	K36	Yes	Yes
[K78] + 745	K37	Yes	Yes
[K78] + 747	K38	Yes	Yes
[K78] + 749	K39	Yes	Yes
[K78] + 751	K40	Yes	Yes
[K78] + 753	K41	Yes	Yes
[K78] + 755	K42	Yes	Yes

Holding Register Address	Motor Parameter	Read Access	Write Access
[K78] + 757	K43	Yes	Yes
[K78] + 759	K44	Yes	Yes
[K78] + 761	K45	Yes	Yes
[K78] + 763	K46	Yes	Yes
[K78] + 765	K47	Yes	Yes
[K78] + 767	K48	Yes	Yes
[K78] + 769	K49	Yes	Yes
[K78] + 771	K50	Yes	Yes
[K78] + 773	K51	Yes	Yes
[K78] + 775	K52	Yes	Yes
[K78] + 777	K53	Yes	Yes
[K78] + 779	K54	Yes	Yes
[K78] + 781	K55	Yes	Yes
[K78] + 783	K56	Yes	Yes
[K78] + 785	K57	Yes	Yes
[K78] + 787	K58	Yes	Yes
[K78] + 789	K59	Yes	Yes
[K78] + 791	K60	Yes	Yes
[K78] + 793	K61	Yes	Yes
[K78] + 795	K62	Yes	Yes
[K78] + 797	K63	Yes	Yes
[K78] + 799	K64	Yes	Yes
[K78] + 801	K65	Yes	Yes
[K78] + 803	K66	Yes	Yes
[K78] + 805	K67	Yes	Yes
[K78] + 807	K68	Yes	Yes
[K78] + 809	K69	Yes	Yes
[K78] + 811	K70	Yes	Yes
[K78] + 813	K71	Yes	Yes
[K78] + 815	K72	Yes	Yes
[K78] + 817	K73	Yes	Yes
[K78] + 819	K74	Yes	Yes
[K78] + 821	K75	Yes	Yes
[K78] + 823	K76	Yes	Yes
[K78] + 825	K77	Yes	Yes
[K78] + 827	K78	Yes	Yes
[K78] + 829	K79	Yes	Yes
[K78] + 831	K80	Yes	Yes
[K78] + 833	K81	Yes	Yes

Holding Register Address	Motor Parameter	Read Access	Write Access
[K78] + 835	K82	Yes	Yes
[K78] + 837	K83	Yes	Yes
[K78] + 839	K84	Yes	Yes
[K78] + 841	K85	Yes	Yes
[K78] + 843	K86	Yes	Yes
[K78] + 845	K87	Yes	Yes
[K78] + 847	K88	Yes	Yes
[K78] + 849	K89	Yes	Yes
[K78] + 851	H0	Yes	Yes
[K78] + 853	H1	Yes	Yes
[K78] + 855	H2	Yes	Yes
[K78] + 857	H3	Yes	Yes
[K78] + 859	H4	Yes	Yes
[K78] + 861	H5	Yes	Yes
[K78] + 863	H6	Yes	Yes
[K78] + 865	H7	Yes	Yes
[K78] + 867	Temperature	Yes	No
[K78] + 869	Rated Load % (6ms average)	Yes	No
[K78] + 871	Speed	Yes	No
[K78] + 873	Rated Load % (15s average)	Yes	No
[K78] + 875	Password	No	Yes