PTS/Modbus Interface Software
User's Manual

Revision 2.2

January 1997

MAN526

1. Introduction

This manual relates to the following versions of software in the PTS unit:

Modbus Interface	Version 2.2
PTS Host software	Version 1.7.3 or later

This document describes the PTS/Modbus Interface. This provides considerable flexibility in operating the machine - allowing changes to the program to be made quickly and easily by the user. It also ensures that improvements to the standard PTS product can be readily incorporated into any machine. The PTS units use the Quin Motor Control language which is described fully in the PTS User's Manual.

Control of the machine is accomplished using the following parts:

- The Modbus system communicates with the Quin unit as if it were a PLC. This allows the Modbus system to display information about the running of the machine which it gets from the Quin unit. In a similar manner the operator can control the machine from a PLC on Modbus.

- The Quin unit controls the running of the motors according to setup data received from the Modbus system. The interface to Modbus is via the auxiliary serial port, thus leaving the main serial port available for initial machine setup and diagnostics.

- It is envisaged that most of the digital I/O such as guard switches will be taken care of using a PLC.

- Generation of maps and setup sequences for the different products would normally be done on a computer away from the machine. This will be used to produce a text file which can be downloaded to the Quin unit via a Modbus protocol extension implemented on AFE systems.

2. Programming

2.1 General

The Modbus interface to the PTS is designed to make the PTS look like a PLC as much as possible. To achieve this, the PTS appears as a number of coils, inputs and registers which can be read or written (as appropriate) by other Modbus nodes using the serial link. Each PTS channel has its own set of registers to allow other Modbus nodes random access to all data in the PTS. In addition there is a set of registers for data not specific to a particular channel. It is possible to address the channel data in two ways. Using the first method, consecutive locations access different data items from the same channel. Using the second method, consecutive locations access the same data item on different channels.

The different types of registers are described in the following paragraphs.

2.2 Coils

These are used to output single bit data such as the digital output lines and also for parameterless commands such as AB or ST.

2.3 Inputs

These are used to input single bit data such as the digital input lines and also for the error and status bits.

2.4 Holding Registers

These are used for the normal PTS commands which take a parameter. Reading the register returns its current value, and writing to the register issues the appropriate command (SV, MA etc.) to the relevant channel. It should be noted that the AFE can only handle 16 bit numbers and therefore the units on the PTS must be set to ensure all data falls within this range. This is accomplished with the SU command.

2.5 Input Registers

These are used for PTS commands which return data only such as DP, DC etc. Some of these commands can return data greater than 16 bits and so the units must be set appropriately using the SU command.

2.6 Recipe Files

Note that recipe files can only be used with a Modbus protocol extension implemented by AFE.

2.7 Modbus Unit Number

The unit number of the PTS on the Modbus network defaults to 1. This can be changed by setting the value of YJ on channel 1 to the required unit number. Because the Modbus interface program only reads the unit number on start-up, the YJ parameter must be saved in non-volatile memory to take effect. The following example sets the unit number to 10.

```
1: CH1/YJ10
1: SP
```

When the PTS is next turned on, the unit number will be set to 10 and the Modbus interface program will display the following message.

```
Modbus Interface : Unit number set to 10
```


3. Address Map

The data is organized in coils, inputs, holding registers and input registers as shown on the following pages. Each piece of data is accessible at two addresses. The first addressing mode allows different data items on the same channel to be accessed at consecutive addresses. The channel number is shown by the hundreds digit and is represented by "nn" in the tables. Addresses below 100 are used for system-wide data items which are not specific to a particular channel. The second addressing mode is used for addresses (i.e. coil number, input number etc.) above 5000, and allows the same data item on all channels to be accessed at consecutive addresses.

For example the control word (CW) for channel 1 can be accessed as holding register 106, the control word for channel 3 can be accessed at address 306 and so on. If multiple holding registers are written starting at register 106, then this will alter the control word (CW), debounce time (DB), marker pulse setup (DZ) etc. for channel 1. The control word for channel 1 can also be accessed as holding register 5251, for channel 2 at 5252, for channel 3 at 5253 and so on. The debounce time for channel 1 can be accessed at 5301, for channel 2 at 5302 and so on. The coil, input or register number is given in the tables first for addressing mode 1 (consecutive commands) and secondly for addressing mode 2 (consecutive channels).

In the following tables, nn should be replaced by the channel number (1 to 48) and mm should be replaced by the channel number plus 50 (51 to 98).

3.1 System Data

Coils (Write only):

Address	Command	Contents
2	CM	Compile sequences
3	RD	Read parameters
4	RS	Reset parameters
5	ER	End repeat loop
6	GA	Global abort
7	GF	Global motor-off
8	GS	Global stop
9	GX	Global command abort

These commands are also mapped into system holding registers starting at address 81.

Inputs:

None

Holding Registers:

Address	Command	Contents
2	AS	Start-up sequence number
3	CD	Character delay
4	CH	Current channel (Write only)
5	DW	Display word
6	GX	Command abort (Write only)
7		Reserved
8	XS	Execute sequence (Write only)
9	CP	Parallel channel command (Write only)
10	SY	Set status reporting
11	$V1	Variable V1
12	$V2	Variable V2
13	$V3	Variable V3
14	$V4	Variable V4
15	$V5	Variable V5
16	$V6	Variable V6
17	$V7	Variable V7
18	$V8	Variable V8

Holding Registers (continued)

Address	Command	Contents
19	$V9	Variable V9
20	$V10	Variable V10
21	$V11	Variable V11
22	$V12	Variable V12
23	$V13	Variable V13
24	$V14	Variable V14
25	$V15	Variable V15
26	$V16	Variable V16
27	$V17	Variable V17
28	$V18	Variable V18
29	$V19	Variable V19
30	$V20	Variable V20
31	$V21	Variable V21
32	$V22	Variable V22
33	$V23	Variable V23
34	$V24	Variable V24
35	$V25	Variable V25
36	$V26	Variable V26
37	$V27	Variable V27
38	$V28	Variable V28
39	$V29	Variable V29
40	$V30	Variable V30
41	$V31	Variable V31
42	$V32	Variable V32
43	$V33	Variable V33
44	$V34	Variable V34
45	$V35	Variable V35
46	$V36	Variable V36
47	$V37	Variable V37
48	$V38	Variable V38
49	$V39	Variable V39
50	$V40	Variable V40
51	$V41	Variable V41
52	$V42	Variable V42
53	$V43	Variable V43

Holding Registers (continued)

Address	Command	Contents
54	$V44	Variable V44
55	$V45	Variable V45
56	$V46	Variable V46
57	$V47	Variable V47
58	$V48	Variable V48
59	$V49	Variable V49
60	$V50	Variable V50
81	CM	Compile sequences (Write only)
82	RD	Read parameters (Write only)
83	RS	Reset parameters (Write only)
84	ER	End repeat loop (Write only)
85	GA	Global abort command (Write only)
86	GF	Global motor-off command (Write only)
87	GS	Global stop command (Write only)
88	GX	Global command abort (Write only)

Input Registers:

Address	Command	Contents
2..11		Product Name (up to 20 characters)
12	CS	Checksum

3.2 Channel Data

Coils:

Address		Command	Contents
nn02	50mm	AB	Abort (Write only)
nn03	51nn	SO/CO	Output line 1
nn04	51mm	SO/CO	Output line 2
nn05	52nn	SO/CO	Output line 3
nn06	52mm	SO/CO	Output line 4
nn07	53nn	SO/CO	Output line 5
nn08	53mm	SO/CO	Output line 6
nn09	54nn	SO/CO	Output line 7
nn10	54mm	SO/CO	Output line 8
nn11	55nn	ID	Initialise demand signal offset (Write only)
nn12	55mm	MO	Motor off (Write only)
nn13	56nn	PC	Enter position control mode (Write only)
nn14	56mm		Not used
nn15	57nn	RM	Set continuous reference mode
nn16	57mm	ST	Stop (Write only)
nn17	58nn	UL	Unlink from master channel (Write only)

These commands are also mapped to channel holding registers starting at address nn75.

Inputs:

Address		Command	Contents
nn02	50mm		Limit switch error
nn03	51nn		Reference timeout error
nn04	51mm		Reference limit error
nn05	52nn		Reference correction overrun error
nn06	52mm		Position error
nn07	53nn		Timeout error
nn08	53mm		Upper position limit error
nn09	54nn		Lower position limit error
nn10	54mm		Map timeout error
nn11	55nn		Map overflow error

nn = channel number. mm = channel number + 50.

Inputs (continued)

Address		Command	Contents
nn12	55mm		High analogue limit
nn13	56nn		Low analogue limit
nn14	56mm		Encoder read error
nn15	57nn		SSI encoder noisy
nn16	57mm		Reserved
nn17	58nn		Reserved
nn18	58mm		Unknown command error
nn19	59nn		Invalid command error
nn20	59mm		Context error
nn21	60nn		Parameter range error
nn22	60mm		Memory full error
nn23	61nn		Reserved
nn24	61mm		I/O line in use error
nn25	62nn		Reference timeout error
nn26	62mm		Reference limit error
nn27	63nn		Reference correction overrun error
nn28	63mm		Reserved
nn29	64nn		Input line noisy error
nn30	64mm		Command decode error
nn31	65nn		Clutch timeout error
nn32	65mm		Host input buffer overflow error
nn33	66nn		Reserved
nn34	66mm		Constant velocity mode
nn35	67nn		Normal move mode
nn36	67mm		Profile move mode
nn37	68nn		Position mapping status
nn38	68mm		Stopping status
nn39	69nn		Initialising position
nn40	69mm		Reserved
nn41	70nn		Motor off status
nn42	70mm		Waiting for time
nn43	71nn		Waiting for an input line
nn44	71mm		Waiting for absolute position
nn45	72nn		Waiting for relative position

nn = channel number. mm = channel number + 50.

Inputs (continued)

Address		Command	Contents
nn46	72mm		Waiting for reference
nn47	73nn		Reserved
nn48	73mm		Waiting for wraparound
nn49	74nn		Waiting for bound counter
nn50	74mm		Input line 1
nn51	75nn		Input line 2
nn52	75mm		Input line 3
nn53	76nn		Input line 4
nn54	76mm		Input line 5
nn55	77nn		Input line 6
nn56	77mm		Input line 7
nn57	78nn		Input line 8

These inputs are also mapped to channel input registers starting at address nn08.

Holding Registers:

Address		Command	Contents
nn02	50mm	AV	Set map base/offset adjustment velocity
nn03	51nn	BA	Set map base advance
nn04	51mm	BL	Set backlash compensation distance
nn05	52nn	BT	Set master speed averaging time constant
nn06	52mm	CW	Control word
nn07	53nn	DB	Debounce time
nn08	53mm	DZ	Define zero marker input on/off
nn09	54nn	IN	Initialise position (Write only)
nn10	54mm	IT	Integration time constant
nn11	55nn	KD	Differential gain
nn12	55mm	KF	Velocity feed-forward gain
nn13	56nn	KI	Integral gain
nn14	56mm	KM	Monitor output gain
nn15	57nn	KP	Proportional gain
nn16	57mm	KV	Velocity feedback gain
nn17	58nn	LH	High position limit

nn = channel number. mm = channel number + 50.

Holding Registers (continued)

Address		Command	Contents
nn18	58mm	LL	Low position limit
nn19	59nn	MA	Move to absolute position (Write only)
nn20	59mm	MB	Map base offset
nn21	60nn	ME	Motor error sequence
nn22	60mm	MF	Slave map position offset
nn23	61nn	ML	Link to master channel for mapping (Write only)
nn24	61mm	MP	Map bound
nn25	62nn	MR	Move to relative position (Write only)
nn26	62mm	MS	Map step
nn27	63nn	MT	Map timeout
nn28	63mm	MW	Map options word
nn29	64nn	OC	Set value on expanded output group (Write only)
nn30	64mm	OM	Monitor output offset
nn31	65nn	PA	Set position trigger output advance
nn32	65mm	PV	Profile velocity
nn33	66nn	RF	Set reference offset
nn34	66mm	RL	Set reference repeat length
nn35	67nn	RT	Registration timeout
nn36	67mm	RV	Reference velocity
nn37	68nn	RW	Reference word
nn38	68mm	SA	Acceleration
nn39	69nn	SB	Position overflow bound
nn40	69mm	SC	Creep distance
nn41	70nn	SD	Deadband
nn42	70mm	SE	Error band
nn43	71nn	SF	Auxiliary output function
nn44	71mm	SJ	Deferred adjustment position
nn45	72nn	SL	Settling time
nn46	72mm	SM	Map scaling
nn47	73nn	SR	Maximum reference correction
nn48	73mm	SS	Creep speed
nn49	74nn	SU	Set units
nn50	74mm	SV	Velocity
nn51	75nn	SW	Window on move endpoint

nn = channel number. mm = channel number + 50.

Holding Registers (continued)

Address		Command	Contents
nn52	75mm	TM	Transfer map (Write only)
nn53	76nn	TO	Move timeout
nn54	76mm	TP	Transfer profile (Write only)
nn55	77nn	UE	User error sequence
nn56	77mm	US	Send user signal (Write only)
nn57	78nn	VC	Enter constant velocity mode (Write only)
nn58	78mm	VM	Set virtual motor mode
nn59	79nn	VT	Set velocity averaging time constant
nn60	79mm	WC	Wait for bound overflow count (Write only)
nn61	80nn	XM	Execute map (Write only)
nn62	80mm	XP	Execute profile (Write only)
nn63	81nn	YA	Wildcard parameter A
nn64	81mm	YB	Wildcard parameter B
nn65	82nn	YC	Wildcard parameter C
nn66	82mm	YD	Wildcard parameter D
nn67	83nn	YE	Wildcard parameter E
nn68	83mm	YF	Wildcard parameter F
nn69	84nn	YG	Wildcard parameter G
nn70	84mm	YH	Wildcard parameter H
nn71	85nn	YI	Wildcard parameter I
nn72	85mm	YJ	Wildcard parameter J
nn73	86nn	ZC	Set position counters (Write only)
nn74			Reserved
nn75	87nn	AB	Abort (Write only)
nn76	87mm	SO/CO	Output lines group 1
nn77	88nn	SO/CO	Output lines group 2
nn78	88mm	SO/CO	Output lines group 3
nn79	89nn	ID	Initialise demand position offset (Write only)
nn80	89mm	MO	Motor off (Write only)
nn81	90nn	PC	Position Control (Write only)
nn82	90mm	RM	Set continuous reference mode on/off
nn83	91nn	ST	Stop (Write only)
nn84	91mm	UL	Unlink (Write only)
nn85	92nn	DA	Display analogue input

nn = channel number. mm = channel number + 50.

Holding Registers (continued)

Address		Command	Contents
nn86	92mm	DF	Display reference error
nn87	93nn	DP	Display actual position
nn88	93mm	DS	Display snapshot position data
nn89	94nn	DV	Display velocity
nn90	94mm	DD	Display demand position
nn91	95nn		Motor error code
nn92	95mm		User error code
nn93	96nn		Status word
nn94	96mm		Input group 1
nn95	97nn		Input group 2
nn96	97mm		Input group 3
nn97	98nn		Input group 4
nn98	98mm		Input group 5

Input Registers:

Address		Command	Contents
nn02	50mm	DA	Analogue input
nn03	51nn	DF	Reference error
nn04	51mm	DP	Current actual position
nn05	52nn	DS	Snapshot position
nn06	52mm	DV	Current actual velocity
nn07	53nn	DD	Current demand position
nn08	53mm		Motor error code
nn09	54nn		User error code
nn10	54mm		Status word
nn11	55nn		Input group 1
nn12	55mm		Input group 2
nn13	56nn		Input group 3
nn14	56mm		Input group 4
nn15	57nn		Input group 5

nn = channel number. mm = channel number + 50.

4. Error Codes

System error codes can be read from channel input registers nn08 and nn09. These registers hold respectively the last motor error and last user error which occurred on channel nn. The codes are given in section 5.4 of the relevant PTS Reference Manual.

5. Register Bit Mapping

5.1 Status Word Register

The meaning of the value in the Status word register (channel input register n10) is shown below.

Status Value

Value	Meaning when set
1	Waiting for time (WT)
2	Waiting for input line (WI)
3	Waiting for absolute position (WA)
4	Waiting for relative position (WR)
5	Waiting for reference signal (WR)
6	Waiting for bounds wraparound (WB)
7	Waiting for bounds counter value (WC)
256	Constant velocity mode (VC)
512	Moving (MA/MR)
1024	Profiling (XP)
2048	Mapping (XM)
4096	Stopping (ST)
8192	Initialising (IN)
16384	Torque control mode (TQ)
32768	Motor off

5.2 Input/Output Registers

The bits in the output line holding register (nn94 etc.) and the input line input register (nn11) reflect the state of the input/output lines as shown below.

Input/Output Line Bits

Bit	Input/Output Line
0 (LSB)	Line 1
1	Line 2
2	Line 3
3	Line 4
4	Line 5
5	Line 6
6	Line 7
7	Line 8
8 .. 15	Reserved

6. Multi-drop Modbus Linking

6.1 Mini-PTS

To use the Mini-PTS in multi-drop mode it is necessary to set the Mini-PTS port B to RS485 multi-drop by connecting J12 pin 8 to pin 10 and pin 5 to pin 7. The Mini-PTS can then be connected to the RS485 port on the PC/PLC using bias resistors as follows. It may also help to put similar bias resistors from pin 3 to +5V and from pin 8 to 0V.

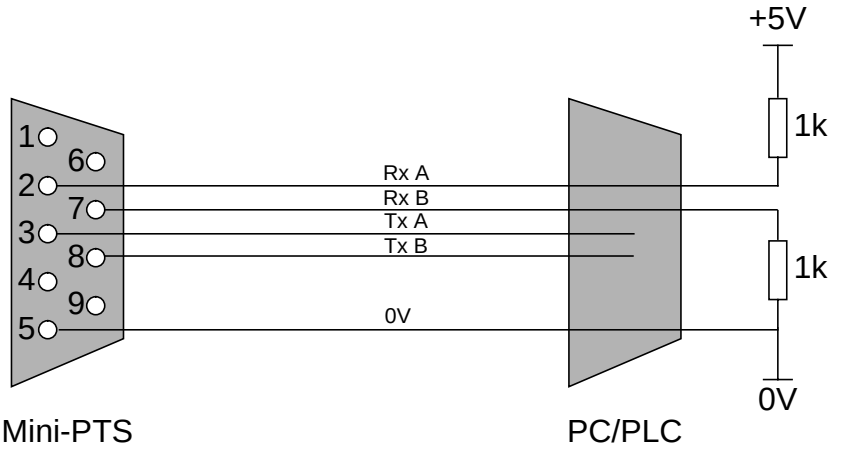

Figure 1. Mini-PTS multi-drop linking.

6.2 Mini-PTS 2+1 and PTS Mk 2

Port B of the Mini-PTS 2+1 and PTS Mk 2 are used for Modbus communications. Modbus and Operator's Panel are mutually exclusive. Port B should be set by the CF command to RS485. The Modbus driver sets the communication interface to 3-state output allowing multi-drop transmission by several PTS slaves. The master would normally be a 4 wire RS422 or RS485 port on a PC or PLC containing termination of one end of the bus. This mode needs the slave reply (Tx) line to be terminated and biased at one point and resistors for this are provided in the PTS. The connections are as follows.

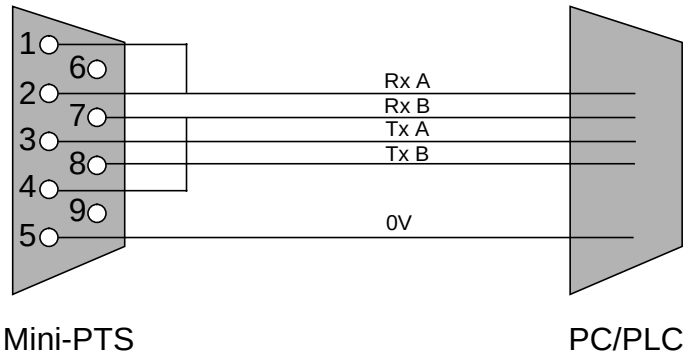

Figure 2. Mini-PTS 2+1 and PTS Mk 2 mulit-drop linking.

This wiring provides +5V bias to the RxA signal and 0V bias to the RxB signal. It also provides 120 ohm termination between RxA and RxB. It is assumed that the TxA and TxB lines are adequately biased in the PC port. If not a similar network may be needed.

