CP750 MODBUS

Register descriptions, wiring and configuration.

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1 Introduction

The LOFA™ CP750 panel is able to support MODBUS™ communications via its RS-485 interface. Using the MODBUS interface, depending on how the panel has been configured, allows the integrator to:

- read the operating state of the panel,
- start and stop the engine,
- override the speed of the engine, and
- change the operating limits and other settings.

The panel operates in one of three modes. These are:

Panel Mode	Behavior	Value
MODBUS Disabled	No MODBUS communication possible.	0
MODBUS Enabled	Ability to read and write operating parameters and panel configuration. **No direct control of engine apart from start and stop overrides.**	1
MODBUS Full Control	**Full control of engine behavior including start, stop and engine speed.** Ability to read and write operating parameters and panel configuration.	2

Table 1. MODBUS operating modes.

The panel mode is changed by using the CANplus™ Configuration tool or by writing to the holding register “MODBUS Operating Mode” described in table 10 the value defined above.

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CANplus is a registered trademark of LOFA Industries Inc.

Throughout this document there are ‘dangerous bends’ symbols. These symbols indicate to take particular notice of the information following such a symbol.

Occasionally there will be a double ‘dangerous bends’ symbol - and this means the information following is **extremely** important!

2 Important Safety Information

2.1 AUTO-Start Warning

This panel/machine is equipped with an automatic engine start-up system that could result in the automatic starting and stopping of the engine/machine at any time. As such:

- The engine may start without warning or notice.
- It is SOLELY the responsibility of the owner/installer/operator to provide warning labels, visible warnings, and audible warnings to notify the operator of an impending start-up.
- ALWAYS use lockout/tag out procedures prior to performing ANY service or configuration operations.
- DO NOT configure operator programmable features while the panel is in AUTO mode (Key in auto-start position). The panel should be configured ONLY when the key is in the Run position.

LOFA Safety Support/Options: LOFA Industries, Inc., makes the following provisions available to all OEMs, Distributors, and Customers:

- Inclusion of Operator Manuals with each shipment that contain information and warnings specific to auto-start functionality. Operator Manuals are also available on the LOFA Industries, Inc. web site: www.LOFA.net
- Internal wiring (may be optional) to facilitate panel or remote mounted warning devices that would sound an audible alarm prior to and/or during an auto-start event.
- Application assistance with respect to sizing and facilitation of wiring strobes and other visual warnings prior to an auto-start event.
- Custom configurations of panel/operator interface functionality with respect to timing, pre-start alarms, etc. that will aid OEMs, distributors, and Customers in fulfilling individual safety policies and mandates.
- Supply of LOFA Industries, Inc. Auto-Start warning labels
- Affixing the LOFA Industries, Inc. standard auto-start warning (label and/or tag) to each auto-start panel prior to shipment.

2.2 Telemetry Device Warning

Telemetry devices may be applied such that remote and out-of-sight engine/machine start-up could be facilitated without knowledge of the localized condition(s), human interaction/presence, or human proximity at the engine/machine site. As such, suitable safety systems will be required to ensure it is safe to initiate a remote start/stop. As such:

- The engine and/or machine may start without warning or notice at the engine/machine site.
- It is SOLELY the responsibility of the owner/installer/operator to provide physical barriers, warning labels, visible warnings, and audible warnings to notify of an impending start-up.
- ALWAYS use lockout/tag out procedures prior to performing ANY service on any engine/machine and disconnect the engine machine from the telemetry system.

LOFA Telemetry Safety Support/Options: LOFA Industries, Inc., makes the following provisions available to all OEMs, Distributors, and Customers:

- Inclusion of information and warnings specific to telemetry safety with each shipment. Additional information may be available at the LOFA Industries, Inc. web site: www.LOFA.net
- Application assistance with respect to sizing and facilitation of wiring strobes and other visual warnings prior to an auto-start event.
- Custom configurations of telemetry device(s) functionality with respect to timing, pre-start alarms, etc. that will aid OEMs, distributors, and Customers in fulfilling individual safety policies and mandates.
- Supply of LOFA Industries, Inc. Auto-Start warning labels.

3 Wiring

Connection to the MODBUS is via a 5 position female M12 Key 'A' connector mounted on the rear panel of the CP750 panel.

Signals are as follows:

Pin	Signal
1	Shield
2	No Connect
3	RS485 A/$\bar{A}$ (Tx-/Rx)
4	No Connect
5	RS485 B/$\bar{B}$ (Tx+/Rx+)

Table 2. MODBUS Pin signals

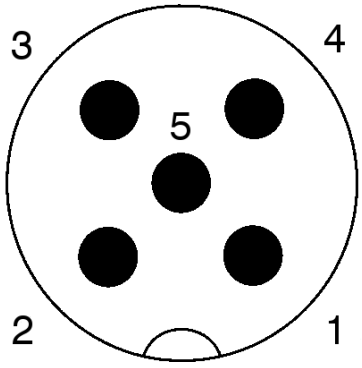

Figure 1. Facing view of panel connector

While the RS485 interface is protected against ESD up to 16kV Human Body Model it is the responsibility of the installer to ensure sufficient protection against lightning strikes, other electrical transients, and possible differences in ground potentials.

4 MODBUS Configuration

4.1 Supported UART modes

Baud Rate	600, 1200, 2400, 4800, 9600, 14400, 19200, 38400, 56800
Parity	Even, Odd, None

Table 3. UART Configuration

Two stop bits are used when no parity is selected. One stop bit is used when using even or odd parity is selected.

Baud Rate	Maximum Length (ft)
600	1500
1200	800
2400	400
4800	200
9600	100
14400	70
19200	50
38400	25
57600	16

Table 4. Maximum Bus Length

Factory default is to use MODBUS RTU, 9600 baud, even parity and 1 stop bit. The UART can be configured to support any of the options described in Table 3.The MODBUS electrical interface is RS-485, and shares a common ground with the engine ground. The default address of the panel is 127 unless specifically ordered from LOFA pre-configured differently.

If the serial communication settings need to be changed, this can be done using either the CANplus configuration tool or via the MODBUS interface itself. If the latter, then it will be necessary to configure the unit by first communicating at the default speed, and subsequently changing the value in holding register 41003 as described in Table 5.

Changes in the panel settings will only occur after a power cycle of the control panel. This can be achieved by manually turning the keyswitch to the 'OFF'

position or by writing to the 'Control Panel Software Restart' described in table 7 in section 5.

To change the baud rate and parity which the system communicates by it is necessary to use either the CANplus PC based configuration suite (preferred) or by writing a specific value to register 41003. The value is shown in table 5.

Any value written to register 41003 that is not shown in table 5 is invalid and if used will result in losing MODBUS communication. Recovery is only by using the CANplus PC based configuration suite to reconfigure the baud rate and parity.

4.2 Multiple register access

The internal buffers of the panel can accommodate consecutive register reads as defined in Table 6.

Baud Rate	Parity	Register Value
600	None	211
600	Odd	227
600	Even	243
1200	None	212
1200	Odd	228
1200	Even	244
2400	None	213
2400	Odd	229
2400	Even	245
4800	None	214
4800	Odd	230
4800	Even	246
9600	None	215
9600	Odd	231
9600	Even	247
14400	None	216
14400	Odd	232
14400	Even	248
19200	None	217
19200	Odd	233
19200	Even	249
38400	None	218
38400	Odd	234
38400	Even	250
57600	None	219
57600	Odd	235
57600	Even	251

Table 5. Baud and parity settings vs Register 41003 value.

Register type	Maximum consecutive read/write
Coil	125
Discrete Inputs	125
Holding Registers	125

Table 6. Maximum consecutive read/writes.

5 Coils

Coils are used as read/write registers. By turning on or off a particular coil, the panel can be instructed to perform the necessary operation. Table 7 details the coils available and their function.

Please note that coils are only operational when the key-switch is in the “Autostart” position.

All coils are read or written using MODBUS function code 1,5 and 15 as appropriate.

Modicon Address	Register Number	Address (Dec)	Address (Hex)	Description
00001	1	0	00 (0_H)	Control Panel Software Restart
00002	2	1	01 (1_H)	Start/Run Engine
00003	3	2	02 (2_H)	Stop Engine

Table 7. Coil registers.

The coil at register number 0 serves to trigger a reset of the panel. This is of use after making changes to the configuration settings as defined in the holding registers described in section 8.

Register 3 (Stop Engine) is available with software version 3.11 and later.

If the panel is reset while the engine is running, this will result in an immediately uncontrolled shutdown of the engine.

Setting the “Stop Engine” coil will either shutdown or stop the engine depending on the MODBUS mode of the panel. When the “Stop Engine” coil is set the “Start/Run Engine” coil is ignored.

5.1 Coil function when in “MODBUS Monitor”

When the panel is set for “MODBUS Monitor” the coils serve the equivalent of the autostart and stop switches. In this mode the CP750 will automatically attempt to restart the engine as required as well as automatically control the engine in all other aspects (e.g. engine speed). When the “Stop Engine” coil is set the “Start/Run Engine” coil is ignored and the engine will shutdown, progressing through any ramp profile that has been configured.

5.2 Coil function when in “MODBUS Full Control”

When the panel is set for “MODBUS Full Control” then setting the “Start/Run Engine” coil will cause the engine to be cranked **one time**. Clearing the coil will stop the engine. When the “Stop Engine” coil is set the “Start/Run Engine” coil is ignored. In this mode any ramp profile that has been configured will be ignored.

Should the engine fail to start then it is the responsibility of the master controller to determine this and attempt restart as appropriate. To attempt to restart an engine that has failed to start during cranking, the “Start/Run Engine” will first need to be cleared and then set again.

6 Discrete Inputs

Discrete inputs are read only registers representing the state of all digital inputs and outputs of the panel. By reading the discrete input registers it is possible to determine, for example, the state of the auxiliary switches, or whether or not the engine is running.

All discrete inputs are read using MODBUS function code 2.

Modicon Address	Register Number	Address	Description
10001	1	0 (0_H)	Engine Wait to Start Lamp
10002	2	1 (1_H)	Engine Protection Shutdown
10003	3	2 (2_H)	DPF Regeneration Inhibit Switch
10004	4	3 (3_H)	DPF Regeneration Force Switch
10005	5	4 (4_H)	DPF Regeneration Inhibited Status
10006	6	5 (5_H)	DPF Regeneration Inhibited by Switch
10007	7	6 (6_H)	Autostart Mode
10008	8	7 (7_H)	Autostart Switch 1
10009	9	8 (8_H)	Autostart Switch 2
10010	10	9 (9_H)	Oil Pressure Fault
10011	11	10 (A_H)	Temperature Fault
10012	12	11 (B_H)	Auxiliary Switch 1 Fault
10013	13	12 (C_H)	Auxiliary Switch 2 Fault
10014	14	13 (D_H)	Preheat Monitor
10015	15	14 (E_H)	Throttle Switch Increase/Run
10016	16	15 (F_H)	Throttle Switch Decrease/ Idle
10017	17	16 (10_H)	Auxiliary 5 (Interlock)
10018	18	17 (11_H)	Auxiliary Out
10019	19	18 (12_H)	Alarm Ouput
10020	20	19 (13_H)	Auxiliary Output 1
10021	21	20 (14_H)	Auxiliary Output 2
10022	22	21 (15_H)	Engine Running

Table 8. Discrete Inputs

7 Input Registers

Input registers are read only registers representing system values, such as software version number, engine speed, battery voltage etc. All input registers are read using MODBUS function code 4.

Modicon Address	Register Number	Address	Description	Notes
30001	1	0 (0_H)	Software Release Number	MSB = major, LSB = minor
30002	2	1 (1_H)	Upper 16 Bits Of Engine Minutes	0.05h/bit
30003	3	2 (2_H)	Lower 16 Bits Of Engine Minutes	0.05h/bit
30004	4	3 (3_H)	Reserved for future use	
30005	5	4 (4_H)	Engine Fuel Delivery Pressure	4kPa/bit
30006	6	5 (5_H)	Fuel Level as measured by CP750 Mechanical Mode Only	0.4%/bit
30007	7	6 (6_H)	Oil Level	0.4%/bit
30008	8	7 (7_H)	Oil Pressure	4kPa/bit
30009	9	8 (8_H)	Coolant Temperature	1°C/bit, -40°C offset.
30010	10	9 (9_H)	Coolant Level	0.4%/bit
30011	11	10 (A_H)	Alternator Current	1A/bit
30012	12	11 (B_H)	Keyswitch Battery Voltage	0.05 V/bit
30013	13	12 (C_H)	Battery Voltage	0.05 V/bit
30014	14	13 (D_H)	Fuel Temperature	1°C/bit, -40°C offset.
30015	15	14 (E_H)	Oil Temperature	0.03125°C/bit, -273°C Offset
30016	16	15 (F_H)	Engine Speed (RPMs)	0.125 rpm/bit
30017	17	16 (10_H)	Driver's Demand Torque	1 %/bit, -125 offset

Continued. . .

Modicon Address	Register Number	Address	Description	Notes
30018	18	17 (11_H)	Actual Engine Torque	1 %/bit, -125 offset
30019	19	18 (12_H)	Transducer Level as percentage of full scale	0.1%/bit
30020	20	19 (13_H)	DPF Lamp	See SPN 3697
30021	21	20 (14_H)	Exhaust Temperature High	See SPN 3698
30022	22	21 (15_H)	Diesel Particulate Filter Status	See SPN 3701
30023	23	22 (16_H)	DPF Regeneration Forced Status	See SPN 4175
30024	24	23 (17_H)	Configuration Tool Serial Number (2 bytes)	LOFA use only
30025	25	24 (18_H)	Firmware Major Release	
30026	26	25 (19_H)	Firmware Minor Release	
30027	27	26 ($1A_H$)	EEPROM Layout Version	LOFA use only
30028	28	27 ($1B_H$)	Tachometer Calibration Timer 3 Ticks (4 bytes)	LOFA use only
30029	29	28 ($1C_H$)	Tachometer Calibration Timer 3 Ticks (4 bytes)	LOFA use only
30030	30	29 ($1D_H$)	Total Engine Run Time (upper 16 bits of 24 bit value)	1 min/bit
30031	31	30 ($1E_H$)	Total Engine Run Time (lower 8 bits of 24 bit value)	1 min/bit
30032	32	31 ($1F_H$)	Job Number (characters 1,2)	LOFA use only
30033	33	32 (20_H)	Job Number (characters 3,4)	LOFA use only
30034	34	33 (21_H)	Job Number (characters 5,6)	LOFA use only
30035	35	34 (22_H)	Job Number (characters 7,8)	LOFA use only
30036	36	35 (23_H)	Job Number (characters 9,10)	LOFA use only
30037	37	36 (24_H)	Configuration (characters 1,2)	LOFA use only
30038	38	37 (25_H)	Configuration (characters 1,2)	LOFA use only
30039	39	38 (26_H)	Configuration (characters 3,4)	LOFA use only
30040	39	38 (26_H)	Configuration (characters 5,6)	LOFA use only
30041	40	39 (27_H)	Configuration (characters 7,8)	LOFA use only

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Modicon Address	Register Number	Address	Description	Notes
30042	41	40 (28_H)	Transducer current	1µA/bit

Table 9. Input Registers

Holding registers are read/write registers that reflect the configuration settings of the panel. Such parameters are typically changed either via the menu capabilities of an attached display, or via the CANplus PC based configuration suite. The ability to change these configuration parameters via the MODBUS allows for re-configuration of a panel remotely.

8 Holding Registers

Please note that it is only possible to write to the holding registers when the panel is in "Autostart" mode.

The "Engine Request Speed" holding register is writable only when "MODBUS Full Control" is enabled and the panel is in "Autostart" mode.

If the engine has been started via a MODBUS write to the start coil it is necessary to maintain at least one MODBUS read or write every 10 seconds to keep the engine running. Failure to maintain active communication, and hence active control of the engine, with the panel will result in an engine shutdown.

All holding registers can be accessed using MODBUS function code 3,5 and 6.

Modicon Address	Register Number	Address	Description	Notes
40001	1	0 (0_H)	CPIO Basic Mode	Mechanical governor = 1, electronic governor = 0
40002	2	1 (1_H)	CPIO J1939 Address	0 . . . 255
40003	3	2 (2_H)	Throttle Mode	1 . . . 2
40004	4	3 (3_H)	TSC1 Source Address	0 . . . 255
40005	5	4 (4_H)	Preheat Mode	0 . . . 3
40006	6	5 (5_H)	Preheat with Start (boolean)	
40007	7	6 (6_H)	Preheat Time (seconds)	0 . . . 250
40008	8	7 (7_H)	After Glow Time (seconds)	0 . . . 250
40009	9	8 (8_H)	Stealth Glow Time (seconds)	0 . . . 250
40010	10	9 (9_H)	J1939 iT4 Switch Status Address	0 . . . 255
40011	11	10 (A_H)	Oil Pressure Fault Mode (boolean)	
40012	12	11 (B_H)	Oil Pressure Ignore Time (seconds)	0 . . . 250

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Modicon Address	Register Number	Address	Description	Notes
40013	13	12 (C_H)	Oil Pressure Fault Shutdown Delay (seconds)	0 . . . 250
40014	14	13 (D_H)	Temperature Fault Mode (boolean)	
40015	15	14 (E_H)	Temperature Ignore Time (seconds)	0 . . . 250
40016	16	15 (F_H)	Temperature Fault Shutdown Delay (seconds)	0 . . . 250
40017	17	16 (10_H)	Aux Switch 1 Fault Mode (boolean)	
40018	18	17 (11_H)	Aux Switch 1 Ignore Time (seconds)	0 . . . 250
40019	19	18 (12_H)	Aux Switch 1 Fault Shutdown Delay (seconds)	0 . . . 250
40020	20	19 (13_H)	Aux Switch 2 Fault Mode (boolean)	
40021	21	20 (14_H)	Aux Switch 2 Ignore Time (seconds)	0 . . . 250
40022	22	21 (15_H)	Aux Switch 2 Fault Shutdown Delay (seconds)	0 . . . 250
40023	23	22 (16_H)	Fuel Fault Level (percent)	
40024	24	23 (17_H)	Alarm Selftest (boolean)	
40025	25	24 (18_H)	Alarm On Time (seconds)	2 . . . 250,255
40026	26	25 (19_H)	Aux Out Activation Delay (seconds)	0 . . . 250
40027	27	26 ($1A_H$)	Aux Out Deactivation Delay (seconds)	0 . . . 250,255
40028	28	27 ($1B_H$)	Aux Out Selftest (boolean)	
40029	29	28 ($1C_H$)	Aux Out Mode	0 . . . 2
40030	30	29 ($1D_H$)	Shutdown Enable Mask (bitfield)	
40031	31	30 ($1E_H$)	Autostart Mode	0 . . . 3
40032	32	31 ($1F_H$)	Autostart Function	0 . . . 3
40033	33	32 (20_H)	Auto Start Delay (seconds)	0 . . . 250
40034	34	33 (21_H)	Auto End Delay (seconds)	0 . . . 250

Continued. . .

Modicon Address	Register Number	Address	Description	Notes
40035	35	34 (22_H)	Restart Delay (seconds)	5 . . . 250
40036	36	35 (23_H)	Restart Attempts	0 . . . 10
40037	37	36 (24_H)	Starter On Time (seconds)	2 . . . 30
40038	38	37 (25_H)	Starter Disengage Speed (100 RPM)	
40039	39	38 (26_H)	Prestart Alarm Time	0 . . . 250
40040	40	39 (27_H)	Auto Start Transducer Enable Delay (seconds)	1 . . . 250
40041	41	40 (28_H)	Warmup Delay	0 . . . 250
40042	42	41 (29_H)	Cool Down Delay (0.1 minutes)	0 . . . 250
40043	43	42 ($2A_H$)	Float Switch 1 Enable Delay (seconds)	
40044	44	43 ($2B_H$)	Float Switch 1 Disable Delay (seconds)	
40045	45	44 ($2C_H$)	Float Switch 2 Enable Delay (seconds)	
40046	46	45 ($2D_H$)	Float Switch 2 Disable Delay (seconds)	
40047	47	46 ($2E_H$)	Reserved	
40048	48	47 ($2F_H$)	Intermediate Run Time	0 . . . 250
40049	49	48 (30_H)	Encoder Speed Interval (RPM)	1 . . . 250
40050	50	49 (31_H)	Bump Switch Speed Interval (RPM)	1 . . . 250
40051	51	50 (32_H)	Under Speed Fault(RPM, 2 bytes)	
40052	52	51 (33_H)	Under Speed Fault(RPM, 2 bytes)	
40053	53	52 (34_H)	Minimum Requested Speed (RPM, 2 bytes)	
40054	54	53 (35_H)	Minimum Requested Speed (RPM, 2 bytes)	
40055	55	54 (36_H)	Idle Speed (RPM, 2 bytes)	
40056	56	55 (37_H)	Idle Speed (RPM, 2 bytes)	

Continued. . .

Modicon Address	Register Number	Address	Description	Notes
40057	57	56 (38_H)	Intermediate Speed (RPM, 2 bytes)	
40058	58	57 (39_H)	Intermediate Speed (RPM, 2 bytes)	
40059	59	58 ($3A_H$)	Run Speed (RPM, 2 bytes)	
40060	60	59 ($3B_H$)	Run Speed (RPM, 2 bytes)	
40061	61	60 ($3C_H$)	Max Requested Speed (RPM, 2 bytes)	
40062	62	61 ($3D_H$)	Max Requested Speed (RPM, 2 bytes)	
40063	63	62 ($3E_H$)	Over Speed Fault (RPM, 2 bytes)	
40064	64	63 ($3F_H$)	Over Speed Fault (RPM, 2 bytes)	
40065	65	64 (40_H)	Over Speed Shutdown Delay (seconds)	
40066	66	65 (41_H)	Ramp time to Intermediate	0 . . . 250
40067	67	66 (42_H)	Ramp To Idle (seconds, 2 bytes)	1 . . . 250
40068	68	67 (43_H)	Ramp To Idle (seconds, 2 bytes)	
40069	69	68 (44_H)	Ramp to Run (seconds, 2 bytes)	1 . . . 250
40070	70	69 (45_H)	Ramp to Run (seconds, 2 bytes)	
40071	71	70 (46_H)	Transducer Type (xdcr type t)	
40072	72	71 (47_H)	Transducer Range (xdcr range t)	
40073	73	72 (48_H)	Servo Gain (RPM*error percent)	1 . . . 250
40074	74	73 (49_H)	Servo Delay (10 ms)	1 . . . 250
40075	75	74 ($4A_H$)	Servo Dead Band (0.1percent)	0 . . . 250
40076	76	75 ($4B_H$)	Servo Filter Weighting (samples)	1 . . . 250

Continued. . .

Modicon Address	Register Number	Address	Description	Notes
40077	77	76 ($4C_H$)	High Set Point (0.1percent, 2 bytes)	
40078	78	77 ($4D_H$)	High Set Point (0.1percent, 2 bytes)	
40079	79	78 ($4E_H$)	Low Set Point (0.1percent, 2 bytes)	
40080	80	79 ($4F_H$)	Low Set Point (0.1percent, 2 bytes)	
40081	81	80 (50_H)	Target Set Point (0.1percent, 2 bytes)	
40082	82	81 (51_H)	Target Set Point (0.1percent, 2 bytes)	
40083	83	82 (52_H)	Transducer High Fault Level (0.1percent, 2 bytes)	
40084	84	83 (53_H)	TransducerHigh Fault Level (0.1percent, 2 bytes)	
40085	85	84 (54_H)	TransducerLow Fault Level (0.1percent, 2 bytes)	
40086	86	85 (55_H)	Transducer Low Fault Level (0.1percent, 2 bytes)	
40087	87	86 (56_H)	Autostart Dwell (seconds)	
40088	88	87 (57_H)	Aux Switch 1 SPN/FMI Byte 0	
40089	89	88 (58_H)	Aux Switch 1 SPN/FMI Byte 1	
40090	90	89 (59_H)	Aux Switch 1 SPN/FMI Byte 2	
40091	91	90 ($5A_H$)	Auto Start Transducer Disable Delay (seconds)	1 . . . 250
40092	92	91 ($5B_H$)	Aux Switch 2 SPN/FMI (packed, 3 bytes)	
40093	93	92 ($5C_H$)	Aux Switch 2 SPN/FMI (packed, 3 bytes)	
40094	94	93 ($5D_H$)	Aux Switch 2 SPN/FMI (packed, 3 bytes)	
40095	95	94 ($5E_H$)	GM Throttle Request Enable (boolean)	

Continued. . .

Modicon Address	Register Number	Address	Description	Notes
40096	96	95 ($5F_H$)	Engine ECU Address	0 . . . 239
40097	97	96 (60_H)	Display Power Timeout (minutes)	1 . . . 250,255
40098	98	97 (61_H)	Reserved	
40099	99	98 (62_H)	Serial Number (2 bytes)	
40100	100	99 (63_H)	Serial Number (2 bytes)	
40101	101	100 (64_H)	At Speed (RPM, 2 bytes)	
40102	102	101 (65_H)	At Speed (RPM, 2 bytes)	
40103	103	102 (66_H)	Enable Below At Speed (RPM)	0 . . . 250,255
40104	104	103 (67_H)	Disable Above At Speed (RPM)	0 . . . 250,255
40105	105	104 (68_H)	Reserved	
40106	106	105 (69_H)	Reserved	
40107	107	106 ($6A_H$)	Overspeed Ignore Time (seconds)	3 . . . 250,255
40108	108	107 ($6B_H$)	Underspeed Ignore Time (seconds)	3 . . . 250,255
40109	109	108 ($6C_H$)	Underspeed Fault Delay (seconds)	
40110	110	109 ($6D_H$)	Transducer Fault Ignore Time (seconds)	0 . . . 250
40111	111	110 ($6E_H$)	Transducer High Fault Delay (seconds)	0 . . . 250
40112	112	111 ($6F_H$)	Transducer Low Fault Delay (seconds)	0 . . . 250
40113	113	112 (70_H)	Fuel Fault Ignore Time (seconds)	0 . . . 250
40114	114	113 (71_H)	Fuel Fault Delay (seconds)	0 . . . 250
40115	115	114 (72_H)	Fuel Level Sender Table (struct sender, 33 bytes)	
40147	147	146 (92_H)	Fuel Level Sender Table (struct sender, 33 bytes) END	
40148	148	147 (93_H)	Temperature Sender Table (struct sender, 33 bytes)	

Continued. . .

Modicon Address	Register Number	Address	Description	Notes
40180	180	179 ($B3_H$)	Temperature Sender Table (struct sender, 33 bytes) END	
40181	181	180 ($B4_H$)	Pressure Sender Table (struct sender, 33 bytes)	
40213	213	212 ($D4_H$)	Pressure Sender Table (struct sender, 33 bytes) END	
40214	214	213 ($D5_H$)	Reserved	
40215	215	214 ($D6_H$)	J1939 Interlock Address	0 . . . 255
40216	216	215 ($D7_H$)	CP700 Enabled	
40217	217	216 ($D8_H$)	Engine Settings	
40218	218	217 ($D9_H$)	Transducer Fault Mode	0 . . . 2
41001	1001	1000 ($3E8_H$)	(Desired) Engine Requested Speed	0.125 rpm/bit
41002	1002	1001 ($3E9_H$)	Reserved	
41003	1003	1002 ($3EA_H$)	UART Configuration (Baud, Parity and Stop Bits)	
41004	1004	1003 ($3EB_H$)	CANbus Speed Select (canbus kbps t)	
41005	1005	1004 ($3EC_H$)	Modbus Slave Address	0 . . . 255
41006	1006	1005 ($3ED_H$)	Delay Before Send	
41007	1007	1006 ($3EE_H$)	Modbus Operating Mode (see table 1)	0 . . . 2
41008	1008	1007 ($3EF_H$)	Tachometer Calibration Speed (RPM, 2 bytes)	

Table 10. Holding Registers

8.1 Auxiliary Output Modes

When in MODBUS Full Control mode the panel will still control the Alarm and Auxiliary outputs based on the values set into the respective holding registers.

Behavior of the auxiliary output is determined by the value in the “Aux Out Mode” holding register (40029). Valid values are:

Aux Out Mode	Value
Engine Running	0
Autostart Armed	1
Engine At Speed	2

Table 11. Aux Out Mode.

9 Example Operation

9.1 Monitor Only

A CP750 panel has been configured to automatically control a pump. It is required that the status of the pump is remotely monitored and a SCADA system has been connected using RS485 MODBUS RTU to the CP750 panel.

To do this:

1. Ensure panel is set to ‘MODBUS Enable” using the CANplus Configuration tool.
2. Ensure MODBUS setting are compatible with the MODBUS master device. See section 4.
3. Turn CP750 keyswitch to the “Autostart” postion.
4. CP750 behaves as before: automatically starting, adjusting engine speed, and stopping as previously configured.

With this configuration all available discrete inputs, input registers and holding registers may be read via the MODBUS.

What the SCADA system **cannot** do in this mode is override the engine running speed.

The SCADA system may, when the panel is configured in this mode, change all other settings in the holding registers. These settings will become active on the next power cycle of the panel power.

9.2 Remotely change configuration

A CP750 is being used in a “monitor only” type application – as described in section 9.1. The panel has been previously configured to start the engine when the transducer input reaches 50%. This setting is to be changed to 60%.

This is achieved by:

- Writing the value 600 (60%/0.1%) to holding register address 40077.
- Power cycling the panel.

Power cycling the panel is necessary in order for the new settings to become active. This is best achieved by manually turning the key switch to the off position. If this is not possible then it is possible to restart the panel by writing to the “Control Panel Software Restart” coil described is section 5.

If the “Control Panel Software Restart” coil is used to restart the panel then the engine will be immediately stopped if already running. No fault code will be generated and, should a start condition be present, the engine will be immediately restarted.

9.3 Remotely Controlling the Engine

9.3.1 Important

When configured for “MODBUS Full Control” the CP750 can be be completely remote controlled via the MODBUS interface. In this mode the panel will only provide minimal engine control and will not start or stop the engine based on the normally used float switch or transducer inputs. In this configuration the panel will also not offer such features as engine speed ramping nor warm up/cool down delays or attempt to restart the engine should it fail to start when cranked. Such control is limited to:

- Starting or stopping the engine based on the state of the “Engine Run” coil.
- Stopping the engine when a fault is detected.
- Setting the engine speed based on the value in the “(Desired) Engine Requested Speed” holding register.

It is important to note that the controller issuing the MODBUS commands is responsible for all other aspects of the requested engine behavior.

Please note that the value written to the “(Desired) Engine Requested Speed” holding register is the RPM value multiplied by 8. This is because the SAE J1939 specification states that the RPM measurement sent to the engine ECU is in units of one eighth of an RPM.

When in “MODBUS Full Control” the CP750 will not ramp engine speed automatically. To achieve gradual speed changes the controller must write suitably values into the “(Desired) Engine Requested Speed” (Address 41001) register incrementing or decrementing over time as necessary to achieve the required ramp profile.

Unless expressly required it is recommended that the “(Desired) Engine Requested Speed” holding register is always set to the engine idle speed prior to attempting an engine start.

9.3.2 Starting an engine remotely

As an example, a CP750 has been configured for “MODBUS Full Control.” To start the engine the following commands could be executed:

1. “(Desired) Engine Requested Speed” (Address 41001) is set to the starting idle speed times 8 (e.g. a value of 6400 which would equate to 800 RPM).
2. The “Engine Run” (Address 00002) coil is set.
3. The discrete input “Engine Running” (Address 10022) is repeatedly checked and when set indicates that the engine has successfully been started.
4. The engine speed can now be changed by writing to the “(Desired) Engine Requested Speed” (Address 41001) as necessary.

Should the discrete input “Engine Running” still be clear (0) after the period of time specified in the holding register “Starter On Time” (address 40037) then the engine has failed to properly start.

If the “Engine Run” coil remains set after a failure to start has occurred, the engine will **not** immediately attempt to restart. To restart the engine it is necessary to first clear the “Engine Run” coil.

9.3.3 Stopping an engine remotely

A CP750 controlled engine is currently running and it is necessary to stop the engine by first running for a period of time at a lower RPM (the cool down period) and finally stopping the engine completely.

1. “(Desired) Engine Requested Speed” (Address 41001) is set to the cool down speed (e.g. 8000 which would mean 1000 RPM).
2. The controller implements a delay - enough for the engine to cool down.
3. “(Desired) Engine Requested Speed” (Address 41001) is set to the idle speed (e.g. 6400 which would mean 800 RPM).
4. The controller implements a delay - enough for the engine to reach idle, or continually checks the engine RPM until idle is reached.
5. The “Engine Run” (Address 00002) coil is cleared.

9.3.4 Typical Ramp Profile

When the panel is in any other mode other than ‘MODBUS Full Control’ it will increase and decrease engine speed based on a number of configurable parameters. This engine

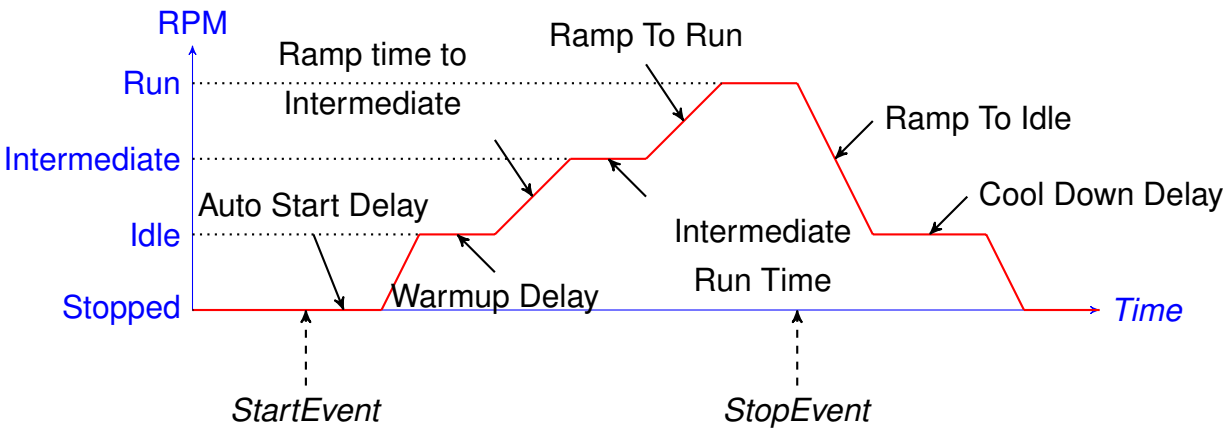

Figure 2. Typical ramp profile

speed profile (shown in figure 2) is designed to allow the engine to achieve normal operating temperature before beginning full operation, and to allow a cool down period once work has finished. If the panel is to be left in an autostart mode **without** being controlled via MODBUS these parameters can be set by writing to the various holding registers or by using the PC based CANplus configuration tool.

If the panel is configured for 'MODBUS Full Control it **will not** automatically control the engine speed in this manner.

To emulate such a speed profile it is necessary for the controller to write into the '(Desired) Engine Requested Speed' holding register (41001) the required time based profile. Registers such as "Warm up Delay", "Ramp time to intermediate" etc. will all be ignored in this mode.

9.4 Configuring Auxiliary Output

9.4.1 Activate electrical clutch at specific engine speed

It is required to energize and electrically activated clutch when the engine reaches a speed of 1400 RPM. This is achieved by configuring the panel to use the auxiliary output in the "At Speed' mode (please see section 8.1.) The panel can be configured using either the CANplus PC based configuration tool or via the MODBUS interface.

if using the MODBUS interface to configure the panel, turn the key switch in the "Autostart" position and write the defined values to the required holding registers as per table 12.

Holding Register	Value
40029: Aux Out Mode	2
40101: At Speed RPM	1400

Table 12. Settings for active auxiliary output at 1400 RPM.

Once these values have been written, it is imperative that the panel is restarted - either by turning the key switch to the OFF and back to the AUTOSTART position or by triggering a panel software restart by writing to the “Control Panel Software Restart” coil at address 00001 (please see table 7) for the new settings to become active.

10 Troubleshooting

10.1 No Communication With Device

10.1.1 Verify MODBUS Configuration

Verify that the same baud rate, parity, stop bits, and data bits are being used on all connected devices. Also verify that other devices are using MODBUS RTU. To verify the settings on the CP750 use the CANplus configuration tool. Supported configuration settings can be seen in Table 3.

The CP750 uses 8 data bits for all configurations.

Two stop bits are used when no parity is selected. One stop bit is used when using even or odd parity is selected.

10.1.2 Delay Before Reply

Verify that an appropriate delay before send has been set using the CANplus configuration tool. Other MODBUS devices may request a minimum and/or maximum delay in their documentation.

10.1.3 Terminating Resistors and Wire Type

Ensure that only two terminating resistors are present on the bus. One terminator is required at each end of the bus. Ensure the wire used for the bus is a twisted pair. If a shield is present around the pair leave disconnected at the CP750.

10.1.4 Ground Potentials

The CP750 does not have an isolated RS-485 connection. Communication may be affected if there is a ground potential difference between the CP750 and master device. If this occurs it may be necessary to implement some form of bus isolation between devices.

10.2 Receiving Errors

Verify that the master device is not exceeding the maximum number of consecutive read/writes. The maximum number of consecutive read/writes for each register type is shown in Table 6. When performing a consecutive read/write command verify that all of the addresses are valid. When performing a consecutive write command verify that all of the written values are within range. Table 13 shows supported error messages and their potential causes.

Code	Name	Cause
2	Illegal Data Address	Reading/Writing a non-vaild address.
3	Illegal Data Value	Read/Writing to many register/coils consecutively.
4	Slave Device Failure	Writing a value that is out of range.

Table 13. Exception Codes

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