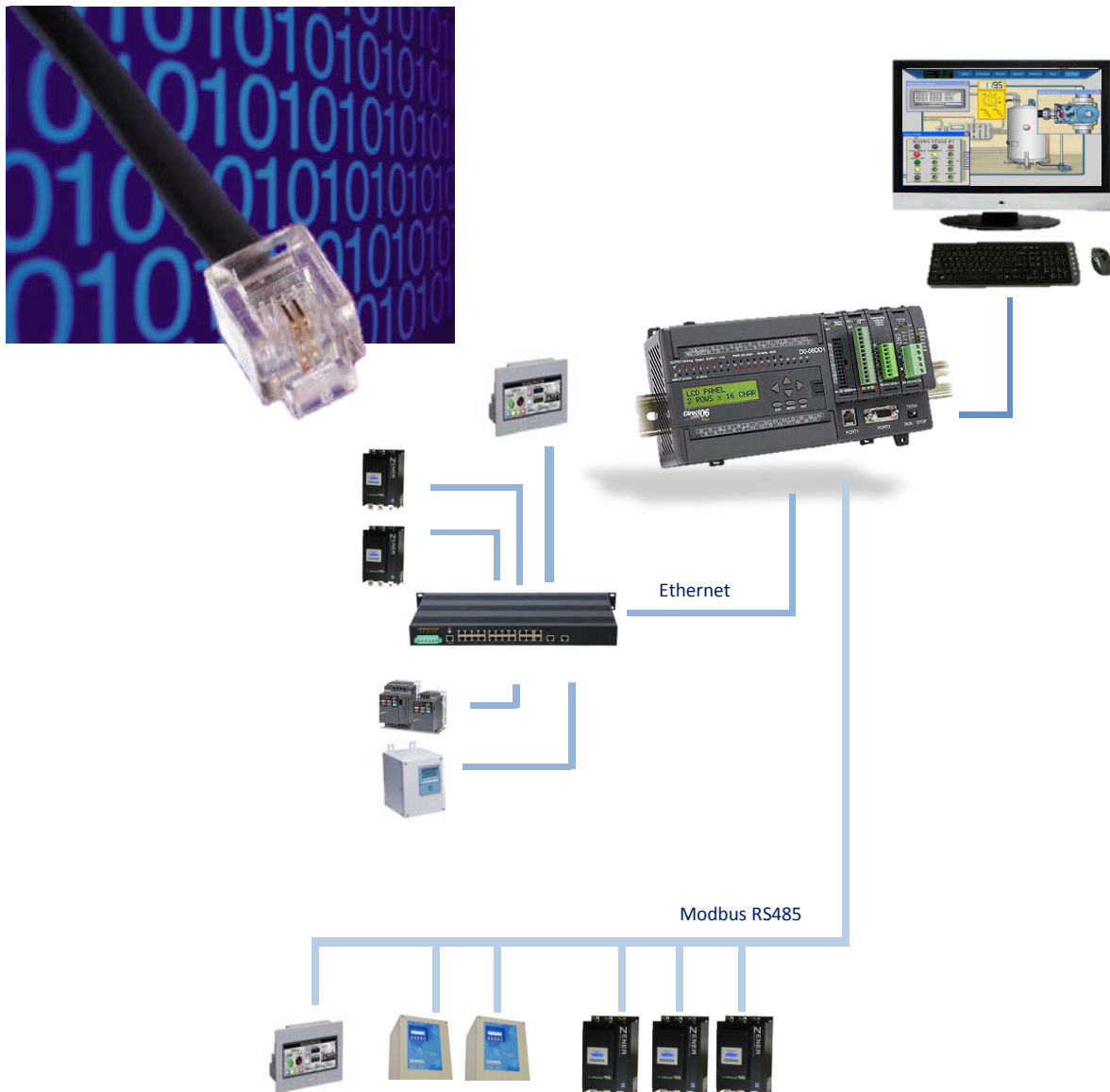


ZENER VARIDRIVE SOLUTIONS

ZENER SMARTSTART® 6000

Networking Guide



IMPORTANT – Read this first !

Each device on a Modbus RS485 serial bus must have a unique address; otherwise abnormal behaviour of the whole bus can occur, potentially inhibiting communication with all devices.

Only one network client must control and/or configure a Smartstart® 6000 at any given time, otherwise conflicts in register writes can arise which may result in unexpected behaviour or compromise system/motor protection. Network security must be in place to prevent access by unauthorised network clients.

On changeover between local and network control and vice versa, the motor may start or stop depending on the state of the new command source (local or network). This may result in an unintended operation on change of a configuration parameter or on change of state of the 'Local' input. The local and network control system (e.g. PLC) must be designed to satisfy the system's safety and operational requirements. Edge sense start logic (A53) and/or 3-wire control can be utilised to help avoid unintended motor starts.

Essential Services Override (ESO) request via network should only be used as backup to the normal local ESO request. Contact Zener for more information on ESO operation and associated risks.

Where Smartstart® 6000 configuration via network is utilised, network client (e.g. PLC) programming must be suitably designed and validated. Incorrect changes to Smartstart® 6000 settings may cause unexpected system behaviour and/or compromise motor/system protection.

This guide must be read in conjunction with the Smartstart® 6000 User Manual [1].

PLEASE NOTE:

This manual applies to Firmware Revision 1.30 and later. Earlier revisions will not support some functions like changing of parameters via communications.

Data Logger and SD card slot:

The Modbus TCP/IP option board includes a **Data Logger and SD card slot**. The logged data is saved to an SC card when fitted and cannot be accessed using communications.

For more information on the data logging function refer to the Data Logging Option manual document: [IM]I0057.

This manual and other manuals for the Smartstart® 6000 can be found on the support page:

<http://www.zener.com.au/support-6.php>

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1 Introduction

The Smartstart® 6000 supports the following networking features:

- Modbus RTU over EIA/RS-485 via embedded interface (3 wire cabling – screw terminal)
- Modbus over TCP via Ethernet option board (CAT 5, RJ45 connector)
- Monitoring, control and configuration of the SmartStart® 6000 via network
- Motor stops on a network timeout error (soft-stop or trip options)
- Digital input supports an override switch (force ‘Local’ control and configuration)
- Configurable network access permissions
- Comprehensive network diagnostic alarms and screens
- Easily configured via the Network menu

1.1 References

This document uses ‘[n]’ shorthand to reference the following documents:

- [1] SS6000 Soft Starter User Manual, IMI0042, Zener Electric (www.zener.com.au)
- [2] APPENDIX A: Smartstart® 6000 Modbus Map
- [3] Modbus Application Protocol Specification V1.1b3 (www.modbus.org)
- [4] Modbus over Serial Line Specification and Implementation Guide V1.02 (www.modbus.org)
- [5] Modbus Messaging on TCP/IP Implementation Guide V1.0b (www.modbus.org)
- [6] Basics of the RS-485 Standard, Technical Article, B&B Electronics (www.bb-elec.com)
- [7] RS-422 and RS-485 Applications eBook v1.0, B&B Electronics (www.bb-elec.com)

1.2 Definitions

Ox	Prefix for hexadecimal number (base 16)
AOK	All Okay
AR	Auto Reset/Restart. Automatically attempts to reset trip and restart motor.
CAT5	Category 5 (or 5e) cabling for Ethernet over twisted pair
CIDR	Classless Inter-Domain Routing (IP address format #.#.#.#/#)
Client	A device (e.g. PLC or SCADA) that initiates requests (also see master)
Coast	Free-wheel stop
Commit	A command issued by the network client to save configuration settings to NVM
Common	The signal common in the EIA/TIA standards
CRC	Cyclic Redundancy Check (detects communication errors)
Device	Electronic component connected to network (client or server)
DHCP	Dynamic Host Configuration Protocol (e.g. automatic IP address assignment)
EN	Local 'Enable' digital input. Must on to accelerate and run motor.
Enable	An input or flag that enables local/network control/configuration (check context).
ESO	Essential Services Override
FC	Function Code (Modbus definition)
FE	Framing Error (invalid stop bit)
HMI	Human-Machine Interface (e.g. console)
IP	Internet Protocol
LAN	Local Area Network (e.g. TCP/IP over Ethernet with CAT5 cabling)
LEN	Length (e.g. length error – packet too short or broken up)
Local	Local control and/or configuration (e.g. configurable input to 'force local')
LSB	Least Significant Bit (bit 0)
Master	Legacy term for client (e.g. RS485 terminology)
N/C	Normally Closed
Net	Network (or bus)
NG	Networking Guide (this document)
N/O	Normally Open
NVM	Non-Volatile Memory (e.g. EEPROM)
OR	Over Run (character overrun error)
Par2	A control input or flag used to select 2nd set of ramp control settings (when ON/TRUE)
PC	Personal Computer
PE	Parity Error
PLC	Programmable Logic Controller (network client/master)
RAM	Random Access Memory
Req	Request (from client to server)
Reset	Normally refers to trip reset. This can also trigger a motor restart.
Rollback	A command issued by the network client to retrieve last save configuration settings
ROM	Read Only Memory
Rsp	Response (from server back to client)
RTU	Remote Terminal Unit or a reference to the Modbus binary transmission mode
SCADA	Supervisory Control And Data Acquisition
Server	A device (e.g. Smartstart® 6000) that sends responses back to client (also see slave)
Slave	Legacy term for server (e.g. RS485 terminology)
TCP	Transmission Control Protocol
T/O	Timeout
Unit ID	Modbus TCP header field used to address serial line slave devices via gateway
XC	eXception Code (Modbus definition)

2 Getting Started

2.1 Prepare Check List

Prepare for commissioning on network by filling in the following check list.

	Item / Description	Parameter	Default	Setting	
Configure	Network protocol: Disabled; Modbus/RS485; or Modbus/TCP.	N01 Net Protocol	Disabled		
	Control via network and timeout behaviour: Disabled; Stop On T/O; or Trip On T/O. Note 1.	N02 Net Control	Disabled		
	Set control data loss timeout: 0.1 to 60.0 seconds.	N03 Net Timeout	5.0s		
	Configure via network: From 'Disabled' to 'All Settings'. Note 2 & 3.	N04 Net Config	Disabled		
	MB / RS485	Address: 1 to 247	N10 RS485 Addr	0	
		Speed: 4800 to 38400 baud	N11 RS485 Speed	19k2	
		Format: 8e1, 8o1, 8n1 or 8n2	N12 RS485 Format	8e1	
	Modbus / TCP	Set static IP Address or 0.0.0.0 for automatic assignment.	N20 IP Address	0.0.0.0 (DCHP)	
Set number of 1's in the subnet mask (CIDR notation).		N25 IP Mask Bits	/24		
Connect	Are site schematics or network cabling guidelines available?				
	Phone number for SCADA control centre (if applicable).				
	Modbus / RS485	Have suitable RS485 line terminators been installed at each end of line?			
		Have suitable RS485 line polarisation resistors been installed?			
Provision	Who will program and configure the network client (e.g. PLC) to work with the Smartstart®?				

Notes:

1. Enabling Net Control (N02) restricts local control functionality. Consider configuring a digital input as 'Local' to allow changeover to full local control.
2. Enabling Net Config (N04) disables setup by local user via console. Consider setting N04 last or configuring a digital input as 'Local' to allow changeover to local setup.
3. Important settings can be protected by setting N04 to an appropriate network configuration access level (see table in section 6.1).

2.2 Configure Network Settings

It is generally preferable to configure the network settings last, after all other settings have been configured. Enabling N04 Net Config will disable local user configuration access to other settings. Consider using the 'Input' menu to configure a digital input as 'Local' to allow for local override.

Configure the Smartstart® 6000 network settings before connecting it to a live network as incorrect settings could disrupt network communications. Use the console buttons to access the 'Network' menu. Set and review parameters as per the check list. Press [ESC] to exit the menu system. Settings changes take effect after menu exit and motor off.

2.3 Connect to Network

Before connecting the Smartstart® 6000 to a network, make sure the requirements for shielding, twisted pairs, signal common, line termination and line polarisation are understood (see section 8 Network Protocol Specifications). The Smartstart® 6000 provides following network terminals.

Smartstart® Terminal	Modbus Name [4]	EIA-485 Name	Recommended Wire Colour [4]	Description
17: SCREEN	-	-	Shield	Protective ground
22: RS485 DATA+	D1	B/B'	Yellow	High when bus idle (Note 2)
23: RS485 DATA-	D0	A/A'	Brown	Low when bus idle (Note 2)
24: RS485 COM	Common	C/C'	Green	Signal common (isolated)
ETHERNET PORT	-	-	CAT5 cable	RJ45 on RHS of Smartstart® 6000

Procedure:

1. Inform system control of task activity (e.g. possible alarms or disruptions)
2. Isolate Smartstart® 6000 (control and power circuits)
3. Wire network cabling to Smartstart® 6000 terminals per above table (Notes 2 and 3)
4. Turn Smartstart® 6000 on and check 'Net' status on the time/date screen (e.g. 'Live')
5. Inform system control of task completion (e.g. ready to provision for new Smartstart®)

Notes:

1. Incorrect configuration can disrupt the network (e.g. address must be unique).
2. Some vendors use A/B naming opposite to the EIA-485 standard.
3. Unplugging the Modbus RS485 connector also breaks the motor thermistor circuit.

2.4 Provision System for new Starter

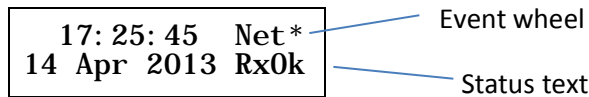
The Smartstart® 6000 is provisioned into a system by programming and configuring the network client (e.g. PLC). Information in this guide is provided to assist this process. Once provisioned, check the time/date screen to confirm Smartstart® 6000 is communicating correctly (e.g. Net status shows 'RxOK').

After the starter is correctly provisioned on the network, it is possible for a network client to automatically identify and configure the Smartstart® 6000 to suit the site and application. See chapter 6 for more information.

3 Network Diagnostics

3.1 Network Status Summary

The network status summary is shown on the RHS of the time & date dashboard screen:



The clockwise rotating 'event wheel' indicates the approximate rate of network transactions.

Status Text	Status Description	Possible causes / solutions
Off	Networking is disabled	Networking has not been configured. Check setting of 'Net Protocol' parameter.
Boot	Network adapter is initialising	Network adapter option board (e.g. Ethernet) is initialising.
Idle	Network is idle (no activity)	Smartstart® 6000 is not connected; network client is not connected or not running.
Live	Network is active, but the Smartstart® 6000 is NOT addressed	A network client is not programmed and/or not provisioned to address the Smartstart® 6000. The Smartstart® network address is not set correctly.
FLT!	Network adapter fault	Network adapter (e.g. Ethernet option board) is not detected or faulty (warning alarm is also raised).
BRK!	Communication break condition	Network wire is broken, short-circuited or reverse polarity. Check suitable line terminators and biasing resistors are installed. Check network wiring.
ERR!	Communication error occurred. Message is corrupt (discarded)	Data link settings are incorrect (baud, parity, stop bits, etc.), faulty cabling (wiring, termination, screening) or significant signal interference. Note 1.
BAD!	Processing exception occurred. Request is invalid (discarded)	The Smartstart® 6000 is being addressed okay (no data link errors), but request is invalid. Check network client (e.g. PLC) programming. Note 1.
RxOk	Request processed normally	Smartstart®6000 is receiving and processing requests normally. Note 2.
Ctrl	Control request accepted	Smartstart® 6000 recently received and accepted a control command write request. Note 2.
Conf	Configuration request accepted	Smartstart® 6000 recently received and accepted a configuration write request. Note 2.

Notes:

1. The Network Diagnostic menu can be used to further diagnose communications errors (ERR!) and processing exceptions (BAD!).
2. The 'Ctrl' and 'Conf' messages take precedence over 'RxOk'. They indicate that a control or configuration request was accepted (within last 3s). Control and configuration requests can be blocked by asserting the 'Local' input or changing the network settings ('N02 Net Control' and/or 'N04 Net Config').

3.2 Network Alarms

Network alarms indicate unusual network activity (e.g. incompatible client programming, rogue client, etc.). Warnings W17 or W18 can occur while the 'Local' input is asserted (i.e. force local).

Network Alarm	Comments
W06 NET CTRL T/O	Warns of pending control data loss timeout (when 'Net Control' enabled).
T06 NET CTRL T/O	Network controlled motor tripped due to control data loss timeout.
W16 NET REQ BAD	Invalid request. See exception code (XC) on "C3:ReqsBad" diagnostic screen.
W17 NET CTRL BLK	Control request blocked (i.e. by 'Net Control' par or 'Local' input).
W18 NET CONF BLK	Configuration request blocked (i.e. by 'Net Config' par or 'Local' input).
W19 NET CONF ERR	Configuration data discarded as value was out of bounds (range error).
T19 NET CONF ERR	Motor start attempted after 'NET CONF ERR' warning. Check client program.
T39 NET TRIP SIG	Network client tripped operating motor via the 'Trip' control command flag.

3.3 Network Diagnostic Menu

The network diagnostic menu provides comprehensive network diagnostic information including the diagnostic counters as defined in the Modbus specification [4]. Press the [RESET] key to clear the counters. Use this menu to diagnose network communication and/or measure transaction rate.

Network Diagnostic Screen	Description
Net Status Ctrl * Di ag Fl ags 003Ah	Network status text and event wheel as per "Network Status Summary". Network Diagnostic Flags (in hex) as per Smartstart® Modbus map [2].
C0: ReqsAok 12345 C1: BusMsgs 12345	Count of requests processed normally. Note 2. Count of error-free bus messages. Note 4.
C2: BusErrs 12345 FE PE OR LEN CRC	Count of bus messages with a data link communication error. Note 4. Shows "No comms errors" or lists the type of errors detected. Note 5.
C3: ReqsBad 12345 A001 FC016 XC002	Count of invalid (bad) requests received (processing exception occurred). Shows "No exceptions" or the last exception (bad request). Note 6.
C4: ReqsRxd 12345 A001 FC023 okay	Count of requests received (with or without exceptions). Shows "No requests" or the last function code. Note 6 and 7.
C5: ReqCast 12345 C6: RspNaks 12345	Count of broadcast requests received. Count of exception responses sent.
C7: RspBusy 12345 C8: OvrRuns 12345	Count of busy responses sent (always zero for Smartstart® 6000). Count of messages detected with a character overrun error.

Notes:

1. Press [RESET] to clear all diagnostic registers and counters (only when in this menu).
2. C0 is the event counter described in [3] for FC 11 "Get Comm Event Counter".
3. C1 to C8 correspond to the serial line diagnostic counter numbering as defined in [4].
4. Regarding C1 & C2, the Smartstart® does not error check messages to/from other devices.
5. Errors shown: framing, parity, overrun, length and CRC (FE, PE, OR, LEN & CRC).
6. Shows device address (A) & function code (FC). If applicable exception code (XC) is shown. A000 indicates a broadcast request. Meanings of exception codes (XC) are listed in [3].
7. For Modbus/TCP, the address (A) is the "Unit Identifier" from the Modbus/TCP header.

4 Network Protocols

4.1 Modbus Protocol

Modbus/RS485 and Modbus/TCP share the same application layer protocol (fully defined in [3]).

4.1.1 Modbus Function Codes

Supported Functionality	Supported Modbus Function Codes
Read 16-bit registers	FC 03, 04 & 23
Write 16-bit registers	FC 06, 16 & 23

Notes:

1. A full list of supported function codes is given in section 8.1.
2. Input registers overlap and holding registers (i.e. FC 03 and 04 are functionally equivalent).
3. FC 23 (read/write multiple registers) performs write operation before read.

4.1.2 Modbus Exception Codes

Code	Name	Meaning
XC 01	Illegal Function	Request contained an unsupported function code
XC 02	Illegal Data Address	Request referenced an undefined register address (i.e. not in [2])
XC 03	Illegal Data Value	Error in request format (e.g. implied length is incorrect). Note 1.
XC 11	Gateway target device failed to respond	The Smartstart® 6000 did not respond to a Modbus/TCP request. Check 'Net Protocol' is set to Modbus/TCP. Check gateway device.

Notes:

1. XC 03 does NOT cover range error in data written to registers. The application layer will discard configuration data that fails range check (see alarm 'W19 NET CONF ERR'). The client should read back configuration data where validation is required.

4.1.3 Modbus Map

The Smartstart® 6000 Modbus Map is fully defined in [2] and consists of the following groups:

Group Name	Access	Comments
Product Identification	Read Only	Model, version, etc. (constant data)
Trip Log	Read Only	Log of last 10 trips (persistent data)
Operation History	Read Only	Meters and counters (persistent data)
Operation Status	Read Only	Live status of Smartstart® 6000 operation (dynamic data)
Network Diagnostics	Read Only	Network diagnostic flags and counters (dynamic data)
Commands	Read/Write	Control and configuration commands. Note 2.
Settings	Read/Write	Configuration settings (parameters). Notes 2 & 3.

Notes:

1. Any request to: access undefined registers; write to read-only registers; or partially access long data objects (> 16 bit) will return an exception response (XC 02).
2. A normal response is returned even when control or configuration writes are blocked (see W17 & W18) or configuration data is out of bounds (see W19). Writes can be blocked by assertion of the 'Local' input or by network settings (see 'Net Control' and 'Net Config'). The client should read back configuration data when validation is required (e.g. use FC 23).
3. Data written to settings area is not saved to NVM unless a commit command is issued.
4. To avoid unexpected behaviour, ensure only one Modbus client writes to registers.
5. Ensure network security is in place to prevent writes from unauthorised clients.

5 Starter Monitoring and Control

5.1 Starter Status

Network clients can read any defined data object at any time to monitor Smartstart® 6000 status.

5.2 Network Control Permission/Enable

Starter control via network is only permitted when all of the following are satisfied:

- 'N02 Net Control' parameter is set to enable control via network
- 'Local' input (D1 or D2) is NOT asserted (or not configured)
- Enable (EN) digital input is asserted
- Network client (e.g. PLC) is regularly writing to the Control Command register
- Network client has set the Control Command Enable flag

Notes:

1. When control via network is not permitted (e.g. 'Net Control' disabled or 'Local' asserted), attempts to control the stater via network will raise the 'W17 NET CTRL BLK' warning alarm.
2. Both the EN input and the control command Enable flag must be asserted to start and run the motor via network. Loss of either of these conditions will initiate motor ramp down. However the EN input is not required (ignored) during an ESO request.

5.3 Control Command Flags

A network client can control the Smartstart® 6000 by regularly writing to the Control Command Flags register [2]. The following control flags are supported.

Flag	Description
Reset	0->1 = Attempts to reset trip alarm. Motor may start.
Enable	1 = enables start and run of motor; 1->0 = initiates motor stop
Start	1 = start motor (provided Enable on and other conditions permit start)
Coast	1 = force free-wheel stop
ESO	1 = Essential Services Override request (ignores starter and motor protection). Note 4.
Trip	0->1 = force trip of operating motor. Raises 'T39 NET TRIP SIG' alarm.
Par2	1 = use alternate ramp settings (2nd set). This flag is sampled at breakaway only.

Notes:

1. Acceptance of Start flag is per Start Logic (A53) setting (level or edge sense).
2. Enable and Start can be logically coupled for simple run/stop control. Keeping the Enable and Start flags asserted makes system highly available (when set for level sense start logic) and motor will auto start whenever conditions permit (e.g. network restoration, trip reset, restoration of line supply, activation of local enable input, etc.).
3. Where unintentional start must be avoided, review PLC Start flag logic, Start Logic (A53) setting and/or Net Control (N02) setting (e.g. trip on network timeout).
4. ESO is only available when a programmable input has been configured for ESO (Inputs menu). Network ESO request requires: Enable=1, Start=1, Coast=0 and ESO=1. Network ESO request should only be used as a backup of the local ESO request. See [1] for warnings regarding the use of the ESO mode.

5.4 Network Control Status Flags

The following status flags are useful to confirm network control of the Smartstart® 6000.

Register	Status Flag	Usage
Auxiliary Status Flags	Net Control Only	Network allowed to control Smartstart® 6000
“	Net Control Online	Network is controlling the Smartstart® 6000
Network Diagnostic Flags	Control Write Accepted	Network is controlling the Smartstart® 6000

5.5 Network Control Methods

There are number of terminal wiring options to support network control with or without local changeover support. The following is applicable when ‘N02 Net Control’ is enabled.

Control Method	Inputs Used	Description
Network Only	Enable (bridged)	Enable is bridged to +24VDC. Motor start and stop are only controlled by the network client. Local control is not available. If necessary, cycle control supply to accept configuration changes (i.e. force motor restart).
Network with Local Stop	Enable (switched)	Enable is wired to an N/C switch to provide local stop control. There is no provision to force local start. Closing switch may initiate a motor start (where PLC logic asserts Enable and Start flags).
Network with Simple Local control	Enable & Local	Enable and Local are wired to a three (3) position changeover switch (e.g. RUN/STOP/AUTO). This is simplest way to force local control of motor start and stop.
Network with Classic Local control	Enable, Local & Start	Enable and Local are wired to a three (3) position changeover switch (e.g. LOCAL/OFF/REMOTE) and Start is wired to N/O [START] button. Start input is only functional when the ‘Local’ input is asserted.

5.6 Network Control Timeout and Restoration

The motor stops when writes to the Control Command Flags register cease for ‘N03 Net Timeout’. The stop behaviour (normal stop or trip) is defined by the ‘N02 Net Control’ parameter. On restoration of network communications, the motor may automatically start (when network Enable and Start flags are on). This can be avoided by having PLC logic use a pulse timer for motor start, setting ‘A53 Start Logic’ to edge sense, and/or setting ‘N02 Net Control’ to ‘Trip on T/O’. After a ‘T06 NET CTRL T/O’ trip and network restoration, the PLC is able to reset the trip condition by toggling the ‘Reset’ control command flag.

5.7 Operating Motor when Network is down

If it is necessary to run motor when the network (or network client) is down, the Smartstart® 6000 will need to changeover to a ‘local only’ mode. Be aware that the motor may start on changeover. Options to change over to a local control mode are:

- Operate a changeover switch to force local control (assert the ‘Local’ input); or
- Change the ‘N02 Net Control’ parameter to ‘Disabled’ to permit local control.

5.8 Local/Network Changeover

Changing the state of the ‘Local’ input (force local mode) or the ‘N02 Net Control’ setting can change the control source. Bump-less transfer is supported when control signals are same as previous source. Depending on the state of the new control signals (Enable, Start, Stop & Coast), the motor may start or stop on changeover.

6 Starter Configuration

6.1 Network Configuration Access

Starter configuration via network is only permitted when all of the following are satisfied:

- 'N04 Net Config' parameter is set to enable configuration via network (see table)
- 'Local' input (D1 or D2) is NOT asserted (or not configured)
- Network client has recently set the Enable flag of the Configuration Command register

When configuration via network is not permitted (e.g. 'Net Config' disabled, 'Local' asserted, etc.), attempts to configure the starter via network will raise the 'W18 NET CONF BLK' warning alarm.

N04 Net Config	Writable Setting Groups	Comment
0: Disabled	None	All settings are protected (read only)
1: Display Only	Display settings only	Set date and time
2: Adjust Ramps	Display & Ramp settings	Adjust ramp control
3: Input/Output	Display, Ramp, Input & Output	Configure terminal I/O
4: Restart	Display, Ramp, I/O & Restart	Configure resets and auto restart (AR)
5: All settings	Includes Protection & Motor settings	Network can fully configure the starter

6.2 Configuration Command Flags

The Configuration Command register [2] supports the following command flags.

Flag	Description
Enable	1 = Enable configuration operations via network. Auto-clears after 60s. Note 1.
Commit	0->1 = Save configuration settings to NVM. Note 2.
Rollback	0->1 = Recall configuration settings from NVM.

Notes:

1. Enable must be asserted to permit other configuration commands and allow writes to the settings objects. Enable auto-clears after 60s to reinstate configuration write protection.
2. Commit should not be used too frequently as the internal NVM has a limited write cycle life.

6.3 Network Configuration Status Flags

The following configuration status flags [2] are supported.

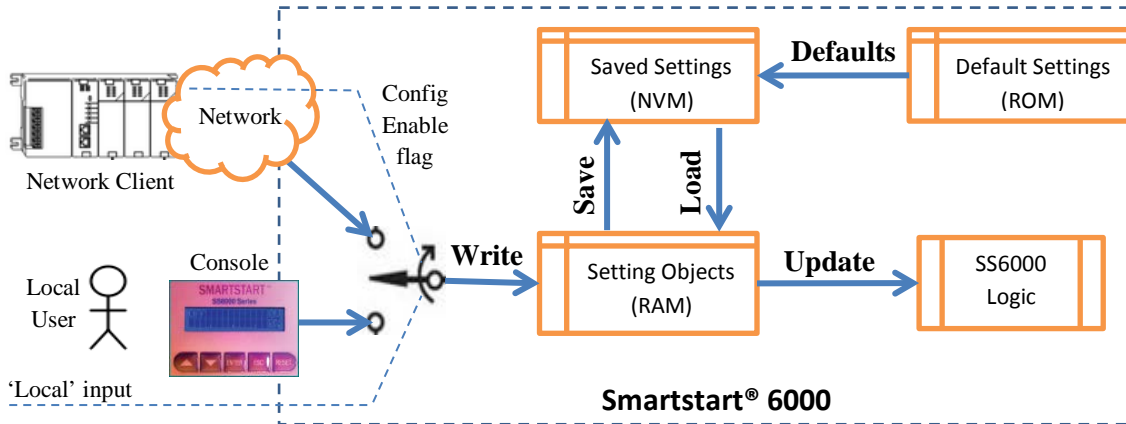
Register	Status Flag	Usage
Special Mode Flags	Network Config Only	Only a network client can configure unit
"	Network Config Enable	Net config Enable flag recently set (60s T/O)
"	Network Config Action	Net config cmd change or settings write (3s T/O)
"	Network Config Blocked	Net configuration operation blocked (3s T/O)
"	Network Config Error	Net config settings range error (3s T/O)
Network Diag Flags	Config Write Accepted	Recent configuration write request accepted

6.4 Configuration Errors

Should a network client attempt to write any setting outside the valid range (see [2]), the data is discarded and a warning alarm is raised (the W19 NET CONF ERR). Attempting to start the motor will raise a trip alarm (T19 NET CONF ERR). Other alarms can be raised should other configuration checks fail (e.g. 'T80 MTR AMPS CFG' for invalid motor amps setting). A trip reset operation is required to clear these alarms (e.g. to allow motor start). Check network client programming against the protocol map [2].

6.5 Configuration Memory Model and Operations

The network client must assert the configuration command Enable flag to be able to write to setting objects (in RAM) and issue special commands (commit = save and rollback = load). Alternatively a local user may override network configuration access by asserting the 'Local' input. In this case, any unsaved settings automatically rollback (load) and the local user is able to edit/write setting objects (RAM). Any changed settings auto-save to NVM when the user exits the setup menu.



Operation	Network Client	Local User	Comment
Write	Set Enable flag & write to setting object(s)	'Local' input ON; enter setup menu & edit settings	Only one client has write access to setting objects at any given time
Abort	Network client loses config access (e.g. 'Local' activated)	Local user loses config access (e.g. 'Local' deactivated)	Settings rollback to last saved values (Load). Abort also forces 'update' if motor is off.
Save	Commit command	Exit setup menu	Setting changes are saved to NVM
Update	Write complete and motor off	Exit setup menu and motor off	After write/edit completed, changes take effect when/after motor is off.
Load	Rollback command or abort	Control supply start or abort	Load settings from NVM.
Defaults	Not available	'Restore Defaults' command	Retrieve factory defaults from ROM (to NVM & RAM).

6.5.1 Local Configuration Edit

While the network has configuration access, a local user can only edit the 'Network' settings. Other settings return 'NET CONF ONLY'. The easiest way to get full local configuration access is to force local with the 'Local' input. Where this is not available, change 'N04 Net Config' to 'Disabled'.

6.5.2 Configuration Save

Configuration changes made by a network client are not automatically saved. A network client can issue the commit command to save changes. Configuration changes made by the local user are automatically saved when the user exits the setup menu.

6.5.3 Configuration Update

While configuration changes can be made at any time, the changes will not take effect until the motor is off (i.e. ramp down complete). A local user must also have exited the setup menu. If required, a local user can force motor OFF by turning the EN input or the control supply OFF.

6.6 Configuration Application Examples

6.6.1 Auto Configure after Starter Replacement

For some applications it is desirable that the system automatically configure an exchanged Smartstart® 6000. This requires installer and network client (e.g. PLC) to perform certain steps:

Who	Step	Description
Installer	Change out Smartstart® 6000	Replace Smartstart® 6000 and reconnect all wiring.
	Configure network settings	Edit network settings as required so network client can access the new Smartstart® 6000. This must include setting 'N04 Net Config' to 'All Settings'.
Network Client (e.g. PLC)	Detect need to reconfigure Smartstart® 6000	When Smartstart® 6000 comes online, read all settings and compare with expected values. Mismatch indicates Smartstart® 6000 needs to be reconfigured.
	Write required settings	Write required settings to Smartstart® 6000. Read back settings to validate configuration (recommended).
	Commit setting changes	Issue commit command to save settings to NVM.
Installer	Check settings	Use menu system to check the Smartstart® is configured as expected to suit installation.
	Protect settings (optional)	Option to protect configuration settings by setting 'N04 Net Config' to 'Disabled'; 'Display Only'; etc.
	Test new Smartstart® 6000	Test motor ramp up and ramp down to confirm operation is correct for installation.

6.6.2 Adjust Ramp Settings between Starts

For some applications it is desirable to adjust the ramp control settings regularly (e.g. between motor starts). During commissioning, the Smartstart® 6000 is configured to suit the primary application (either by a local user or by the network client). If desired, 'N04 Net Config' can then be set to 'Adjust Ramps' and thereby protect critical Smartstart® 6000 settings (e.g. so protection settings cannot be changed). Between motor starts, the network client can write new ramp control settings ready for the next start (stored in shadow RAM). The commit command should not be used for this type of application (i.e. maximise the life of Smartstart® 6000 NVM).

7 Data Representation

This section defines how different Smartstart® 6000 data objects are represented over a network.

7.1 Supported Data Types

Data Type	Length (bits)	Minimum Value	Maximum Value	Description
BOOLEAN	1	0 = False (off)	1=True (on)	Logical flag (typically packed in UINT16)
UINT8	8	0	255	8-bit unsigned integer
INT8	8	-128	+127	8-bit signed integer
UINT16	16	0	65,535	16-bit unsigned integer
INT16	16	-32,768	+32,767	16-bit signed integer
UINT32	32	0	4,294,967,295	32-bit unsigned integer
INT32	32	-2,147,483,648	+2,147,483,647	32-bit signed integer
BCD16	16	0x0000	0x9999	16-bit binary coded decimal (4 digits)
BCD32	32	0x00000000	0x99999999	32-bit binary coded decimal (8 digits)
ASCII[n]	8*n	32 = ' ' (Space)	126 = '~' (Tilde)	Array of printable ASCII characters

7.2 Data Encoding (Byte Order)

Protocol	Byte order	Comments
Modbus	Most significant byte sent first	Also known as big-endian or network order

Notes:

1. Modbus only defines how to encode 16-bit registers. The Smartstart® also uses the big-endian convention for larger data objects so the first register contains the most significant 16-bits. For example a UINT32 of value 200,000 is encoded as reg[N] = 3 & reg[N+1] = 3392.

7.3 Units of Measurement

Following are examples of units used by Smartstart® 6000 to represent quantities over a network.

Units	Descriptions	Data Object Example
0.1 %	Per mille (parts per thousand)	Ramp Progress
%	Percentage (parts per hundred)	C12 Start Torque
0.1 s	Time in tenths of a second	A11 Kick Time
s	Time in seconds	C11 Accel Time
0.1 min	Time in tenths of a minute (6 s)	A52 Minimum Off Time
0.1 hr	Time in tenths of an hour (360 s)	Operating Meter
0.1 Hz	Frequency in tenths of a Hertz	Line Frequency
C	Temperature in degrees Celsius	A42 Starter Over-temperature Reset Level
0.1 A	Current in tenths of an ampere	M01 Motor Amps
0.1 V	Voltage in tenths of a volt	Line Voltage
V	Voltage in volts	M02 Motor Volts
W	Power in Watts	Input Power
0.1 kWh	Energy in tenths of a kWh	Energy Meter
count	Number of items, events, etc.	Trip Counter
code	Numeric code (see encoding below)	Last Trip Code
ENUM	Enumeration (see encoding below)	Operating State

7.4 Encoding of Status Objects (Read Only)

The units for most status objects are defined in the protocol map [2]. The following table lists special encoding of status objects (i.e. where units specified as 'code' or 'ENUM').

Status Object	Encoding	Description
Product Identifier	0x5560	Read this to check the device is actually a Smartstart® 6000. Also consider checking other 'Product Identification' objects.
Trip Log # / Trip Code Active Alarm / Alarm Code Last Warning Code Last Trip Code	0: No alarm 1...99: see [1]	Alarm code/number. See list in user manual [1]. Used for logged trip alarm, current active alarm, last warning alarm, and last trip alarm.
Active Alarm / Alarm Type	0: 'I': Interlock 1: 'W': Warning 2: 'T': Trip	Indicates type of alarm.
Trip Log # / Operating State Operating State (Note 1)	0: 'O' Off 1: 'S' Standby 2: 'R' Ready 3: 'Y' Start Delayed 4: <i>Reserved</i> 5: 'K' Kick Start 6: 'A' Accelerating 7: 'U' Up To Speed 8: 'V' Overtime 9: 'C' Continuous 10: <i>Reserved</i> 11: 'B': Bypass 12: 'D' Decelerating 13: 'w' Deflux wait 14: 'W' Cooling wait 15: 'T' Tripped 16: 'P' AR Pending 17: 'L' AR Lockout 18: 'Z' Shutdown 19: 'z' Brownout	Line supply off and enable off Line supply off and enable on Line supply on and enable off Start delay due to cooling or min off delay Future use Kick start active Accel timer active but not up to speed Accel timer active and up to speed Accel timer expired and not up to speed Continuous conduction (full volts on motor) Future use Bypass contactor closed (full volts on motor) Deceleration ramp down active Short wait to deflux after motor turns off Waiting for starter and/or motor to cool Starter has tripped. See Trip Code for cause. Tripped, but auto reset/restart is pending Final trip after all AR attempts exhausted Control supply shutdown detected (normal) Persistent control supply under-voltage(fault)

Notes:

1. The op code shown (e.g. 'B' for Bypass), is the format displayed in trip log and data logger.

7.5 Encoding of Setting Objects (Read/Write)

The units and range of most setting objects are defined in the protocol map [2]. The following tables list special encoding used for setting objects (i.e. where units specified as 'code' or 'ENUM')

Advanced Setting	Encoding	Description
A21 Acceleration Profile A31 Deceleration Profile	0: Linear 1: Squared	Ramp shape can be configured to be a straight line or a quadratic (parabola).
A22 Acceleration Control A32 Deceleration Control	0: Voltage 1: Torque	Ramp can be configured for open-loop voltage control or closed-loop torque control
A53 Start Logic	0: Level Sense 1: Edge Sense	Select logic to use with start signal. Start signal is via network request or local input (EN or Start).

Control Setting	Encoding	Description
C01 Run Mode	0: Bypass (default) 1: Continuous	Set operating mode for when motor up to speed and acceleration time has expired

Display Setting	Encoding	Description
D01 Menu Access	1: Disabled 2: Read Only 3: Setup (default)	Set level of access a local user has to view and/or change settings. For high security the menu can be hidden or read-only.
D02 Default Screen	1: Clock & Net 2: Overview (default) 3: Thermal Cap. 4: Electrical 5: Power/Torque 6: Voltage Imbalance 7: Current Imbalance 8: Counters 9: Meters	Set the default screen for display on console. The other dashboard screens can be viewed at any time by scrolling with the [Up] and [Down] keys. The overview screen (default) includes a configurable bargraph.
D03 Bargraph Variable	1: Motor Current (def) 2: Motor Torque 3: Motor Thermal 4: Stator Thermal 5: Active Power 6: Power Factor	Select variable to display on bargraph.
D04 Bargraph Full Scale	0: 100% 1: 120% 2: 150% 3: 200% 4: 300% (default) 5: 400% 6: 600%	Set the full scale of bargraph display. Select value to best suit the expected range of the selected bargraph variable (D03).
D05 Flash Alarms D06 Alarm Over Bargraph	0: Disabled 1: Trips Only 2: Fault Warnings 3: Major Warnings 4: All Warnings 5: All Alarms (default)	Set filter level for display of alarms. Can filter alarms that are flashed over dashboard screen. Can filter alarms that override bargraph when motor is off (e.g. stop interlocks).

Motor Setting	Encoding	Description
M03 Motor Wiring	1: Standard 6 wire 2: Alternate 6 wire 3: Three wire (default)	Set how motor is wired to starter. Only applicable for starter models that support 6-wire motors.

Protection Setting	Encoding	Description
P01 Motor Over Load Class	0: Disabled 1: Class 2 2: Class 10a 3: Class 10 (default) 4: Class 15 5: Class 20 6: Class 25 7: Class 30	Set the thermal overload class of the connected motor where i2t thermal overload protection is required.
P02 Motor Over Temperature	0: Disabled (default) 1: N/C Switch 2: PTC Thermistor	Set type of motor temperature probe used for motor over temperature protection.
P03 Phase Rotation	0: Ignore (default) 1: 1-2-3 (normal) 2: 3-2-1 (reverse)	Set required phase sequence of line supply. Can be used to prevent pumps running in wrong direction.
P11 Overtime Alarm P21 Voltage Imbalance Alarm P31 Current Imbalance Alarm P41 Under Current Alarm P51 Over Current Alarm P61 Under Torque Alarm P71 Over Torque Alarm	0: Off 1: Warn 2: Trip	Set alarm level of different protection features. Protection alarm can be disabled (0), warn only (1) or warn and trip (2). Note that warning thresholds are defined either by A43 Warning Level or A44 Warning Delay.

Input Setting	Encoding	Description
X10 Digital Input 1 Mode X20 Digital Input 2 Mode	0: Disabled 1: Enabled 2: Inverted	Set to enable digital inputs (D1 & D2). The polarity can be set to suit application.
X11 Digital Input 1 Variable X21 Digital Input 2 Variable	0: Trip 1: Reset 2: Start 3: Stop 4: Coast 5: Local 6: ESO 7: Par2 8: Brake On	Select required function for digital inputs (D1 & D2).

Output Setting	Encoding	Description
Y10 Relay 1 Mode Y20 Relay 2 Mode Y30 Relay 3 Mode Y40 Relay 4 Mode	0: Disabled 1: Enabled 2: Inverted	Set to enable relay output (RL1...4). The polarity can be set to suit application.
Y11 Relay 1 Variable Y21 Relay 2 Variable Y31 Relay 3 Variable Y41 Relay 4 Variable	0: Test (On) 1: Fan Control 2: Line Control 3: Bypass Control 4: Acceleration Ramp 5: Deceleration Ramp 6: Ramping 7: Up To Speed 8: Motor On 9: Trip Alarm 10: Motor Loss 11: Frequency Error 12: Bypass Fault 13: Stater OL Trip 14: Motor OL Trip 15: Motor OT Trip 16: Phase Rotation 17: Digital Input Trip 18: Over Time 19: Voltage Imbalance 20: Current Imbalance 21: Under Current 22: Over Current 23: Under Torque 24: Over Torque 25: Warning Alarm 26: TOL Warning 27: Regen Power 28: AR Pending 29: AR Lockout 30: ESO Proof 31: Timer Relay 32: Brake Fault	Sets the function of relay outputs (RL1...4). Polarity is also configurable
Y50 Analogue Output Mode	0: Disable 1: 0-5V 2: 0-10V 3: 0-20mA 4: 4-20mA	Set electrical characteristics of the analogue output
Y51 Analog Output Variable	0: Test (100%) 1: Motor Current (def) 2: Motor Torque 3: Motor Thermal 4: Stater Thermal 5: Active Power 6: Power Factor	Select variable for the analogue output. Use Test (100%) to check analogue output is working.

8 Network Protocol Specifications

8.1 Modbus Application Layer

Item	Description	Notes
Function Codes	FC 03 Read Input Registers (max 125) FC 04 Read Holding Registers (max 125) FC 06 Write Single Register FC 16 Write Multiple Registers (max 123) FC 23 Read/Write Multiple Registers (max 121)	
Exception Codes	XC 01 Illegal Function XC 02 Illegal Data Address XC 04 Illegal Data Value XC 11 Gateway target device failed to respond (Modbus/TCP only)	
Reachable Registers	Defined in “Smartstart® 6000 Modbus Map” [2]	
Diagnostics	Available on display: status text, event wheel, diagnostic flags (including communication errors), diagnostic counters (per Modbus specification), last function code & last exception code.	

8.2 Modbus over RS485

Item	Description	Default / Notes
Implementation Class	All “basic” requirements. All “regular” requirements <u>except</u> ASCII transmission mode and 4 wire cabling.	
Addressing	0 to 247	0, Note 1
Baud Rate (bps)	4800, 9600, 19200 & 38400	19200
Parity	ODD, EVEN, NO (8o1, 8e1, 8n1 & 8n2)	EVEN, Note 2
Configurable	Yes (address, baud rate and parity)	
Broadcast	Yes	
Transmission Mode	Binary RTU only	
Electrical Interface	RS485 2 wire cabling (1 twisted pair plus Common)	Note 3
Connector Type	Screw terminals (Data+, Data-, Common & Screen)	
Grounding	Common is isolated (ground/screen terminal available)	Note 4
Line Isolation	Yes. Via internal isolated RS485 transceiver.	
Line Termination	Not provided	Note 5
Line Polarisation	Lightweight only (internal 10K pull up/down resistors)	Note 6

Notes:

1. When address is set to zero (default), only broadcast requests are accepted.
2. The 10 bit character format (8n1) is not compliant with the Modbus specification [4], but is supported for compatibility with other systems.
3. Shielded cable with two twisted pairs is recommended. Use one pair for circuit “Common” and other pair for balanced data lines. Connect shield of each cable segment to protective ground at one end only.
4. The “Common” circuit must be connected to all devices on the bus and connected directly to protective ground (at one point only, typically near the master device). “Screen” terminal provides a local protective ground (e.g. for cable shield).
5. It is required to place a Line Terminator near each of the two ends of the bus [4]. A resistor (e.g. 120 Ohms) is recommended for both Line Terminators [4].
6. Line polarisation (450 to 650 Ohms pull up and pull down) is recommended [4], typically near the master device. Take into account polarisation resistors built into other devices on the bus.

8.3 Modbus over TCP

Item	Description	Default / Notes
Implementation	Modbus TCP/IP server	
Addressing	Set a static IP address or assign via DHCP. Connect via TCP port 502 (fixed). Accepts any Unit Identifier. Note 1.	
Configurable	Yes. IP address and subnet mask bits. Set IP Address to 0.0.0.0 to enable assignment via DHCP.	0.0.0.0/24 (DHCP)
Network Interface	RJ45 Ethernet 10Base-T or 100Base-TX (auto-sensing)	
LEDs	Ethernet Link Activity (on RJ45 connector)	
Isolation	Yes. Via Ethernet magnetics.	
Diagnostics	Net "Boot" displayed while Ethernet adapter boots up. Net "FLT!" and warning "W08 ETH PORT FLT" displayed on boot failure. Other diagnostics as per Modbus application layer.	Check correct option board is fitted
Exception Codes (unique to Modbus/TCP)	XC 11 Gateway target device failed to respond. This indicates that Modbus/TCP client connected the Ethernet adapter okay, but the Smartstart® 6000 is not responding.	Check "N01 Net Protocol" is set correctly

Notes:

1. The Smartstart® 6000 is addressed by IP address and will respond irrespective of value in the Unit Identifier field (Modbus header).

9 APPENDIX A: Modbus Map

This section defines how Smartstart® 6000 data objects map into the Modbus holding register space. A data object can span multiple Modbus registers (e.g. UINT32 spans 2 registers). Modbus registers can contain multiple data objects (e.g. BOOLEAN flags, UINT8 codes, etc.).

Section 7 and the following table provide information to assist interpretation the Modbus map.

Column Title	Example Column Entry	Description
Reg No.	41087	Classic holding register number (40001 + address)
Hex Adr	0x043E	Register address used within protocol (base 16)
Dec Adr	1086	Register address used within protocol (base 10)
Bit	-	Identifies bit position for type BOOLEAN (0 = LSB)
GROUP NAME	OPERATING STATUS	Title of related group of data objects (see section 4.3)
Data Object Name	Motor Current	Name of data object
Regs	1	Number of registers in given data object (or group)
Data Type	UINT16	See section 7 for list supported types
Units (note 1)	0.1 A	Defines units/resolution (e.g. 123 represents 12.3 A)
Description	Current (from line CTs)	Provides extra information (e.g. setting range)

Notes:

1. Where units are shown as 'code' or 'ENUM', refer to tables in section 7
2. Some protocol converters by default try to ping the first holding register which does not exist in the SS6000 Modbus map. Ensure Ping Holding Address is set to a valid SS6000 Modbus register (e.g. 41025).

Reg No.	Hex Adr	Dec Adr	Bit	GROUP NAME / Data Item Name	Regs	Data Type	Units	Description. Also see Networking Guide (NG).
PRODUCT IDENTIFICATION					8	READ ONLY		Constant Data
41025	0x0400	1024		Product Identifier	1	UINT16	code	0x5560 for SMARTSTART 6000
41026	0x0401	1025		Firmware version number	1	UINT16	0.01	100 to 999 (version 1.00 to 9.99)
41027	0x0402	1026		Firmware revision letter	1	ASCII[1]		32 (' ') for none, 65 to 90 ('A' to 'Z')
41028	0x0403	1027		Product Series	1	ASCII[2]		"6E", "6R", "6V" etc (e.g. 0x3652 for "6R")
41029	0x0404	1028		Product Rating (full load current)	1	UINT16	0.1 A	e.g. 30 to 8300 for 3A to 830A models
41030	0x0405	1029		Product Option Flags . . .	1	. . .		See below . . .
		"	0	/ Custom Model		BOOLEAN		1 = Special customised model
		"	1	/ Six Wire Support		BOOLEAN		1 = Model supports 6 wire installation
		"	2	/ Reserved (to bit 15)		BOOLEAN		
41031	0x0406	1030		Modbus Map Version Number	1	UINT16	ENUM	See Modbus Version History (at end of this table)
41032	0x0407	1031		<i>Reserved</i>	1			
TRIP LOG					30	READ ONLY		Persistent Data
41033	0x0408	1032		Trip Log 1: Trip Info . . .	1			L01 trip log (most recent trip) . . .
		"	0..7	/ Operating State		UINT8 (low)	ENUM	Operating state at time of trip (see NG)
		"	8..15	/ Trip Code		UINT8 (high)	code	Cause of trip (see T## codes in user manual)
41034	0x0409	1033		Trip Log 1: Trip Date (month & day)	1	BCD16	mmdd	Date of trip (e.g. 0x1231 for December 31st)
41035	0x040A	1034		Trip Log 1: Trip Time (hour & minute)	1	BCD16	hhmm	Time of trip (e.g. 0x2359 for 23:59 = 11:59 PM)
41036	0x040B	1035		Trip Log 2	3	As above		L02 trip log (info, date and time)
41039	0x040E	1038		Trip Log 3	3	"		L03 "
41042	0x0411	1041		Trip Log 4	3	"		L04 "
41045	0x0414	1044		Trip Log 5	3	"		L05 "
41048	0x0417	1047		Trip Log 6	3	"		L06 "
41051	0x041A	1050		Trip Log 7	3	"		L07 "
41054	0x041D	1053		Trip Log 8	3	"		L08 "
41057	0x0420	1056		Trip Log 9	3	"		L09 "
41060	0x0423	1059		Trip Log 10	3	"		L10 " (oldest trip)
OPERATION HISTORY					8	READ ONLY		Persistent Data
41063	0x0426	1062		Energy Meter (kWh)	2	UINT32	0.1 kWh	kWh meter. Rollover after 99999999.9 (9 digits)
41065	0x0428	1064		Operating Meter (hrs)	2	UINT32	0.1 hr	Hours meter. "
41067	0x042A	1066		Start Counter	2	UINT32	count	Starts. Rollover after 999999999 (9 digits)
41069	0x042C	1068		Trip Counter	2	UINT32	count	Trips. "

NOTE:
Each trip log entry has the same format
(3 registers each). The trip log can be
cleared via the Commands menu.

Reg No.	Hex Adr	Dec Adr	Bit	GROUP NAME / Data Item Name	Regs	Data Type	Units	Description. Also see Networking Guide (NG).
				OPERATION STATUS	42	READ ONLY	Dynamic Data	
41071	0x042E	1070		Protection Threshold Flags . . .	1			<i>Pre-warning indication (e.g. threshold exceeded)</i>
		"	0	/ Starter Thermal Hot		BOOLEAN		1 = starter too hot to start (Ts > reset temp.)
		"	1	/ Motor Thermal Hot		BOOLEAN		1 = motor too hot to start (i2t TOL > reset level)
		"	2	/ Motor Overtemp Hot		BOOLEAN		1 = motor too hot to start (thermistor > ~1k6 ohms)
		"	3	/ Alarm Input D1 Detect		BOOLEAN		1 = trip input prewarning (e.g. low pressure)
		"	4	/ Alarm Input D2 Detect		BOOLEAN		1 = trip input prewarning (e.g. low flow)
		"	5	/ Acceleration Overtime Detect		BOOLEAN		1 = accel timer expired AND NOT up to speed
		"	6	/ Current Imbalance Detect		BOOLEAN		1 = imbalance detected (prewarning)
		"	7	/ Motor Stall Detect		BOOLEAN		1 = stall current detected (prewarning)
		"	8	/ Motor Overcurrent Detect		BOOLEAN		1 = heavy load detected (prewarning)
		"	9	/ Motor Overtorque Detect		BOOLEAN		1 = heavy load detected (prewarning)
		"	10	/ Motor Undercurrent Detect		BOOLEAN		1 = light load detected (prewarning)
		"	11	/ Motor Undertorque Detect		BOOLEAN		1 = light load detected (prewarning)
		"	12	/ Voltage Imbalance Detect		BOOLEAN		1 = imbalance detected (prewarning)
		"	13	/ Brake Fault Detect		BOOLEAN		1 = brake fault detected (prewarning)
		"	14	/ Reserved		BOOLEAN		
		"	15	/ Other Alarm Detect		BOOLEAN		1 = Another alarm input condition is active
41072	0x042F	1071		Protection Warning Flags . . .	1			<i>Pre-trip "warning" indication</i>
		"	0	/ Starter Thermal Warning		BOOLEAN		1 = thermal level above "Warn Level"
		"	1	/ Motor Thermal Warning		BOOLEAN		1 = "
		"	2	/ Motor Overtemp Warning		BOOLEAN		1 = near trip point (Rt > ~1k6 ohms)
		"	3	/ Alarm Input D1 Warning		BOOLEAN		1 = trip timer greater than "Warn Delay"
		"	4	/ Alarm Input D2 Warning		BOOLEAN		1 = "
		"	5	/ Acceleration Overtime Warning		BOOLEAN		1 = "
		"	6	/ Current Imbalance Warning		BOOLEAN		1 = "
		"	7	/ Motor Stall Warning		BOOLEAN		1 = "
		"	8	/ Motor Overcurrent Warning		BOOLEAN		1 = "
		"	9	/ Motor Overtorque Warning		BOOLEAN		1 = "
		"	10	/ Motor Undercurrent Warning		BOOLEAN		1 = "
		"	11	/ Motor Undertorque Warning		BOOLEAN		1 = "
		"	12	/ Voltage Imbalance Warning		BOOLEAN		1 = "
		"	13	/ Brake Fault Warning		BOOLEAN		1 = "
		"	14	/ Reserved		BOOLEAN		
		"	15	/ Other Alarm Warning		BOOLEAN		1 = Another alarm warning (see Warning Code)

Reg No.	Hex Adr	Dec Adr	Bit	GROUP NAME / Data Item Name	Regs	Data Type	Units	Description. Also see Networking Guide (NG).
OPERATION STATUS (Continued)								
41073	0x0430	1072		Protection Trip Flags . . .	1			<i>Trip indication (most common operation trips)</i>
		"	0	/ Starter Thermal Trip		BOOLEAN		1 = starter thermal overload/overtemp trip
		"	1	/ Motor Thermal Trip		BOOLEAN		1 = motor i2t thermal overload trip
		"	2	/ Motor Overtemp Trip		BOOLEAN		1 = motor overtemp (Rt reached 3k ohms)
		"	3	/ Alarm Input D1 Trip		BOOLEAN		1 = external trip input timeout
		"	4	/ Alarm Input D2 Trip		BOOLEAN		1 = external trip input timeout
		"	5	/ Acceleration Overtime Trip		BOOLEAN		1 = timeout waiting for motor to get up to speed
		"	6	/ Current Imbalance Trip		BOOLEAN		1 = imbalance timeout
		"	7	/ Motor Stall Trip		BOOLEAN		1 = motor stalled
		"	8	/ Motor Overcurrent Trip		BOOLEAN		1 = heavy load timeout
		"	9	/ Motor Overtorque Trip		BOOLEAN		1 = heavy load timeout
		"	10	/ Motor Undercurrent Trip		BOOLEAN		1 = light load timeout
		"	11	/ Motor Undertorque Trip		BOOLEAN		1 = light load timeout
		"	12	/ Voltage Imbalance Trip		BOOLEAN		1 = imbalance timeout
		"	13	/ Brake Fault Trip		BOOLEAN		1 = brake fault timeout
		"	14	/ Reserved		BOOLEAN		
		"	15	/ Other Alarm Trip		BOOLEAN		1 = Another alarm has tripped (see Trip Code)
41074	0x0431	1073		Input/Output Flags . . .	1			
		"	0	/ Control Supply Healthy		BOOLEAN		1 = on; 0 = PSU dip/brownout
		"	1	/ Line Supply On		BOOLEAN		1 = three phase line supply on (L1, L2, L3)
		"	2	/ Line Rotation 123 (Fwd)		BOOLEAN		1 = line on with forward rotation sequence
		"	3	/ Line Rotation 321 (Rev)		BOOLEAN		1 = line on with reverse rotation sequence
		"	4	/ Enable Input (EN)		BOOLEAN		1 = on/closed (local start/stop control)
		"	5	/ Digital Input 1 (D1)		BOOLEAN		1 = on/closed (programmable input)
		"	6	/ Digital Input 2 (D2)		BOOLEAN		1 = on/closed (programmable input)
		"	7	/ Thermistor Input		BOOLEAN		1 = okay/closed/cold (Rt < ~1k6 ohms)
		"	8	/ Current Sensed		BOOLEAN		1 = CTs sensing current
		"	9	/ Motoring (+ve power)		BOOLEAN		1 = power going to motor
		"	10	/ Regenerating (-ve power)		BOOLEAN		1 = power returning to line supply
		"	11	/ Reserved		BOOLEAN		
		"	12	/ Relay Output 1		BOOLEAN		1 = on/closed (programmable relay)
		"	13	/ Relay Output 2		BOOLEAN		1 = on/closed (programmable relay)
		"	14	/ Relay Output 3		BOOLEAN		1 = on/closed (programmable relay)
		"	15	/ Relay Output 4		BOOLEAN		1 = on/closed (programmable relay)

Reg No.	Hex Adr	Dec Adr	Bit	GROUP NAME / Data Item Name	Regs	Data Type	Units	Description. Also see Networking Guide (NG).
OPERATION STATUS (Continued)								
41075	0x0432	1074		Programmable Input Flags . . .	1			
		"	0	/ Trip Input		BOOLEAN		1 = trip request (e.g. low oil pressure)
		"	1	/ Reset Input		BOOLEAN		1 = reset trip request (e.g. panel keyswitch)
		"	2	/ Start Input		BOOLEAN		1 = start request at terminals (e.g. start button)
		"	3	/ Stop Input		BOOLEAN		1 = stop request at terminals
		"	4	/ Coast Input		BOOLEAN		1 = coast request at terminals
		"	5	/ Local Input		BOOLEAN		1 = request "Force Local" (disable net ctrl & cnfg)
		"	6	/ ESO Input		BOOLEAN		1 = local ESO request (overrides protection!)
		"	7	/ Par2 Input		BOOLEAN		1 = selects alternate ramp settings
		"	8	/ Reserved (to bit 15)		BOOLEAN		
401076	0x0433	1075		Programmable Signal Flags . . .	1			
		"	0	/ Trip Signal		BOOLEAN		1 = post delay signal
		"	1	/ Reset Signal		BOOLEAN		1 = post delay signal
		"	2	/ Start Signal		BOOLEAN		1 = post delay signal
		"	3	/ Stop Signal		BOOLEAN		1 = post delay signal
		"	4	/ Coast Signal		BOOLEAN		1 = post delay signal
		"	5	/ Local Signal		BOOLEAN		1 = post delay signal
		"	6	/ ESO Signal		BOOLEAN		1 = post delay signal
		"	7	/ Par2 Signal		BOOLEAN		1 = post delay signal
		"	8	/ Reserved (to bit 15)		BOOLEAN		
41077	0x0434	1076		Active Alarm . . .	1			<i>Highest priority active alarm</i>
		"	0..7	/ Alarm Code		UINT8 (low)	code	See codes in user manual (0...99)
		"	8..15	/ Alarm Type		UINT8 (high)	ENUM	0 = interlock; 1 = warning; 2 = trip (I## W## T##)

Reg No.	Hex Adr	Dec Adr	Bit	GROUP NAME / Data Item Name	Regs	Data Type	Units	Description. Also see Networking Guide (NG).
				OPERATION STATUS (Continued)				
41078	0x0435	1077		Special Mode Flags . . .	1			
			0	/ Local Config Only		BOOLEAN		1 = only the local console user can configure unit
			1	/ Network Config Only		BOOLEAN		1 = only the network client can configure unit
			2	/ Torque Control Active		BOOLEAN		1 = torque control active (accel or decel)
			3	/ Voltage Control Active		BOOLEAN		1 = voltage control active (kick, accel or decel)
			4	/ Current Limiting Active		BOOLEAN		1 = current limiting active (accel or decel)
			5	/ ESO Request		BOOLEAN		1 = ESO request (local or via network)
			6	/ ESO Proof		BOOLEAN		1 = ESO request, motor on and current sensed
			7	/ Any Trip Override		BOOLEAN		1 = starter on with any trip alarm (ESO)
			8	/ Starter Trip Override		BOOLEAN		1 = starter on with "starter" trip overridden (ESO)
			9	/ Starter Stressed (persistent flag)		BOOLEAN		1 = starter has been over stressed (void warranty)
			10	/ AR Pending		BOOLEAN		1 = automatic trip reset is pending (could restart)
			11	/ AR Lockout		BOOLEAN		1 = AR lockout on final trip (after AR Attempts)
			12	/ Network Config Enable		BOOLEAN		1 = Net Config Enable flag recently set (60s T/O)
			13	/ Network Config Action		BOOLEAN		1 = Net Config cmd change or settings write (3s T/O)
			14	/ Network Config Blocked		BOOLEAN		1 = Net configuration operation blocked (3s T/O)
			15	/ Network Config Error		BOOLEAN		1 = Net config setting range error (3s T/O)
41079	0x0436	1078		Auxiliary Status Flags . . .	1			
			0	/ Prewarning		BOOLEAN		1 = protection threshold exceeded
			1	/ Warning		BOOLEAN		1 = warning alarm (see Warning Code)
			2	/ Tripped		BOOLEAN		1 = latched trip/fault alarm (see Trip Code)
			3	/ Standby		BOOLEAN		1 = standing by for line power-up start (local only)
			4	/ Ready		BOOLEAN		1 = only waiting for Enable/Start command
			5	/ Local Control Only		BOOLEAN		1 = force local control or net control disabled
			6	/ Local Enable Command		BOOLEAN		1 = local control enable conditions
			7	/ Local Start Command		BOOLEAN		1 = local start request
			8	/ Network Control Only		BOOLEAN		1 = net control enabled AND NOT force local
			9	/ Network Control Online		BOOLEAN		1 = network control command recently accepted
			10	/ Net Enable Command		BOOLEAN		1 = network control enable conditions
			11	/ Net Start Command		BOOLEAN		1 = network start request
			12	/ Wait Delay (cooling)		BOOLEAN		1 = motor off delay or waiting to cool (mtr str)
			13	/ Start Delay Active		BOOLEAN		1 = start requested, but start is being delayed
			14	/ Reserved		BOOLEAN		
			15	/ Reserved		BOOLEAN		

Reg No.	Hex Adr	Dec Adr	Bit	GROUP NAME / Data Item Name	Regs	Data Type	Units	Description. Also see Networking Guide (NG).
OPERATION STATUS (Continued)								
41080	0x0437	1079		Operating Status Flags . . .	1			
		"	0	/ Line Control		BOOLEAN		1 = external line contactor on/close command
		"	1	/ Reserved		BOOLEAN		
		"	2	/ Fan Control		BOOLEAN		1 = internal fan on/run command
		"	3	/ Operating		BOOLEAN		1 = motor on/energised (SCRs or bypass)
		"	4	/ Ramping		BOOLEAN		1 = regulating conduction (kick, accel or decel)
		"	5	/ Starting		BOOLEAN		1 = ramp up active (starting, includes kick start)
		"	6	/ Kick Start		BOOLEAN		1 = kick start boost active
		"	7	/ Overtime		BOOLEAN		1 = accel timer expired and NOT Up To Speed
		"	8	/ Up To Speed		BOOLEAN		1 = at operating speed (continuous or bypass)
		"	9	/ Run Mode		BOOLEAN		1 = Up To Speed AND accel timer expired
		"	10	/ Bypass Control		BOOLEAN		1 = bypass contactor on/close command
		"	11	/ Continuous		BOOLEAN		1 = SCRs continuously firing
		"	12	/ Reserved		BOOLEAN		
		"	13	/ Stopping		BOOLEAN		1 = ramp down active (stopping/decel)
		"	14	/ Reserved		BOOLEAN		
		"	15	/ Reserved		BOOLEAN		

Reg No.	Hex Adr	Dec Adr	Bit	GROUP NAME / Data Item Name	Regs	Data Type	Units	Description. Also see Networking Guide (NG).
				OPERATION STATUS (Continued)				
41081	0x0438	1080		Last Warning Code	1	UINT16	code	Cause of last warning (see W## codes in manual)
41082	0x0439	1081		Last Trip Code	1	UINT16	code	Cause of last trip (see T## codes in user manual)
41083	0x043A	1082		Operating State	1	UINT16	ENUM	Current operating state (see NG)
41084	0x043B	1083		AR Counter	1	UINT16	count	Counts trips. Indicates # for next restart attempt.
41085	0x043C	1084		AR Delay	1	UINT16	s	Delay to next auto trip reset (0 = anytime)
41086	0x043D	1085		Ramp Progress Timer	1	UINT16	0.1 %	Ramps up to 1000 (accel) and down to 0 (decel)
41087	0x043E	1086		Motor Current (A)	1	UINT16	0.1 A	Current (from line CTs)
41088	0x043F	1087		Motor Current (%)	1	UINT16	0.1 % In	Current as % of motor rating
41089	0x0440	1088		Output Torque (%)	1	INT16	0.1 % Tn	Power/torque as % of motor rating (signed)
41090	0x0441	1089		Input Power (W, 32 bit)	2	INT32	1 W	Measured active input power (signed 32 bit)
41092	0x0443	1091		Input Power (%)	1	INT16	0.1 % Pn	Real input power as % of motor rating (signed)
41093	0x0444	1092		Power Factor	1	INT16	0.001	Power factor (cos phi, signed)
41094	0x0445	1093		Motor Thermal Capacity	1	UINT16	0.1 %	Thermal capacity remaining (trips at 0%)
41095	0x0446	1094		Motor Thermistor Resistance	1	UINT16	1 ohm	Value above 10k ohms indicates open circuit
41096	0x0447	1095		Starter Heatsink Temperature	1	UINT16	0.1 K	Measured heatsink temperature
41097	0x0448	1096		Starter Thermal Capacity	1	UINT16	0.1 %	Thermal capacity remaining (trips at 0%)
41098	0x0449	1097		Ambient Temperature	1	UINT16	0.1 K	Ambient temperature (0 K = not available)
41099	0x044A	1098		Line Voltage (V)	1	UINT16	0.1 V	Line voltage
41100	0x044B	1099		Line Voltage (%)	1	UINT16	0.1 %	Line voltage
41101	0x044C	1100		Line Frequency	1	UINT16	0.1 Hz	Line frequency
41102	0x044D	1101		Current Imbalance	1	UINT16	0.1 %	Current imbalance
41103	0x044E	1102		Phase L1 Current	1	UINT16	0.1 A	Phase current
41104	0x044F	1103		Phase L2 Current	1	UINT16	0.1 A	Phase current
41105	0x0450	1104		Phase L3 Current	1	UINT16	0.1 A	Phase current
41106	0x0451	1105		Voltage Imbalance	1	UINT16	0.1 %	Voltage imbalance
41107	0x0452	1106		Phase L12 Voltage	1	UINT16	0.1 V	Phase to phase voltage
41108	0x0453	1107		Phase L23 Voltage	1	UINT16	0.1 V	Phase to phase voltage
41109	0x0454	1108		Phase L31 Voltage	1	UINT16	0.1 V	Phase to phase voltage
41110	0x0455	1109		<i>Reserved</i>	3			

Reg No.	Hex Adr	Dec Adr	Bit	GROUP NAME / Data Item Name	Regs	Data Type	Units	Description. Also see Networking Guide (NG).
				NETWORK DIAGNOSTICS	10	READ ONLY		Dynamic Data
41113	0x0458	1112		Network Diagnostic Flags . . .	1			
		"	0	/ Listen Only Mode		BOOLEAN		1 = special network diagnostic mode (LOM)
		"	1	/ Bus Active		BOOLEAN		1 = bus activity detected (Live, not Idle)
		"	2	/ Broadcast Request Received		BOOLEAN		1 = broadcast request received (no errors)
		"	3	/ Normal Request Received		BOOLEAN		1 = addressed request received (no errors)
		"	4	/ Normal Response Sent		BOOLEAN		1 = normal response sent
		"	5	/ Control Write Accepted		BOOLEAN		1 = control write accepted (Net status = 'Ctrl')
		"	6	/ Config Write Accepted		BOOLEAN		1 = config write accepted (Net status = 'Conf')
		"	7	/ Reserved		BOOLEAN		
		"	8	/ Communication Error		BOOLEAN		1 = data error detected (FE, PE, OR, LEN, CRC)
		"	9	/ Framming Error		BOOLEAN		1 = invalid stop bit detected (FE)
		"	10	/ Parity Error		BOOLEAN		1 = invalid parity bit detected (PE)
		"	11	/ Character Overrun		BOOLEAN		1 = receive buffer overrun error (OR)
		"	12	/ Length Error		BOOLEAN		1 = unexpected msg length (LEN) short, split etc.
		"	13	/ CRC Error		BOOLEAN		1 = cyclic Redunancy Check failed (CRC)
		"	14	/ Bad Request Received (exception)		BOOLEAN		1 = exception occurred processing request
		"	15	/ Exception Response Sent		BOOLEAN		1 = exception response sent (after bad request)
NOTE: Most of the above flags auto-clear every 10 seconds.								
41114	0x0459	1113		Good Requests Received (AOK)	1	UINT16	count	C0: ReqsAok = Modbus "Comm Event Counter"
41115	0x045A	1114		Bus Message Count (total on bus)	1	UINT16	count	C1: BusMsgs = Bus messages without data errors
41116	0x045B	1115		Bus Comms Error Count	1	UINT16	count	C2: BusErrs = Bus messages with data errors
41117	0x045C	1116		Server Exception Error Count	1	UINT16	count	C3: ReqsBad = Bad requests (exceptions)
41118	0x045D	1117		Server Message Count	1	UINT16	count	C4: ReqsRxd = Requests received (good & bad)
41119	0x045E	1118		Server No Response Count	1	UINT16	count	C5: ReqCast = Broadcast requests rxd (no rsp)
41120	0x045F	1119		Server NAK Count (response sent)	1	UINT16	count	C6: RspNaks = Exception responses sent (neg ack)
41121	0x0460	1120		Server Busy Count (response sent)	1	UINT16	count	C7: RspBusy = Server busy exception rps sent
41122	0x0461	1121		Character Overrun Count	1	UINT16	count	C8: OvrRuns = Messages with overrun error
NOTE: The above data is also viewable via the Network Diagnostic menu. See Networking Guide (NG) for more detail.								

Reg No.	Hex Adr	Dec Adr	Bit	GROUP NAME / Data Item Name	Regs	Data Type	Units	Description. Also see Networking Guide (NG).
				COMMANDS	4	READ/WRITE	For write access, see Networking Guide (NG)	
42049	0x0800	2048		Control Command Flags	1			
		"	0	/ Reset		BOOLEAN		0->1 = attempt to reset trip condition
		"	1	/ Enable		BOOLEAN		1 = allow start/run; 0 = stop/decel motor
		"	2	/ Start		BOOLEAN		1 = start motor (pulse to latch)
		"	3	/ Coast		BOOLEAN		1 = force a freewheel stop
		"	4	/ ESO		BOOLEAN		1 = ESO request (requires Enable+Start+!Coast)
		"	5	/ Trip		BOOLEAN		0->1 = Trip operating motor ('T39 NET TRIP SIG' alm)
		"	6	/ Par2		BOOLEAN		1 = Use 2nd set of ramp control parameters
		"	7	/ Reserved (to bit 15)		BOOLEAN		For future compatibility, only write zero here.
42050	0x0801	2049		Config Command Flags	1			
		"	0	/ Enable Configuration		BOOLEAN		1 = enable configuration operations via netowrk
		"	1	/ Commit Configuration		BOOLEAN		0->1 = save configuration settings to NVM
		"	2	/ Rollback Configuration		BOOLEAN		0->1 = load configuration settings from NVM
		"	3	/ Reserved (to bit 15)		BOOLEAN		For future compatibility, only write zero here.
42051	0x0802	2050		<i>Reserved</i>	2			For future compatibility, only write zero here.
				DISPLAY SETTINGS	16	READ/WRITE	For write access, see Networking Guide (NG)	
42053	0x0804	2052		D01 Menu Access	1	UINT16	ENUM	3* = Setup: 1 to 3
42054	0x0805	2053		D02 Default Screen	1	UINT16	ENUM	2* = Overview: 1 to 9
42055	0x0806	2054		D03 Bargraph Variable	1	UINT16	ENUM	1* = Motor Current: 1 to 6
42056	0x0807	2055		D04 Bargraph Full Scale	1	UINT16	ENUM	4* = 300%: 0 to 6
42057	0x0808	2056		D05 Flash Alarms	1	UINT16	ENUM	5* = All Alarms: 0 to 5
42058	0x0809	2057		D06 Alarm Over Bargraph	1	UINT16	ENUM	5* = All Alarms: 0 to 5
42059	0x080A	2058		<i>Reserved</i>	2			
42061	0x080C	2060		A43 Warning Alarm Level	1	UINT16	%	90% : 50 to 100% of trip point (raise warning).
42062	0x080D	2061		A44 Warning Alarm Delay	1	UINT16	%	50% : 25 to 100% of trip delay (raise warning).
42063	0x080E	2062		D11 Year	1	UINT16	year	2000 to 2999
42064	0x080F	2063		D12 Month	1	UINT16	month	1 to 12 (January to December)
42065	0x0810	2064		D13 Day	1	UINT16	day	1 to 31 (max can also be 28, 29 or 30)
42066	0x0811	2065		D21 Hour	1	UINT16	hour	0 to 23
42067	0x0812	2066		D22 Minute	1	UINT16	minute	0 to 59
42068	0x0813	2067		D23 Second	1	UINT16	seconds	0 to 59

NOTE: For Units of 'ENUM' or 'code', see tables in Networking Guide (NG) for full list of options.

Reg No.	Hex Adr	Dec Adr	Bit	GROUP NAME / Data Item Name	Regs	Data Type	Units	Description. Also see Networking Guide (NG).
RAMP SETTINGS					22	READ/WRITE		For write access, see Networking Guide (NG)
42069	0x0814	2068		C01 Run Mode	1	UINT16	ENUM	0* = Bypass ; 1 = Continuous; *=default
42070	0x0815	2069		C02 Current Limit 1	1	UNIT16	%	450% : 100 to 450%
42071	0x0816	2070		C03 Current Limit 2	1	UNIT16	%	450% : 100 to 450%
42072	0x0817	2071		<i>Reserved</i>	1			
42073	0x0818	2072		C11 Accel Time 1	1	UNIT16	s	10s : 1 to 60s
42074	0x0819	2073		C12 Start Torque 1	1	UNIT16	%	30% : 0 to 200%
42075	0x081A	2074		C13 Final Torque 1	1	UNIT16	%	100% : 15 to 200%
42076	0x081B	2075		C21 Decel Time 1	1	UNIT16	s	0s : 0 to 120s (0s = coast)
42077	0x081C	2076		C22 Release Torque 1	1	UNIT16	%	20% : 0 to 100%
42078	0x081D	2077		C31 Accel Time 2	1	UNIT16	s	15s : 1 to 60s
42079	0x081E	2078		C32 Start Torque 2	1	UNIT16	%	30% : 0 to 200%
42080	0x081F	2079		C33 Final Torque 2	1	UNIT16	%	100% : 15 to 200%
42081	0x0820	2080		C41 Decel Time 2	1	UNIT16	s	15s : 0 to 120s (0s = coast)
42082	0x0821	2081		C42 Release Torque 2	1	UNIT16	%	20% : 0 to 100%
42083	0x0822	2082		A11 Kick Time	1	UNIT16	0.1 s	0.0s : 0.0 to 2.0s; 0.0s = kick start disabled.
42084	0x0823	2083		A12 Kick Level	1	UNIT16	%	70% : 50 to 100%
42085	0x0824	2084		A21 Accel Profile	1	UINT16	ENUM	0 = Linear; 1* = Squared ; *=default
42086	0x0825	2085		A22 Accel Control	1	UINT16	ENUM	0 = Voltage; 1* = Torque ; *=default
42087	0x0826	2086		A31 Decel Profile	1	UINT16	ENUM	0* = Linear ; 1 = Squared; *=default
42088	0x0827	2087		A32 Decel Control	1	UINT16	ENUM	0 = Voltage; 1* = Torque ; *=default
42089	0x0828	2088		<i>Reserved</i>	2			
INPUT SETTINGS					10	READ/WRITE		For write access, see Networking Guide (NG)
42091	0x082A	2090		A53 Start Logic	1	UINT16	ENUM	0* = Level Sense ; 1 = Edge Sense; *=default
42092	0x082B	2091		<i>Reserved</i>	1			
42093	0x082C	2092		X10 Digital Input 1 Mode	1	UINT16	ENUM	0 = Disabled; 1* = Enabled ; 2 = Inverted; *=default
42094	0x082D	2093		X11 Digital Input 1 Variable	1	UINT16	ENUM	1* = Reset : 0 to 6. See NG for list of values.
42095	0x082E	2094		X12 Digital Input 1 Delay	1	UINT16	0.1 s	3.0s : 0.0 to 300.0s
42096	0x082F	2095		X20 Digital Input 2 Mode	1	UINT16	ENUM	0* = Disabled ; 1 = Enabled; 2 = Inverted; *=default
42097	0x0830	2096		X21 Digital Input 2 Variable	1	UINT16	ENUM	0* = Trip : 0 to 6. See NG for list of values.
42098	0x0831	2097		X22 Digital Input 2 Delay	1	UINT16	0.1 s	3.0s : 0.0 to 300.0s
42099	0x0832	2098		<i>Reserved</i>	2			

NOTE:
By default the ramp 1 settings are used. The ramp 2 settings are only used when the Par2 digital input or the Par2 control command flag is asserted. Par2 is sampled once, on motor start (i.e. at breakaway).

Reg No.	Hex Adr	Dec Adr	Bit	GROUP NAME / Data Item Name	Regs	Data Type	Units	Description. Also see Networking Guide (NG).
				OUTPUT SETTINGS	18	READ/WRITE	For write access, see Networking Guide (NG)	
42101	0x0834	2100		Y10 Relay 1 Mode	1	UINT16	ENUM	0 = Disabled; 1* = Enabled ; 2 = Inverted; *=default
42102	0x0835	2101		Y11 Relay 1 Variable	1	UINT16	ENUM	2* = Line Ctrl : 0 to 30 (see NG)
42103	0x0836	2102		Y20 Relay 2 Mode	1	UINT16	ENUM	0 = Disabled; 1* = Enabled ; 2 = Inverted; *=default
42104	0x0837	2103		Y21 Relay 2 Variable	1	UINT16	ENUM	3* = Bypass Ctrl : 0 to 30 (see NG)
42105	0x0838	2104		Y30 Relay 3 Mode	1	UINT16	ENUM	0 = Disabled; 1* = Enabled ; 2 = Inverted; *=default
42106	0x0839	2105		Y31 Relay 3 Variable	1	UINT16	ENUM	7* = Up To Speed : 0 to 30 (see NG)
42107	0x083A	2106		Y40 Relay 4 Mode	1	UINT16	ENUM	0 = Disabled; 1* = Enabled ; 2 = Inverted; *=default
42108	0x083B	2107		Y41 Relay 4 Variable	1	UINT16	ENUM	9* = Trip Alarm : 0 to 30 (see NG)
42109	0x083C	2108		Y50 Analog Output Mode	1	UINT16	ENUM	0* = Off ; 1=0-5V; 2=0-10V; 3=0-20mA; 4=4-20mA
42110	0x083D	2109		Y51 Analog Output Variable	1	UINT16	ENUM	1* = Mtr Current : 0 to 6 (see NG)
42111	0x083E	2110		Y52 Analog Output Full Scale	1	UINT16	%	200%: 50 to 500%
42112	0x083F	2111		<i>Reserved</i>	3			
42115	0x0842	2114		Y90 Timer Cycles	1	UINT16	count	0: 0 to 120; 0 = disabled. Up to 5 starts per hour.
42116	0x0843	2115		Y91 Timer Start (time of day)	1	UINT16	mins	420 (7am): 0 to 1439 minutes. As late as 23:59.
42117	0x0844	2116		Y92 Timer Run (duration)	1	UINT16	mins	120 (2hrs): 1 to 1200 minutes. Up to 20 hours.
42118	0x0845	2117		Y93 Timer Wait (duration)	1	UINT16	mins	180 (3hrs): 1 to 1200 minutes. Up to 20 hours.
				RESTART SETTINGS	14	READ/WRITE	For write access, see Networking Guide (NG)	
42119	0x0846	2118		A41 Motor Overload Reset Level	1	UINT16	%	75% : 10 to 90% of i2t thermal model (trips @ 100%)
42120	0x0847	2119		A42 Starter Overtemp Reset Level	1	UINT16	C	60C : 40 to 90 degrees Celsius (heatsink)
42121	0x0848	2120		A52 Minimum Off Time	1	UINT16	0.1 min	0.0 minutes: 0.0 to 600.0 mins (limit starts/hour)
42122	0x0849	2121		<i>Reseved</i>	1			
42123	0x084A	2122		R01 Manual Reset	1	UINT16	ENUM	0 = Disabled; 1* = Enabled ; *=default
42124	0x084B	2123		R02 Power Reset	1	UINT16	ENUM	0 = Disabled; 1* = Enabled ; *=default
42125	0x084C	2124		R03 Start Reset	1	UINT16	ENUM	0* = Disabled ; 1 = Enabled; *=default
42126	0x084D	2125		<i>Reseved</i>	1			
42127	0x084E	2126		R11 Auto Restart Attempts	1	UINT16	count	0 : 0 to 15 (0 = disabled = default)
42128	0x084F	2127		R12 Auto Restart Minimum Delay	1	UINT16	s	10s : 5 to 3600s
42129	0x0850	2128		R13 Auto Restart Clearing Time	1	UINT16	s	1200s : 10 to 7200s
42130	0x0851	2129		<i>Reseved</i>	3			

Reg No.	Hex Adr	Dec Adr	Bit	GROUP NAME / Data Item Name	Regs	Data Type	Units	Description. Also see Networking Guide (NG).
PROTECTION SETTINGS					32	READ/WRITE		For write access, see Networking Guide (NG)
42133	0x0854	2132		P01 Motor Overload Class	1	UINT16	ENUM	3* = Class 10: (0 to 7). See NG for list.
42134	0x0855	2133		P02 Motor Overtemp Input	1	UINT16	ENUM	0* = Disabled; 1 = N/C Switch; 2 = PTC Thermistor.
42135	0x0856	2134		P03 Phase Rotation	1	UINT16	ENUM	0* = Ignore; 1 = fwd (1-2-3); 2 = rev (3-2-1)
42136	0x0857	2135		<i>Reserved</i>	3			
42139	0x085A	2138		P11 Overtime Alarm	1	UINT16	ENUM	0* = Off; 1 = Warn; 2 = Trip; *=default
42140	0x085B	2139		P12 Overtime Delay	1	UINT16	s	120s : 5 to 300s
42141	0x085C	2140		P21 Voltage Imbalance Alarm	1	UINT16	ENUM	0 = Off; 1 = Warn; 2* = Trip; *=default
42142	0x085D	2141		P22 Voltage Imbalance Level	1	UINT16	%	25% : 5 to 25%
42143	0x085E	2142		P23 Voltage Imbalance Delay	1	UINT16	s	5s : 0 to 5s
42144	0x085F	2143		P31 Current Imbalance Alarm	1	UINT16	ENUM	0 = Off; 1 = Warn; 2* = Trip; *=default
42145	0x0860	2144		P32 Current Imbalance Level	1	UINT16	%	25% : 5 to 25%
42146	0x0861	2145		P33 Current Imbalance Delay	1	UINT16	s	10s : 1 to 10s
42147	0x0862	2146		P41 Under Current Alarm	1	UINT16	ENUM	0* = Off; 1 = Warn; 2 = Trip; *=default
42148	0x0863	2147		P42 Under Current Level	1	UINT16	%	10% : 10 to 100%
42149	0x0864	2148		P43 Under Current Delay	1	UINT16	s	10s : 1 to 90s
42150	0x0865	2149		P51 Over Current Alarm	1	UINT16	ENUM	0* = Off; 1 = Warn; 2 = Trip; *=default
42151	0x0866	2150		P52 Over Current Level	1	UINT16	%	100% : 80 to 250%
42152	0x0867	2151		P53 Over Current Delay	1	UINT16	s	10s : 0 to 30s
42153	0x0868	2152		P61 Under Torque Alarm	1	UINT16	ENUM	0* = Off; 1 = Warn; 2 = Trip; *=default
42154	0x0869	2153		P62 Under Torque Level	1	UINT16	%	10% : 10 to 100%
42155	0x086A	2154		P63 Under Torque Delay	1	UINT16	s	10s : 1 to 90s
42156	0x086B	2155		P71 Over Torque Alarm	1	UINT16	ENUM	0* = Off; 1 = Warn; 2 = Trip; *=default
42157	0x086C	2156		P72 Over Torque Level	1	UINT16	%	100% : 80 to 250%
42158	0x086D	2157		P73 Over Torque Delay	1	UINT16	s	10s : 0 to 30s
42159	0x086E	2158		<i>Reserved</i>	6			
MOTOR SETTINGS					10	READ/WRITE		For write access, see Networking Guide (NG)
42165	0x0874	2164		M00 Motor Wiring	1	UINT16	ENUM	1 = Std 6 wire; 2 = Alt 6 wire; 3* = 3 wire; *=default
42166	0x0875	2165		M01 Motor Amps	1	UINT16	0.1 A	default is starter amps (40 to 130%, but in 0.1A)
42167	0x0876	2166		M02 Motor Volts	1	UINT16	1 V	default is starter volts (48 to 116%, but in volts)
42168	0x0877	2167		M03 Motor Power Factor	1	UINT16	0.01	0.90 : 0.60 to 0.98 (cos phi)
42169	0x0878	2168		A51 Motor Stator Resistance	1	UINT16	0.1 %	3.0% : 1.5 to 5.0%
42170	0x0879	2169		<i>Reserved</i>	5			