

**DCSi-III:
ESP Power Optimizer,
Power Plus Optimizer,
Power Plus DSP,
Chopper Optimizer**

Users Guide

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1. Introduction

This document defines the NWL Transformers Distributed Control Systems Interface (DCSi) Module for use with NWL's Optimizer Family Controllers. The DCSi Module will serve as an interface between NWL's ESP Power Optimizer™ and Plant Distributed Control Systems (DCS) using Modbus RTU or ASCII protocol.

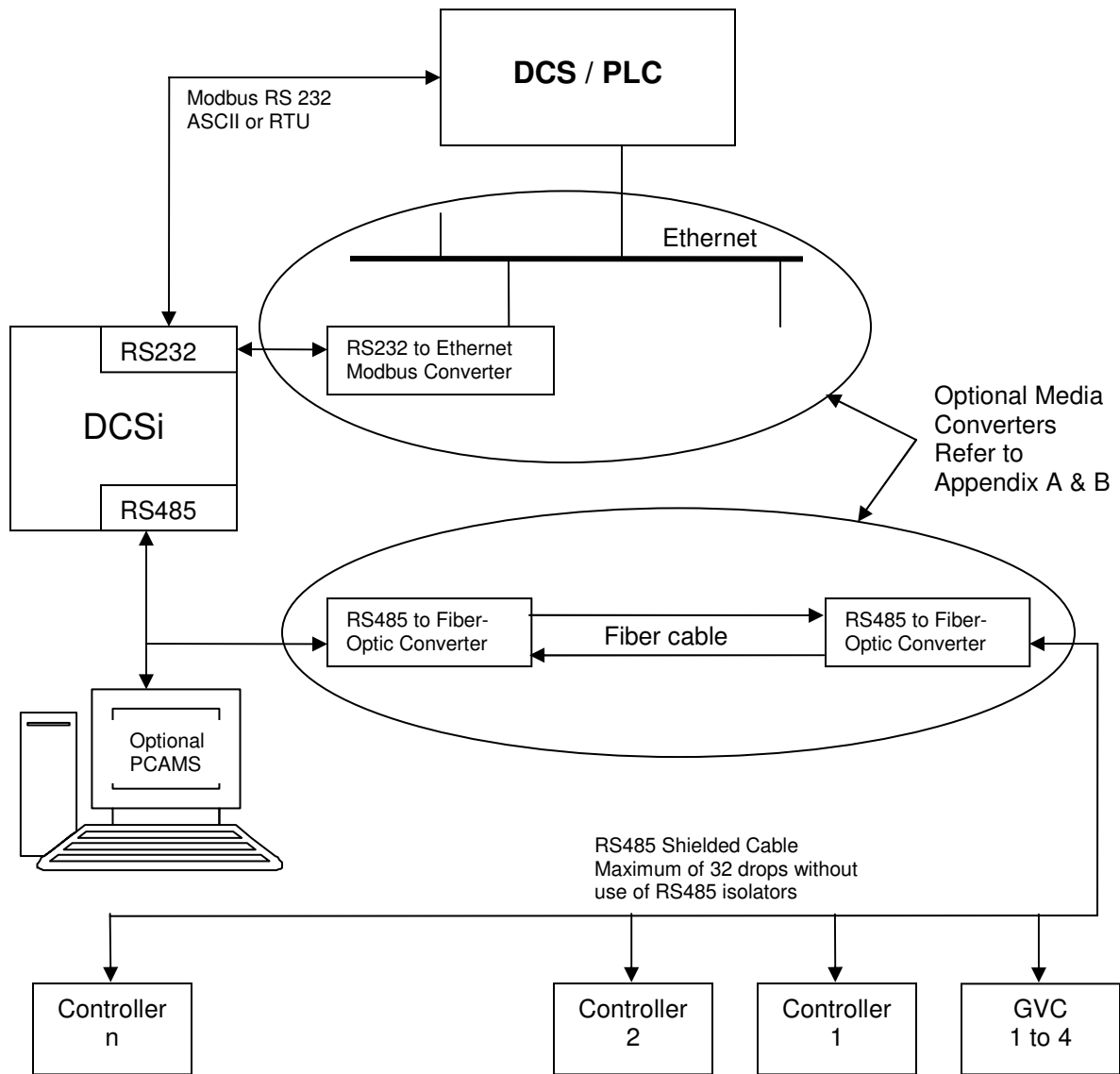
2. Acronyms/Definitions

DCSi	Distributed Control System Interface – The DCSi will provide an interface between a plant's distributed control system Modbus link and the NWL Optimizer/DSP Controller communication link.
GVC	Graphical Voltage Controller – Keypad/Display Module – Hand-held user interface used to monitor and program the Optimizer boards
ESP Power Optimizer	Microprocessor Controller for controlling SCR type Precipitator Power supplies
PowerPlus Optimizer	Microprocessor Controller for controlling High Frequency type Precipitator Power supplies
PowerPlus DSP	Microprocessor Controller for controlling High Frequency type Power supplies utilizing a DSP Processor with High Speed Sampling.
Chopper Optimizer	Microprocessor Controller for controlling Medium Frequency type Power supplies

3. Design Overview

The DCSi has two communication ports. Port 1 will communicate to the DCS system using either Modbus ASCII or Modbus RTU utilizing RS232. Port 2 will communicate to the Optimizer network utilizing RS485. The DCSi/Optimizer link addressing scheme allows for 1 DCSi, 1 PCAMS, 4 GVCs, and 90 Optimizers. The communication link is limited to 32 of these devices. With the use of RS485 isolators the network can be expanded to the full range of addressing. A system block diagram is shown below:

3.1 DCSi One Line Communication Diagram



DCSi One Line Communication Diagram

4. Hardware

4.1 DCSi Microcontroller Bd

NWL's Communications Microcontroller Board with the following features:

Processor	ST Micro UP3354, 40 MHz clock
Communication Ports	1 RS485 using microcontroller UART 1 RS232 using microcontroller UART
Memory	288K x 8 Flash 32K x 8 RAM
Watchdog Timer	

4.2 DCSi Power Supply/Terminal Module

NWL Transformers DCSi Power Supply/Terminal Module

Input	100-240 +10% -15% VAC, 50/60 Hz
Output	5 VDC \pm 5% @ 1000 mA
Environment	0° - 70° C operating, 5% - 95% relative humidity, non-condensing
Switches	10 position DIP switch for configuration, rear power switch
LED's	LED's showing Power and link activity.

4.3 DCSi Connector Pin Assignments

The DCSi does not use hardware handshaking and only requires the TXD, RXD, and GND connections. *The Plant DCS may require signals to be tied to specific voltage levels. Check your documentation for more information.*

Sample cable from Computer to DCSi (note the twist of pins 2 & 3)

9 Pin PC (AT) RS232 Serial Port		connects to	Rs232 3-pin Terminal	DCSi, 9pin D-sub
Pin 1	Carrier Detect (DCD)			
Pin 2	Receive Data (RXD)	—————	Pin 2	Pin 3
Pin 3	Transmit Data (TXD)	—————	Pin 1	Pin 2
Pin 4	Data Terminal Ready (DTR)			
Pin 5	Ground (GND)	—————	Pin 3	Pin 5
Pin 6	Data Set Ready (DSR)			
Pin 7	Request to Send (RTS)			
Pin 8	Clear to Send (CTS)			
Pin 9	Ring Indicator (RI)			

RS485 Connector (J3) to ESP Power Optimizers

The Length, Type, and routing of RS485 cable can make or break a RS485 network. Please be sure to use RS485 certified cable, keep segment lengths to less than 4000 ft, and DO NOT route the cable along with or next to high current devices/cabling or other noise emitting sources. Refer to NWL Drawing B117136 Rev A for NWL recommended RS485 guidelines.

J3 Pin #	Description
1	High
2	Low
3	Signal Common



For convenience also located on the front panel of the DCSi is a network port (RJ45) which can be used to attach a GVC Display module for viewing and/or confirmation of Optimizer network data. Power for the GVC is provided via this port therefore no remote power supply is required.

5. Functional Overview

5.1 Configuration

NWL Link	9600/19200 Baud (automatic detection) 8 data bits, 1 stop bit, no parity
DCS Link	19200/38400 Baud configurable Modbus RTU: 1 start bit, 8 data bits, no parity and stop bit Modbus ASCII: 1 start bit, 8 data bits, no parity and stop bit Modbus Slave Addresses configurable

5.2 Dip Switch Configuration

The DCSi's configuration is controlled via a 10 position Dip switch located on the front of the unit. The following tables provide the details for each switch position.

SW1-1	DCS Link Baud Rate
Off	38400
On	19200 (default)

SW1-2	DCSi Mode
Off	Redundant
On	Primary (default)

SW1-3	# of NWL Nodes *
Off	12 (default)
On	24

* - For best performance SW1-3 should be set to scan the minimum number of nodes connected. Therefore if the attached rs485 communication line has 12 or fewer Optimizer nodes setting this switch to off will provide better performance.

SW1-4	Unused

SW1-5	SW1-6	Modbus Slave Address
On	On	1 – 4 (default)
On	Off	5 – 8
Off	On	9 – 12
Off	Off	13 – 16

SW1-7 Bit 6	Protocol
Off	Modbus ASCII
On	Modbus RTU (default)



SW1-8	Extended Registers **
Off	No
On	Yes (default)

** - Note: Extended Registers refers to the Rotating Hammer Registers (Holding Registers 40083 -> 40146). If your application does not require this information SW1-8 should be set to the off position to increase bandwidth and scanning rate of remaining registers.

SW1-9	Unused

SW1-10	Rs485 120 ohm terminating resistor
Off	None
On	In Circuit (default)

5.3 Software

Programming the Plant's DCS to communicate with the NWL Transformers DCSi requires prior knowledge of the Modbus communications protocol. This section defines the Modbus register assignments utilized by the DCSi but does not discuss Modbus programming techniques.

The DCSi operates two (2) communications ports - 1 NWL Link, and 1 DCS Link. The NWL Link protocol and communication port parameters are automatically configured. The DCSi supports the Anti-collision protocol for the NWL Link.

5.3.1 Optimizer Recognition

The DCSi will scan the NWL Link after startup to determine the Optimizers that are on the link. Optimizers that do not respond will be re-checked for communications approximately every 10 minutes.

5.3.2 DCS Writes

When the DCS writes a value to the Optimizer via the DCSi, the DCSi will write the value followed by an immediate read. The value read will be updated in the Optimizer registers internal to the DCSi. This way, the DCS can read back the value (after a certain amount of delay), to determine if the value was accepted or rejected. If it was accepted, then the value will have been changed. If rejected, then the value would be the same as previous.

5.3.3 Supported Modbus Functions

Function #	Description	Register Range
3	Read Holding Registers	40001 - 50000
4	Read Input Registers	30001 - 40000
6	Preset Single Register	40001 - 50000
16	Preset Multiple Registers	40001 - 50000
17	Report Slave ID	n/a



5.3.4 DCSi Slave Type

The DCSi will report a Slave ID (function code 17) of 3 for a **Micro 584** Slave Type. The DCSi device has the following restrictions:

Function #	Maximum Registers per Query	Maximum Registers per Response
3	125	125
4	125	125
6	1	1
16	10	10

5.3.4.1 Modbus Slave Address

The Slave Address in combination with the Registers selected will determine which Controller is selected.

Modbus Slave Address	Controller Address Range
1, 5, 9, 13	10 - 33
2, 6, 10, 14	34 - 57
3, 7, 11, 15	58 - 81
4, 8, 12, 16	82 - 99

5.3.5 Input Registers

The input registers are for monitoring only. The DCSi continuously updates each Optimizers Input registers on a round robin basis. Input registers are scanned approximately every 1 second. Therefore each individual Optimizer's Input Registers will be updated per the following equation.

$$\text{Input Reg Update Rate (Seconds)} = \text{Qty of Active Optimizers}$$

Each Optimizer is assigned a block of input register numbers as shown below:

Register # Range	Optimizer Address
30001 – 30400	10
30401 – 30800	11
30801 – 31200	12
31201 – 31600	13
31601 – 32000	14
32001 – 32400	15
32401 – 32800	16
32801 – 33200	17
33201 – 33600	18
33601 – 34000	19
34001 – 34400	20
34401 – 34800	21
34801 – 35200	22
35201 – 35600	23
35601 – 36000	24
36001 – 36400	25
36401 – 36800	26
36801 – 37200	27
37201 – 37600	28
37601 – 38000	29
38001 – 38400	30
38401 – 38800	31
38801 – 39200	32
39201 – 39600	33
39601 – 40000	DCSi Status



The function of each register is shown in the following table. The register numbers in the table are for Optimizer address 10. By offsetting the register addresses in multiples of four hundred, other Optimizers are addressed.

Reg#	Addr	Description				Range				Units			
		ESP Power Optimizer	Power Plus	Power Plus DSP	Chopper	ESP...	Pwr. Plus	Pwr. Plus DSP	Chop.	ESP...	Pwr. Plus	Pwr. Plus DSP	Chop.
30001	10	Communication Status				0 – 1				Disabled/Enabled			
30002	10	Prim. Voltage	Line voltage			0 – 720				VAC			
30003	10	Prim. Current	Line current			0-750				AAC			
30004	10	Sec. Voltage1	KV	Sec. voltage		0 – 200				KVDC			
30005	10	Sec. Voltage2	Spare	KVpk	Spare	0-200	N/a	0-200	N/a	KVDC	N/a	KVDC	N/a
30006	10	Secondary Current				0 – 5000				mADC			
30007	10	Secondary Power				0 – 9999				KW x 10			
30008	10	Cond. Angle	Duty Cycle		Spare	0-160	0-100	0-10000	N/a	deg	%	%*100	N/a
30009	10	Current cond.	Spare	KVproduct	Spare	0-180	N/a	0-40000	N/a	deg	N/a	KV	N/a
30010	10	Spark rate				0-999				Sparks/min			
30011	10	Arc Rate	Spare	Arc Rate	Spare	0-99	N/a	0-99	N/a	Arc/min	N/a	Arc/min	N/a
30012	10	Contactor Status				0-1				Off, On			
30013	10	Alarm Status				0-24				See Note 1			
30014	10	Limit Status				0-8				See Note 2			
30015	10	Hammer 1 Status			Spare	0-1			N/a	Off,On			N/a
30016	10	Hammer 2 Status			Spare	0-1			N/a	Off,On			N/a
30017	10	Hammer 3 Status			Spare	0-1			N/a	Off,On			N/a
30018	10	Hammer 4 Status			Spare	0-1			N/a	Off,On			N/a
30019	10	Remote On Input Status				0-1				Off,On			
30020	10	Remote Enable Input Status				0-1				Off,On			
30021	10	Local/Remote Status				0-1				Local, remote			
30022	10	Pri.current x 10	Line current x 10			0-7500				AAC x 10			
30023	10	VAC Low Out of Range	Spare			0-1	N/a			No, Yes	N/a		
30024	10	VAC High Out of Range	Spare			0-1	N/a			No, Yes	N/a		
30025	10	AAC Low Out of Range	Spare			0-1	N/a			No, Yes	N/a		
30026	10	AAC High Out of Range	Spare			0-1	N/a			No, Yes	N/a		
30027	10	KVDC Low Out of Range	Spare			0-1	N/a			No, Yes	N/a		



Reg#	Addr	Description				Range				Units			
		ESP Power Optimizer	Power Plus	Power Plus DSP	Chopper	ESP...	Pwr. Plus	Pwr. Plus DSP	Chop.	ESP...	Pwr. Plus	Pwr. Plus DSP	Chop.
30028	10	KVDC High Out of Range	Spare		0-1	N/a			No, Yes	N/a			
30029	10	mADC Low Out of Range	Spare		0-1	N/a			No, Yes	N/a			
30030	10	mADC High Out of Range	Spare		0-1	N/a			No, Yes	N/a			
30031	10	KW Low Out of Range	Spare		0-1	N/a			No, Yes	N/a			
30032	10	KW High Out of Range	Spare		0-1	N/a			No, Yes	N/a			
30033	10	SPM High Out of Range	Spare		0-1	N/a			No, Yes	N/a			
30034	10	APM High Out of Range	Spare		0-1	N/a			No, Yes	N/a			
30035	10	Spare	Bus Voltage		N/a		0-700		N/a		VDC		
30036	10	Spare	Bus Current		N/a		0-500		N/a		ADC		
30037	10	Spare	Fan Current	Bus Current Ext	N/a		0-100	0-500	N/a		AAC * 10	ADC	
30038	10	Spare	Heat Sink Temp.	Volt.ref DAC	N/a		0-99	0-102	N/a		Deg C	%	
30039	10	Spare	IE ON Actual	Curr.Ref. DAC	N/a		1-200	0-110	N/a		mSec * 10	%	
30040	10	Spare	IE OFF Actual	Bus Power	N/a		1-990	0-9999	N/a		mSec * 10	KW*10	
:													
:													
30399	10	Device Type			1,2	3,4	9, 10	5,6,7,8	Local Port, Network Port				
30400	10	Device Address			10-99								
30401	11	Communication Status			0 - 1				Disabled/Enabled				
:													
:													
39600	33	Device Address			10-99								



5.3.6 System Input Register

The following registers are reserved for DCSi status information.

Reg#	Addr	Description	Range	Units
39601	N/a	Spare		
:				
:				
39994	N/a	NWL Link Communication Status	0-1	Disabled, Enabled
39995	N/a	DIP Switch Configuration	0-255	
39996	N/a	DCSi Uptime Days counter	0-65535	Days
39997	N/a	DCSi Uptime Hours counter	0-24	Hours
39998	N/a	DCSi Uptime Seconds counter	0-3600	Seconds
39999		DCSi Firmware Version ID	0-999	Version x 100
40000		Spare		

5.3.7 Holding Registers

The holding registers can be read and written, except registers 40168 and 40169, which are write-only. The Holding Registers will be updated upon power-up of the DCSi and then on a round robin basis occurring every 6 seconds. Therefore each individual's Optimizer's Holding Registers will be updated per the following equation.

$$\text{Holding Reg Update Rate (sec)} = 6 * \text{Qty of Active Optimizers}$$

Each SCPU is assigned a block of holding register numbers as shown below:

Register # Range	Optimizer Address	Register # Range	Optimizer Address
40001 – 40400	10	45201 – 45600	23
40401 – 40800	11	45601 – 46000	24
40801 – 41200	12	46001 – 46400	25
41201 – 41600	13	46401 – 46800	26
41601 – 42000	14	46801 – 47200	27
42001 – 42400	15	47201 – 47600	28
42401 – 42800	16	47601 – 48000	29
42801 – 43200	17	48001 – 48400	30
43201 – 43600	18	48401 – 48800	31
43601 – 44000	19	48801 – 49200	32
44001 – 44400	20	49201 – 49600	33
44401 – 44800	21	49601 – 50000	DCSi Status
44801 – 45200	22		



The function of each register is shown in the following table. The register numbers in the table are for Optimizer address 10. By offsetting the register addresses in multiples of four hundred, other Optimizers are addressed.

Note: All listed Registers are available in the PRO version of the DCSi. Only Registers that are listed in **BOLD with gray background** are available in the LITE version of the DCSi.

Reg#	Addr	Description				Range				Units				
		ESP Power Optimizer	Power Plus	Power Plus DSP	Chopper	ESP...	Pwr. Plus	Power Plus DSP	Chop.	ESP...	Pwr. Plus	Power Plus DSP	Chop.	
40001	10	Power Up with HV Mode				0-1				Off, Previous				
40002	10	IE Mode OFF/ON			Spare	0-1		N/a		Off, On		N/a		
40003	10	Manual Mode OFF/ON			Spare	0-1		N/a		Off, On		N/a		
40004	10	Fast Recovery OFF/ON		AutoTune Mode OFF/ON	Spare	0-1		N/a		Off, On		N/a		
40005	10	Back Corona OFF/ON		Spare		0-1		N/a		Off, On		N/a		
40006	10	Setback Offset Mode			Auto-Select Mode	Spare	0-1		N/a		Manual, Auto		Off, On	N/a
40007	10	Max. Cond. Select	Spare			1, 10	N/a			Volt Curr	N/a			
40008	10	Spark Setback			Spare	1-30			N/a		%		N/a	
40009	10	Quench time	Quench time (7)		Spare	1-10	0-20	1-20	N/a		Cycles	ms		N/a
40010	10	Fast Ramp	Fast Ramp (7)	Spare		2-20	0-20	N/a			Cycles	ms	N/a	
40011	10	Spark Rate			Spare	1-120			N/a		SPM		N/a	
40012	10	Ramp Mode		Spare		0-2		N/a		Linear, 3-Slope, 4-Slope		N/a		
40013	10	Current Limit				See Note 10	10 – 110			%				
40014	10	Secondary Voltage Limit				See Note 10	10 – 110			%				
40015	10	Secondary Undervoltage Trip			Spare	0-30			N/a		KVDC		N/a	
40016	10	Undervoltage Delay			Spare	See Note 10	5 – 45		N/a		Sec		N/a	



Reg#	Addr	Description				Range				Units			
		ESP Power Optimizer	Power Plus	Power Plus DSP	Chopper	ESP...	Pwr. Plus	Power Plus DSP	Chop.	ESP...	Pwr. Plus	Power Plus DSP	Chop.
40017	10	Pri. Volt. Limit	Spare		See Note 10	N/a			%	N/a			
40018	10	Pri. Uv. Trip	Spare		0-200	N/a			VAC	N/a			
40019	10	IE Half-Cyc On	Spare		1-20	N/a			½ cyc	N/a			
40020	10	IE Cyc Off	Spare		1-20	N/a			Cyc	N/a			
40021	10	Back Corona Time	Spare		10-180	N/a			Sec	N/a			
40022	10	Back Corona Increment	Spare		5-20	N/a			%	N/a			
40023	10	Back Corona Delay	Spare		1-60	N/a			Sec	N/a			
40024	10	Back Corona Phaseback	Spare		0-20	N/a			%	N/a			
40025	10	Setback Offset Setting		Spare	10-100		N/a		% N/a				
40026	10	Max.Volt. Conduction	Max Duty Cycle(8)	Max. voltage limit(8)	90-160	50-100		50-102	Deg	% N/a			
40027	10	Max Current Limit			30 - 110				% N/a				
40028	10	Spare			N/a				N/a				
40029	10	Spare			N/a				N/a				
40030	10	Spare			N/a				N/a				
40031 - 40040	10	Aux Alarm 1 Name			0 - 9, A - Z, Space				ASCII				
40041 - 40050	10	Aux Alarm 2 Name			0 - 9, A - Z, Space				ASCII				
40051 - 40060	10	Aux Alarm 3 Name			0 - 9, A - Z, Space				ASCII				
40061 - 40070	10	Aux Alarm 4 Name			0 - 9, A - Z, Space				ASCII				
40071	10	Ovr. Volt. Alarm. count	Ovr. Volt. Alarm. count		0-9999				See Note 9				
40072	10	Ovr. Current Alarm Count	Line Overcurrent count		0-9999								



Reg#	Addr	Description				Range				Units			
		ESP Power Optimizer	Power Plus	Power Plus DSP	Chopper	ESP...	Pwr. Plus	Power Plus DSP	Chop.	ESP...	Pwr. Plus	Power Plus DSP	Chop.
40073	10	Sparks Over 60 Alarm Count	Spare	Line VAC abnormal count	Spare	0-9999	N/a	0-9999	N/a				
40074	10	Controller High Temp. Alarm Count	Spare	Vbus abnormal count	Spare	0-9999	N/a	0-9999	N/a				
40075	10	SCR Unbal. Count	Spare		Fuse count	0-9999	N/a		0-9999				
40076	10	On/Off Starts Count				0 - 9999							
40077	10	Undervoltage Alarm Count				0 - 9999							
40078	10	SCR High Temp Alarm Count	Spare			0-9999	N/a						
40079	10	Clear Aux Alarm 1 Count				0							
40080	10	Clear Aux Alarm 2 Count				0							
40081	10	Clear Aux Alarm 3 Count				0							
40082	10	Clear Aux Alarm 4 Count				0							
40083 - 40085	10	Hammer 1 Name			Spare	0-9, A-Z, space			N/a	ASCII			N/a
40086	10	Hammer 1 Initial Wait Hours			Spare	0-23			N/a	Hours			N/a
40087	10	Hammer 1 Initial Wait Mins			Spare	0-59			N/a	Minutes			N/a
40088	10	Hammer 1 Initial Wait Secs			Spare	0-59			N/a	Seconds			N/a
40089	10	Hammer 1 Wait Hours			Spare	0-23			N/a	Hours			N/a
40090	10	Hammer 1 Wait Mins			Spare	0-59			N/a	Minutes			N/a
40091	10	Hammer 1 Wait Secs			Spare	0-59			N/a	Seconds			N/a
40092	10	Hammer 1 Duration Mins			Spare	0-59			N/a	Minutes			N/a
40093	10	Hammer 1 Duration Secs			Spare	0-59			N/a	Seconds			N/a
40094	10	Hammer 1 Clean Hours			Spare	0-23			N/a	Hours			N/a
40095	10	Hammer 1 Clean Mins			Spare	0-59			N/a	Minutes			N/a
40096	10	Hammer 1 Clean Secs			Spare	0-59			N/a	Seconds			N/a
40097	10	Hammer 1 Feedback			Spare	0-2			N/a	None, Input Closed, Input Open			N/a
40098	10	Hammer 1 Mode			Spare	0-3			N/a	See Note 3			N/a
40099 - 101	10	Hammer 2 Name			Spare	0-9, A-Z, space			N/a	ASCII			N/a
40102	10	Hammer 2 Initial Wait Hours			Spare	0-23			N/a	Hours			N/a



Reg#	Addr	Description				Range				Units			
		ESP Power Optimizer	Power Plus	Power Plus DSP	Chopper	ESP...	Pwr. Plus	Power Plus DSP	Chop.	ESP...	Pwr. Plus	Power Plus DSP	Chop.
40103	10	Hammer 2 Initial Wait Mins			Spare	0-59			N/a	Minutes			N/a
40104	10	Hammer 2 Initial Wait Secs			Spare	0-59			N/a	Seconds			N/a
40105	10	Hammer 2 Wait Hours			Spare	0-23			N/a	Hours			N/a
40106	10	Hammer 2 Wait Mins			Spare	0-59			N/a	Minutes			N/a
40107	10	Hammer 2 Wait Secs			Spare	0-59			N/a	Seconds			N/a
40108	10	Hammer 2 Duration Mins			Spare	0-59			N/a	Minutes			N/a
40109	10	Hammer 2 Duration Secs			Spare	0-59			N/a	Seconds			N/a
40110	10	Hammer 2 Clean Hours			Spare	0-23			N/a	Hours			N/a
40111	10	Hammer 2 Clean Mins			Spare	0-59			N/a	Minutes			N/a
40112	10	Hammer 2 Clean Secs			Spare	0-59			N/a	Seconds			N/a
40113	10	Hammer 2 Feedback			Spare	0-2			N/a	None, Input Closed, Input Open			N/a
40114	10	Hammer 2 Mode			Spare	0-3			N/a	See Note 3			N/a
40115 -117	10	Hammer 3 Name			Spare	0-9, A-Z, space			N/a	ASCII			N/a
40118	10	Hammer 3 Initial Wait Hours			Spare	0-23			N/a	Hours			N/a
40119	10	Hammer 3 Initial Wait Mins			Spare	0-59			N/a	Minutes			N/a
40120	10	Hammer 3 Initial Wait Secs			Spare	0-59			N/a	Seconds			N/a
40121	10	Hammer 3 Wait Hours			Spare	0-23			N/a	Hours			N/a
40122	10	Hammer 3 Wait Mins			Spare	0-59			N/a	Minutes			N/a
40123	10	Hammer 3 Wait Secs			Spare	0-59			N/a	Seconds			N/a
40124	10	Hammer 3 Duration Mins			Spare	0-59			N/a	Minutes			N/a
40125	10	Hammer 3 Duration Secs			Spare	0-59			N/a	Seconds			N/a
40126	10	Hammer 3 Clean Hours			Spare	0-23			N/a	Hours			N/a
40127	10	Hammer 3 Clean Mins			Spare	0-59			N/a	Minutes			N/a
40128	10	Hammer 3 Clean Secs			Spare	0-59			N/a	Seconds			N/a
40129	10	Hammer 3 Feedback			Spare	0-2			N/a	None, Input Closed, Input Open			N/a
40130	10	Hammer 3 Mode			Spare	0-3			N/a	See Note 3			N/a
40131 -133	10	Hammer 4 Name			Spare	0-9, A-Z, space			N/a	ASCII			N/a
40134	10	Hammer 4 Initial Wait Hours			Spare	0-23			N/a	Hours			N/a
40135	10	Hammer 4 Initial Wait Mins			Spare	0-59			N/a	Minutes			N/a
40136	10	Hammer 4 Initial Wait Secs			Spare	0-59			N/a	Seconds			N/a
40137	10	Hammer 4 Wait Hours			Spare	0-23			N/a	Hours			N/a
40138	10	Hammer 4 Wait Mins			Spare	0-59			N/a	Minutes			N/a
40139	10	Hammer 4 Wait Secs			Spare	0-59			N/a	Seconds			N/a
40140	10	Hammer 4 Duration Mins			Spare	0-59			N/a	Minutes			N/a



Reg#	Addr	Description				Range				Units			
		ESP Power Optimizer	Power Plus	Power Plus DSP	Chopper	ESP...	Pwr. Plus	Power Plus DSP	Chop.	ESP...	Pwr. Plus	Power Plus DSP	Chop.
40141	10	Hammer 4 Duration Secs			Spare	0-59			N/a	Seconds			N/a
40142	10	Hammer 4 Clean Hours			Spare	0-23			N/a	Hours			N/a
40143	10	Hammer 4 Clean Mins			Spare	0-59			N/a	Minutes			N/a
40144	10	Hammer 4 Clean Secs			Spare	0-59			N/a	Seconds			N/a
40145	10	Hammer 4 Feedback			Spare	0-2			N/a	None, Input Closed, Input Open			N/a
40146	10	Hammer 4 Mode			Spare	0-3			N/a	See Note 3			N/a
40147	10	Spare	Spare	Spare	N/a			N/a	N/a			N/a	
40148	10	Spare	Spare	Spare	N/a			N/a	N/a			N/a	
40149	10	Spare	Spare	Spare	N/a			N/a	N/a			N/a	
40150	10	Spare	Spare	Spare	N/a			N/a	N/a			N/a	
40151	10	Spare	Spare	Spare	N/a			N/a	N/a			N/a	
40152	10	Spare	Spare	Spare	N/a			N/a	N/a			N/a	
40153	10	Spare	Spare	Spare	N/a			N/a	N/a			N/a	
40154	10	Spare	Spare	Spare	N/a			N/a	N/a			N/a	
40155	10	Spare	Spare	Spare	N/a			N/a	N/a			N/a	
40156	10	Spare	Spare	Spare	N/a			N/a	N/a			N/a	
40157	10	Spare	Spare	Spare	N/a			N/a	N/a			N/a	
40158	10	Spare	Spare	Spare	N/a			N/a	N/a			N/a	
40159	10	Spare	Spare	Spare	N/a			N/a	N/a			N/a	
40160	10	Spare	Spare	Spare	N/a			N/a	N/a			N/a	
40161	10	Spare	Spare	Spare	N/a			N/a	N/a			N/a	
40162	10	Spare	Spare	Spare	N/a			N/a	N/a			N/a	
40163	10	Spare	Spare	Spare	N/a			N/a	N/a			N/a	
40164	10	Spare	Spare	Spare	N/a			N/a	N/a			N/a	
40165	10	Spare	Spare	Spare	N/a			N/a	N/a			N/a	
40166	10	Spare	Spare	Spare	N/a			N/a	N/a			N/a	
40167	10	Spare	Spare	Spare	N/a			N/a	N/a			N/a	
40168	10	Turn On/Off High Voltage				0-1 (Write-Only)				Off, On See Note 11			
40169	10	Clear Alarm				0-13	0-24	0-12	See Note 6				
40170	10	Power Control Active			Spare	0-1			N/a	No, Yes			N/a
40171	10	Spare	IE ms On	Inverter Freq.	N/a	1-100		10-30	N/a	mSec * 10		KHz x 10	
40172	10	Spare	IE ms Off	Spare	N/a	1-200		N/a	N/a	mSec * 10		N/a	
40173	10	Spare			Fuse Mode	N/a			0-1	N/a		Off, On	



Reg#	Addr	Description				Range				Units			
		ESP Power Optimizer	Power Plus	Power Plus DSP	Chopper	ESP...	Pwr. Plus	Power Plus DSP	Chop.	ESP...	Pwr. Plus	Power Plus DSP	Chop.
40174	10	Spare		Fuse Time	N/a			1-30	N/a			sec	
40175	10	Spare		Fuse Setback	N/a			1-99	N/a			%	
40176	10	Spare		Output Type	N/a			0-1	N/a			AC, DC	
40177	10	Spare				N/a				N/a			
:													
:													
40400	10	Spare				N/a				N/a			
40401	11	Power Up with HV Mode				0-1				Off, On			
:													
:													
49600	33	Spare				N/a				N/a			

The register definitions for each of the remaining Controller's is in the identical order as Controller Address 10 registers offset by 400. Controller Address 11 registers start at 30401, Controller Address 12 registers start at 30801, etc.

Note 1: The following table defines the alarm value association:

Value	Alarm Description			
	ESP Power Optimizer	PowerPlus	PowerPlus DSP	Chopper
0	No Alarms			
1	Controller Ovr. current	Line Overcurrent		
2	SCR Over Temp	Secondary Overcurrent		
3	Controller High Oil Temp	Overvoltage (hardwr)		Spare
4	Controller Low Oil Level	Open Circuit		IGBT Error
5	Undervoltage			
6	Ovr. Volt	Overvoltage (softwr)		
7	SCR Unbal.	Over Temp		Bus Ovr. current
8	Loss of Line Sync	Spare		Fuse Alarm
9	Aux Alarm 1			
10	Aux Alarm 2			
11	Aux Alarm 3			



Value	Alarm Description			
	ESP Power Optimizer	PowerPlus	PowerPlus DSP	Chopper
12	Aux Alarm 4			
13	Hammer 1 Alarm			Spare
14	Hammer 2 Alarm			Spare
15	Hammer 3 Alarm			Spare
16	Hammer 4 Alarm			Spare
17	Spare		Line VAC	Spare
18	Spare		Vbus Low	Spare
19	Spare		Liq Lev Low	Spare
20	Spare		Door Open	Spare
21	Spare		Fan Con	Spare
22	Spare		Step Con	Spare
23	Spare		Main Con	Spare
24	Spare			

Note 2: The following table defines the limit value association:

Value	Limit Description			
	ESP Power Optimizer	PowerPlus	PowerPlus DSP	Chopper
0	Controller in Ramp Mode			
1	Current Limit			
2	Voltage Limit			
3	Cond. Limit	Duty Cycle Limit		Full Duty Cycle
4	Back Corona Hold			Fuse Process Active
5	V/I Curve in Operation			
6	Spark Occurred			
7	Arc Occurred	Spare	Arc Occurred	Spare
8	Back Corona Check			Spare

Note 3: The following table defines the hammer mode value association:

Value	Hammer Mode Description		
	ESP Power Optimizer	PowerPlus	Chopper
0	Off		Spare
1	Program Run		Spare



2	Program Run with Clean	Spare
3	Continuous	spare

Note 6: The following table defines the clear alarm value association:

Value	Alarm Description			
	ESP Power Optimizer	PowerPlus	PowerPlus DSP	Chopper
0	No Alarms			
1	Controller Ovr. current	Line Overcurrent		
2	SCR Over Temp	Secondary Overcurrent		
3	Controller High Oil Temp	Overvoltage (hardwr)		
4	Controller Low Oil Level	Open Circuit	IGBT Error	
5	Undervoltage			
6	Ovr. Volt	Overvoltage (softwr)		
7	SCR Unbal.	Over Temp	Bus Ovr. current	
8	Loss of Line Sync	Spare	Fuse Alarm	
9	Aux Alarm 1			
10	Aux Alarm 2			
11	Aux Alarm 3			
12	Aux Alarm 4			
13	Clear Next Hammer Alarm			Spare
14	Spare			
15	Spare			
16	Spare			
17	Spare	Line VAC	Spare	
18	Spare	Vbus Low	Spare	
19	Spare	Liq Lev Low	Spare	
20	Spare	Door Open	Spare	
21	Spare	Fan Con	Spare	
22	Spare	Step Con	Spare	
23	Spare	Main Con	Spare	
24	Spare			

Note 7:
“0” will disable function

Note 8:



A value equal to zero will disable this feature.

Note 9:

Sum of Hardware and Software detected Over-Voltage Alarms.

Note 10:

Pri. Voltage Limit range is 30 – 107% for GVC Controller software **v4.02 and below**;

Pri. Voltage Limit range is 10 – 110% for GVC Controller software **v4.03 and above**;

Sec. Voltage Limit range is 50-102% for GVC Controller software **v4.02 and below**;

Sec. Voltage Limit range is 10-110% for GVC Controller software **v4.03 and above**;

Sec. Current Limit range is 0 – 110% for GVC Controller software **v4.02 and below**;

Sec. Current Limit range is 10 – 110% for GVC Controller software **v4.03 and above**;

UV Trip delay range is 15-45 sec for GVC Controller software **v4.02 and below**;

UV Trip delay range is 5-45 sec for GVC Controller software **v4.03 and above**;

UV Trip delay range is 5-45 sec for Chopper Controller software .

UV Trip delay range is 5-45 sec for Power Plus Controller software.

Note 11:

Register 40168 – Write a ‘1’ to this register only once to turn the HV on. Repeatedly writing a ‘1’ to this register will act as restarts, preventing the HV from ramping up.

5.3.8 System Holding Register

The following registers are reserved for controlling the DCSi.

Register #	Description	Valid Range	Units
49601	Spare	-	N/A
:			
49998	DCSi ENTER DIAG MODE Command Reserved for NWL use	0-1	N/A
49999 See note 1	DCSi Reset Command Clears all memory locations and reinitializes the UARTs.	1	N/A

Note 1:

Writing a value = 1 via Function code 06 to register 49999 Clears all memory locations and reinitializes the UARTs.



Appendix A : rs232 to Ethernet Modbus TCP converter:

If your DCS/PLC supports MODBUS over Ethernet (Modbus TCP), you can add a commercially available converter to the DCSi rs232 port to convert the native rs232 modbus data to the Modbus TCP protocol.

We have tested and verified that a product manufactured by Digi Corporation is compatible with the DCSi to perform this function. The Product tested was a Digi model “DIGI ONE TS” p/n 70001805. The Digi One TS was configured for use in it’s ‘Industrial Automation’ mode. For further instructions please refer to the “Industrial Automation Configuration for use with Modbus” section of the Digi One TS user guide.



Appendix B: Fiber Optic rs485 Media Converter:

The DCSi supports the use of any commercially available media converters enabling the use of fiber optic cable on the rs485 comm link in place of shielded cable. However due to the multi-drop configuration of the rs485 comm link, the network must be converted back to shielded cable prior to the first Controller. Refer to the DCSi One Line Communication Diagram in this manual.

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