



**Modbus Communications**  
**For Models**  
**PVI 14-36TL**

Revision B

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# 1. Yaskawa - Solectria Solar PVI 14-36TL Modbus

## 1.1 Introduction

This manual explains the Modbus protocol in use for Yaskawa - Solectria Solar's PVI 14-36TL inverters. This does not include all the Modbus protocol details. It is expected that the person(s) reading this manual have a clear understanding of Modbus protocol.

Each register/data point contains a raw 16-bit signed or unsigned number. The appropriate multiplier must be applied to each word to obtain the scaled representation.

## 1.2 Abbreviations

<b>IP</b>	Internet Protocol
<b>MB</b>	MODBUS
<b>TCP</b>	Transport Control Protocol
<b>uint16</b>	16bit unsigned integer
<b>uint32</b>	32bit unsigned integer
<b>uint64</b>	64bit unsigned integer
<b>int16</b>	16bit signed integer
<b>int32</b>	32bit signed integer

## 1.3 Modbus Information

The Yaskawa - Solectria Solar PVI 14-36TL inverters Modbus register listing may contain some registers that are not supported for all inverter models. The inverter will respond with the following values if a feature is not supported for a specific inverter model.

Not Implemented for an int16 is 0x8000.

Not Implemented for a uint16 is 0xFFFF.

Not Implemented for an int32 is 0x80000000.

Not Implemented for a uint32 is 0xFFFFFFFF.

Not Implemented for a string is 0x00.

## 1.4 Data Encoding

The MODBUS specification is not explicit on how to encode numbers other than 16-bit integers. Differences do exist between one manufacturer's implementation and another's. 32 bit and 64 bit data for PVI 14-36TL inverters is encoded as described below.

### 32-bit integer Value

Values are stored in big-endian (i.e. most significant byte first) order per the MODBUS specification and consist of two consecutive 16-bit registers.

MODBUS Register	1		2	
byte	0	1	2	3
bits	31---24	23---16	15---8	7---0

### 64-bit integer Value

64-bit integers are stored using four registers in big-endian order and consists of 4 consecutive 16-bit registers.

MODBUS Register	1		2		3		4	
byte	0	1	2	3	4	5	6	7
bits	63 - 56	55 - 48	47 - 40	39 - 32	31 - 24	23 - 16	15 - 8	7 - 0

## 1.5 RS485 Modbus

Modbus Mode: RTU

Data Bits: 8

Parity: None

Stop Bits: 1

Mode: Half-Duplex

Baud Rate: 9600 or 19200

Modbus Id Range: 1-128

Modbus Cable Distance: 3000ft with no more than 300 ft between inverters

## 2 Modbus Register Tables

### 2.1 Inverter Input (Read Only) Registers

The MODBUS read function code for the PVI 14-36TL inverter Input (RO) registers is 0x04.

Modbus Register	Register Size	Description	Type	Unit	Multiplier	Type	RD/WR	Supported Inverter Model
0x0005	1	Inverter Firmware Versions The data format is 0xAABB where AA indicates DSP Firmware version and BB indicates LCD Firmware version.	uint16	N/A	0.01	uint16	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x0006	4	Inverter Serial Number The Serial Number is composed of 13 digits represented as the 13 Least Significant bytes. E.g. a read value 0X0001013011353001 is equal to Serial Number 1013011353001	uint64	N/A	BCD	uint64	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x000A	10	Inverter Model Information Identifies the TL Inverter Model information; I.e. PVI14TL-208, PVI20TL-480, PVI23TL-480, PVI28TL-480, PVI36TL-480	string(20)	N/A	1	string(20)	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x0016	2	Total Lifetime Energy Produced to the Grid	uint32	kWh	1	uint32	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x0018	1	Accumulated Energy Production for the Day	uint16	kWh	0.1	uint16	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x001A	1	Power Factor reading E.g. when reading this register 0x0320 is representing PF = 0x0320 *0.001 = 0.8 For PVI 14 - 20TL the reading is the actual Power Factor setting. For PVI 23 -36TL this reading is a calculated reading based on inverter measurement.	int16	N/A	0.001	int16	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x001B	1	Maximum Active AC Power during the Day	uint16	kW	0.1	uint16	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x001D	1	Active AC Power Reading	uint16	kW	0.1	uint16	RD	14TL, 20TL, 23TL, 28TL, 36TL

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Modbus Register	Register Size	Description	Type	Unit	Multiplier	Type	RD/WR	Supported Inverter Model
0x001E	1	Apparent AC Power Reading	uint16	kVA	0.1	uint16	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x001F	1	Grid Voltage Uab	uint16	V	0.1	uint16	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x0020	1	Grid Voltage Ubc	uint16	V	0.1	uint16	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x0021	1	Grid Voltage Uca	uint16	V	0.1	uint16	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x0022	1	Grid A Phase Current	uint16	A	0.1	uint16	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x0023	1	Grid B Phase Current	uint16	A	0.1	uint16	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x0024	1	Grid C Phase Current	uint16	A	0.1	uint16	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x0025	1	DC Voltage, MPPT Zone 1	uint16	V	0.1	uint16	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x0026	1	DC Current, MPPT Zone 1	uint16	A	0.1	uint16	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x0027	1	DC2 Voltage, MPPT Zone 2	uint16	V	0.1	uint16	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x0028	1	DC2 Current, MPPT Zone 2	uint16	A	0.1	uint16	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x002B	1	Grid Frequency	uint16	Hz	0.1	uint16	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x002C	1	Power Module heatsink temperature	int16	C	0.1	int16	RD	14TL, 20TL, 23TL, 28TL, 36TL

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Modbus Register	Register Size	Description	Type	Unit	Multiplier	Type	RD/WR	Supported Inverter Model
0x002D	1	Internal Inverter Temperature	int16	C	0.1	int16	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x002F	1	Inverter Operation State information <i>See the "Inverter States" section for detailed description</i>	uint16	N/A	1	uint16	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x0030	4	Error Timestamp (yyyy-mm-dd-hh-mm-ss-NULL) eg. 0x2012071615181000 = 2012-7-16 15:18:10	uint64	N/A	BCD	uint64	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x0034	1	Permanent Fault (PFault) Alarm Register Severity - High Requires site visit to check the cause. The inverter will stay off until both DC and AC power are cycled.	uint16	N/A	1	Uint16	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x0035	1	Warning Alarm Register Severity - Low The inverter discovered a small anomaly, but will continue to generate power.	uint16	N/A	1	uint16	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x0036	1	Fault0 Alarm Register Severity - Medium The inverter has discovered a failure such as grid or PV out of range conditions. The inverter will resume power generation when the condition clears.	uint16	N/A	1	uint16	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x0037	1	Fault1 Alarm Register Severity - Medium The inverter has discovered a failure such as grid or PV out of range conditions. The inverter will resume power generation when the condition clears.	uint16	N/A	1	uint16	RD	14TL, 20TL, 23TL, 28TL, 36TL
0x0038	1	Fault2 Alarm Register Severity - Medium The inverter has discovered a failure such as grid or PV out of range conditions. The inverter will resume power generation when the condition clears. Exception: Bits 15 Arc Fault in models PVI 14TL and PVI 20TL are high severity and stay on permanently like other PFaults.	uint16	N/A	1	uint16	RD	14TL, 20TL, 23TL, 28TL, 36TL

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Modbus Register	Register Size	Description	Type	Unit	Multiplier	Type	RD/WR	Supported Inverter Model
0x0039	1	<p>Fault3 Alarm Register (PVI 23-36TL only) Severity - Medium The inverter has discovered a failure such as grid or PV out of range conditions. The inverter will resume power generation when the condition clears. Exception: Arc Fault condition indicated by bit 15 will shut the inverter production down until the Arc Fault condition and both DC and AC power are recycled.</p>	uint16	N/A	1	uint16	RD	23TL, 28TL, 36TL
0x003A	1	<p>Fault4 Alarm Register (PVI 23-36TL only) Severity - Medium The inverter has discovered a failure such as grid or PV out of range conditions. The inverter will resume power generation when the condition clears. Exception: Arc Fault condition indicated by bit 2 will shut inverter production down until the Arc Fault condition and both DC and AC power are recycled.</p>	uint16	N/A	1	uint16	RD	23TL, 28TL, 36TL



## 2.2 Inverter States

The PVI 14-36TL inverters have 5 operational states built into the inverters as described in the table below. The inverter operational state can be read from either the front panel LEDs or by reading Modbus register 0x002F.

Register Address	Data	Inverter State	Description	LED State			
				Power	Run	Grid	Fault
0x002F	0x8000	Fault	Inverter is in Fault State and is not producing power. Site visit may be required.	On	Off	On	Blink
	0x4000	Check	Inverter is checking the input and output status. If the input and output conditions are met and no failure is detected, the Inverter will connect to the grid and begin generating power and transfer to Running state	On	Off	On	Off
	0x2000	Standby	Inverter is not generating power due to either low PV power or a manual shutdown. If the inverter is in standby State due to low PV power it will change to Check State when enough PV power is available.	On	Off	On	Off
	0x1000	Running	Inverter is running normally and generating power.	On	On	On	Off
	0x0800	Derating	Inverter's power generation is curtailed due to abnormal operation or it has been programmed to derate its production.	On	Blink	On	Off

### 2.3 Inverter Holding (Control RD/WR) Registers

The Modbus read function code for the PVI 14-36TL inverter holding (RD/WR) registers is 0x03.

The Modbus write function code is 0x06 for a single register write and 0x10 for multiple register writes.

**Note!** Please do not write to any of the reserved or unlisted register addresses. Doing so could damage the inverter and void the warranty.

Modb. Reg.	Reg Size	Description	Name	Unit	Type	Multiplier	Default Value	Min Value	Max Value	Support. Inverter Model
0x1000	1	Inverter Power On and Power Off command 0xAAAA turns the unit power production On and 0x5555 turns the unit power production Off The Inverter will automatically turn back on whenever DC power is cycled. E.g. Inverter will turn back on in the morning when the sun comes up.	On/Off	N/A	uint16	1	0xAAAA (On)	0x5555 (OFF)	0xAAAA (ON)	14TL, 20TL, 23TL, 28TL, 36TL
0x1001	1	Temporary Active Power setting (curtailment) This setting will be reset overnight or when the inverter is power cycled. Curtailment mode must be enabled by writing 1 to register 0x1046. Range [0.0%,100.%] of nameplate kW rating, E.g. 70.7%, then TmpPSet = 0x02c3 For PVI 36TL: 36kW * 70.7% = 25 kW	TmpPSet	%	uint16	0.10	1000	0	1000	14TL, 20TL, 23TL, 28TL, 36TL
0x1002	1	Temporary Power Factor setting This setting will be reset to its default value overnight or when the inverter is power cycled. Power Factor mode must be enabled by writing 1 to register 0x1047 for the 23TL, 28TL and 36TL inverters only. Temporary Power Factor setting takes priority over the Permanent Power Setting in register 0x1014 E.g. 0.931 then TmpPFSet = 0X03A3 -0.931 then TmpPFSet = 0xFC5D	TmpPFSet	N/A	int16	0.001	1000	-1000, -800	800, 1000	14TL, 23TL, 28TL, 36TL
								-1000, -900	900, 1000	20TL

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Modb. Reg.	Reg Size	Description	Name	Unit	Type	Multiplier	Default Value	Min Value	Max Value	Support. Inverter Model
0x1003	1	Temporary Reactive Power setting This setting will be reset overnight or when the inverter is power cycled. The inverter can produce Reactive Power up to a maximum of 60% of its nameplate rating. Range = 0% - 60%. Reactive Power mode must be enabled by writing 1 to register 0x1047 for the PVI 23/28TL/36TL inverters only. E.g. 50% Var based on the nameplate rating, then TmpQSet = 0x01F4 For PVI 36TL: 36kW * 50% = 18kVar	TmpQSet	%	uint16	0.10	0	-600	600	14TL, 20TL, 23TL, 28TL, 36TL
0x1004	4	System time setting Format: yyyy-mm-dd-hh-mm-ss-NUL, e.g. 0x2012071615181000 = 2012-7-16 15:18:10	TimeSet	N/A	uint64	BCD	N/A	N/A	N/A	14TL, 20TL, 23TL, 28TL, 36TL
0x100B	1	High Grid Frequency Trip Time 1 Defines the amount of time the inverter takes to trip when the High Grid Frequency Trip Limit 1 is exceeded.	TFMaxTrip	sec	uint16	0.01	300	0	600	14TL, 20TL, 23TL, 28TL, 36TL
0x100C	1	High Grid Voltage Trip Limit 1 Defines the high grid voltage limit of when the inverter trips.	VMax	V	uint16	0.1	2280	2240	2490	14TL
							5280	4800	5520	20TL, 23TL, 28TL, 36TL
0x100D	1	High Grid Voltage Trip Time 1 Controls the time delay it takes the inverter to trip when the High Grid Voltage Trip Limit 1 is exceeded.	TVmaxTrip	sec	uint16	0.01	1	5	600	14TL, 20TL, 23TL, 28TL, 36TL
0x100E	1	Low Grid Voltage Trip Limit 1 Defines the low grid voltage limit of when the inverter trips.	VMin	V	uint16	0.1	1830	1040	1870	14TL
							4224	2400	4800	20TL, 23TL, 28TL, 36TL

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Modb. Reg.	Reg Size	Description	Name	Unit	Type	Multiplier	Default Value	Min Value	Max Value	Support. Inverter Model
0x100F	1	Low Grid Voltage Trip Time 1 Defines the time it takes the inverter to trip when the Low Grid Voltage Trip Limit 1 is exceeded.	TVminTrip	sec	uint16	0.01	2	5	600	14TL, 20TL, 23TL, 28TL, 36TL
0x1010	1	High Grid Frequency Trip Limit 1 Defines the high grid frequency limit of when the inverter trips.	FMax	Hz	uint16	0.01	6050	6000	6500	14TL, 20TL, 23TL, 28TL, 36TL
0x1011	1	Low Grid Frequency Trip Limit 1 Defines the low grid frequency limit of when the inverter trips.	FMin	Hz	uint16	0.01	5930	4500	6000	14TL, 20TL, 23TL, 28TL, 36TL
0x1012	1	Low Grid Frequency Trip Time 1 Defines the time it takes the inverter to trip when the Low Grid Frequency Trip Limit 1 is exceeded.	TFMinTrip	sec	uint16	0.01	16	5	6000	14TL, 20TL, 23TL, 28TL, 36TL
0x1013	1	Permanent Active Power Setting (curtailment) This Active Power setting will be retained overnight and when the inverter is power cycled. Range [0.0%, 100.0%], E.g. 70.7%, then P_EE = 0x02c3 Permanent Active Power Setting has to be enabled by writing 1 to register 0x1046 for the 23TL - 36TL inverters only.	P_EE	%	uint16	0.10	1000	0	1000	14TL, 20TL, 23TL, 28TL, 36TL
0x1014	1	Permanent Power Factor Setting This setting will be retained overnight and when the inverter is power cycled. Writing to the TmpPFSet register (0x1002) will overwrite this setting. The last one written to is in effect. E.g. 0.931 then PrmPFSet = 0x03A3 -0.931 then PrmPFSet = 0xFC5D Power Factor mode must be enabled by writing 1 to register 0x1047 for the 23TL, 28TL and 36TL inverters only. The Temporary Power Factor setting in register 0x1002 takes precedence over the Permanent Power Setting	PrmPFSet	N/A	int16	0.001	1000	1000	-9000	20TL
								9000	1000	14TL, 23TL, 28TL, 36TL

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Modb. Reg.	Reg Size	Description	Name	Unit	Type	Multiplier	Default Value	Min Value	Max Value	Support. Inverter Model
0x1015	1	Startup Delay Time The delay time the inverter waits before starting power generation and connecting to the grid, after the DC and grid connections conditions are met.	StartDelay	sec	uint16	1	60	0	600	23TL, 28TL, 36TL
0x101D	1	Ramp Rate Setting Defines the Soft-Start power-on ramp rate of when the inverter reconnects to the grid. Note: Other Ramp Rates are not Controllable using Modbus control.	SoftPStep	kW/sec	uint16	0.01	1.44	0.01	2.88	14TL, 23TL, 28TL, 36TL
0x101E	1	The 2 <sup>nd</sup> level high grid voltage limit	VMaxII	V	uint16	0.1	5760	4800	6240	23TL, 28TL, 36TL
							2496	2288	4850	14TL
0x101F	1	Trip time when the VMAXII is exceeded	TVmaxTriplI	sec	uint16	0.01	16	5	60000	14TL, 23TL, 28TL, 36TL
0x1020	1	Trip point for under voltage at 2 <sup>nd</sup> level	VMinII	V	uint16	0.1	2400	2400	4800	23TL, 28TL, 36TL
							1040	1000	1830	14TL
0x1021	1	Trip time for under voltage at 2 <sup>nd</sup> level	TVminTriplI	sec	uint16	0.01	16	5	60000	14TL, 23TL, 28TL, 36TL
0x1022	1	Trip point for over frequency at 2 <sup>nd</sup> level	FMaxII	Hz	uint16	0.01	6400	5000	6500	36TL
0x1023	1	Trip time for over frequency at 2 <sup>nd</sup> level	TFMaxTriplI	sec	uint16	0.01	5	5	60000	36TL
0x1024	1	Trip point for under frequency at 2 <sup>nd</sup> level	FMinII	Hz	uint16	0.01	5900	4500	6000	36TL
0x1025	1	Trip time for under frequency at 2 <sup>nd</sup> level	TFMinTriplI	sec	uint16	0.01	5	5	60000	36TL
0x1026	1	Recovery voltage point after over voltage trip	VMaxRcov	V	uint16	0.1	5180	2000	5330	23TL, 28TL, 36TL
							2250	2280	2496	14TL
0x1027	1	Reconnection voltage point after under voltage trip	VMinRcov	V	uint16	0.1	4324	0	4800	23TL, 28TL, 36TL

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Modb. Reg.	Reg Size	Description	Name	Unit	Type	Multiplier	Default Value	Min Value	Max Value	Support. Inverter Model
							1860	1040	2080	14TL
0x1028	1	Reconnection delay time after grid voltage failure	VRcovT	sec	uint16	0.01	300	0	600	14TL, 23TL, 28TL, 36TL
0x1029	1	Reconnection frequency point after over frequency trip	FMaxRcov	Hz	uint16	0.01	6040	5000	6500	14TL, 23TL, 28TL, 36TL
0x102A	1	Reconnection frequency point after under frequency trip	FMinRcov	Hz	uint16	0.01	5940	4500	6000	14TL, 23TL, 28TL, 36TL
0x102B	1	Reconnection delay time after grid frequency failure	FRcovT	sec	uint16	0.01	300	0	600	14TL, 23TL, 28TL, 36TL
0x102C	1	Frequency entry point for the Frequency - Watt functionality Note: The inverter needs to be configured for Rule 21 mode via the front panel LCD for this feature to work.	FDeratStart	Hz	uint16	0.01	6050	5000	6500	36TL
0x102D	1	Frequency exit point for the Frequency-Watt functionality Note: The inverter needs to be configured for Rule 21 mode via the front panel LCD for this feature to work.	FDeratStop	Hz	uint16	0.01	6400	6000	6500	36TL
0x102E	1	Enable or disable Low Voltage Ride Through (LVRT) 1 = No reactive Power output during LVRT 2= Reactive Power output during LVRT <i>LVRT is disabled when IEEE 1547 grid standard enabled. See the installation manual for more information.</i>	LvrtEn	N/A	uint16	1	0	0	2	36TL
0x102F	1	Low Voltage Ride Through (LVRT)	VLvrtStart	%	uint16	0.1	880	700	900	36TL
0x1033	1	Power Factor Control Mode (PFP) (Mode 4): The first % value for the PF versus Power curve. <i>See Smart Grid section below for more details.</i>	PF_PCurveActPw1	%	uint16	0.1	50	0.1	100	36TL
0x1034	1	Power Factor Control Mode (PFP) (Mode 4): The first PF value for the PF versus Power curve. <i>See Smart Grid section below for more details.</i>	PF_PCurvePF1	N/A	uint16	0.001	1000	-800	800	36TL
0x1035	1	Power Factor Control Mode (PFP) (Mode 4): The second % value for the PF versus Power curve. <i>See Smart Grid section below for more details.</i>	PF_PCurveActPw2	%	uint16	0.1	1000	0	1000	36TL

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Modb. Reg.	Reg Size	Description	Name	Unit	Type	Multiplier	Default Value	Min Value	Max Value	Support. Inverter Model
0x1036	1	Power Factor Control Mode (PFP) (Mode 4): The second PF value for the PF versus Power curve. <i>See Smart Grid section below for more details.</i>	PF_PCurvePF2	N/A	uint16	0.001	-900	-800	800	36TL
0x1037	1	Power Factor Control Mode (PFP) (Mode 4): The PF versus Power curve turn on grid voltage. The curve is active when the grid voltage is greater than this voltage. <i>See Smart Grid section below for more details.</i>	PF_PCurveLockInV	V	uint16	0.1	4800	4800	5280	36TL
0x1038	1	Power Factor Control Mode (PFP) (Mode 4): The PF versus Power curve turn off grid voltage. The curve is inactive when the grid voltage is lower than this voltage. <i>See Smart Grid section below for more details.</i>	PF_PCurveLockOutV	V	uint16	0.1	4320	4224	4800	36TL
0x1039	1	Volt-VAr Mode: Parameters for the Volt-VAr curve <i>See the Volt-VAr section for more details.</i>	Q_UCurveVolt1s	V	uint16	0.1	5184	4800	5280	36TL
0x103A	1	Volt-VAr Mode: [Parameters for the Volt-VAr curve <i>See the Volt-VAr section for more details.</i>	Q_UCurveReactPw1s	%	uint16	0.1	0	-600	600	36TL
0x103B	1	Volt-VAr Mode: Parameters for the Volt-VAr curve <i>See the Volt-VAr section for more details</i>	Q_UCurveVolt2s	V	uint16	0.1	5280	4800	5280	36TL
0x103C	1	Volt-VAr Mode: Parameters for the Volt-VAr curve <i>See the Volt-VAr section for more details</i>	Q_UCurveReactPw2s	%	uint16	0.1	-500	-600	600	36TL
0x103D	1	Volt-VAr Mode: Parameters for the Volt-VAr curve <i>See the Volt-VAr section for more details</i>	Q_UCurveVolt1i	V	uint16	0.1	441.6	422.4	480	36TL
0x103E	1	Volt-VAr Mode: Parameters for the Volt-VAr curve <i>See the Volt-VAr section for more details</i>	Q_UCurveReactPw1i	%	uint16	0.1	0	-600	600	36TL
0x103F	1	Volt-VAr Mode: Parameters for the Volt-VAr curve <i>See the Volt-VAr section for more details</i>	Q_UCurveVolt2i	V	uint16	0.1	4320	4224	4800	36TL
0x1040	1	Volt-VAr Mode: Parameters for the Volt-VAr curve <i>See the Volt-VAr section for more details</i>	Q_UCurveReactPw2i	%	uint16	0.1	500	-600	600	36TL

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Modb. Reg.	Reg Size	Description	Name	Unit	Type	Multiplier	Default Value	Min Value	Max Value	Support. Inverter Model
0x1041	1	Volt-VAr mode: If the active power is greater than this number, Volt-VAr mode is activated.	Q_UCurveLockInP	%	uint16	0.1	200	50	1000	36TL
0x1042	1	Volt-VAr mode: If the active power is lower than this number, Volt-VAr mode is deactivated.	Q_UCurveLockOutP	%	uint16	0.1	50	50	1000	36TL
0x1043	1	Frequency-Watt: Over frequency derating enable/disable 1 = Reserved 2 = Rule 21 curve	FreqDeratOption	N/A	uint16	1	0	0	2	36TL
0x1044	1	Trip point of over-frequency power derating	FDeratStart	Hz	uint16	0.01	6050	5000	6500	36TL
0x1045	1	Reserved								
0x1046	1	Enable or Disable temporary Power or Power Factor control 0 = Disable 1 = Enable	RemoteActivePwDispatchModeOption	N/A	uint16	N/A	0	0	1	23TL, 28TL, 36TL
0x1047	1	This register is used to select the inverter Reactive Power mode. This setting is a permanent setting that is maintained through power cycling events. 0: Disable Reactive Power Control. 1: Enable Temporary Power Factor or Temporary Reactive Power control 2: Enable Permanent Reactive Power Control. 3: Enable Permanent Power Factor Control 4: Enable Power Factor Control Mode 5: Enable Volt-VAr mode: <i>See the Reactive Power Control section for more details.</i>	Reactive Power generation Mode Select	N/A	uint16	N/A	0	0	5	23TL, 28TL, 36TL



### 3 Smart Grid Features

#### 3.1 VAR and PF Control Operation

Yaskawa - Solectria Solar PVI 23-36TL inverters are capable of providing Volt-VAR control to support voltage regulations at the local grid. The inverters can produce either inductive or capacitive VAR, up to 60% of its kVA nameplate rating. The amount of VAR produced can be programmed at inverter via its LCD display interface locally or remotely through Modbus communications.

The inverters can provide VAR by two means. Either by enabling VAR control mode or PF-control mode

- In VAR-control mode, the inverters will provide a fixed amount of VAR regardless of the amount of Real Power available from PV. The amount of VAR can be programmed to be dependent on Grid grid voltage.
- In PF-control mode, the inverters will change the amount of VAR in accordance with the amount of Real Power available from the PV array to maintain the programmed PF value

The Yaskawa - Solectria Solar PVI 23-36TL inverters are capable of running in 4 different reactive power modes. One of the Reactive Power modes must be selected before attempting to control any of the Reactive Power control functionality.

### **3.1.1 Disable Reactive Power Control (Mode 0)**

The inverter will not produce any reactive power in Disable Reactive Power Control Mode (0).

#### **Register Write Procedure:**

1. Write 0 to register 0x1047

### **3.1.2 Fixed Temporary Power Factor or Fixed Temporary Reactive Power Control (Mode 1)**

When the inverter is in Temporary Power Factor or Temporary Reactive Power mode (Mode 1), the inverter will produce a fixed amount of Reactive Power or Power Factor according to the settings in registers TmpPFSet (0x1002) or TmpQSet (0x1003). The setting for these registers is temporary and will be reset back to default value overnight or when the inverter is power cycled.

#### **Register Write Procedure:**

1. Write 1 to register 0x1046
2. Write 1 to register 0x1047
3. Write the desired value to register 0x1002 or 0x1003

### **3.1.3 Permanent Fixed Reactive Power Control (Q\_EE) (Mode 2)**

The reactive power control can only be configured using the LCD and the front panel keyboard. Please see the installation manual for more information.

### **3.1.4 Permanent Fixed Power Factor Control (PF\_EE) (Mode 3)**

In the Permanent Fixed Power Factor mode (Mode 3), the inverter will produce a fixed amount of Reactive Power according to the Permanent Power Factor register (0x1014, PrmPFSet) setting. The setting for this register is permanent and will not reset back to default value overnight or when the inverter is power cycled.

#### **Register Write Procedure:**

1. Write 0x5555 to register 0x1000 to turn the inverter Off.
2. Write 3 to register 0x1047
3. Write the desired value to register 0x1014
4. Write 0xAAAA to register 0x1000 to turn the inverter On.

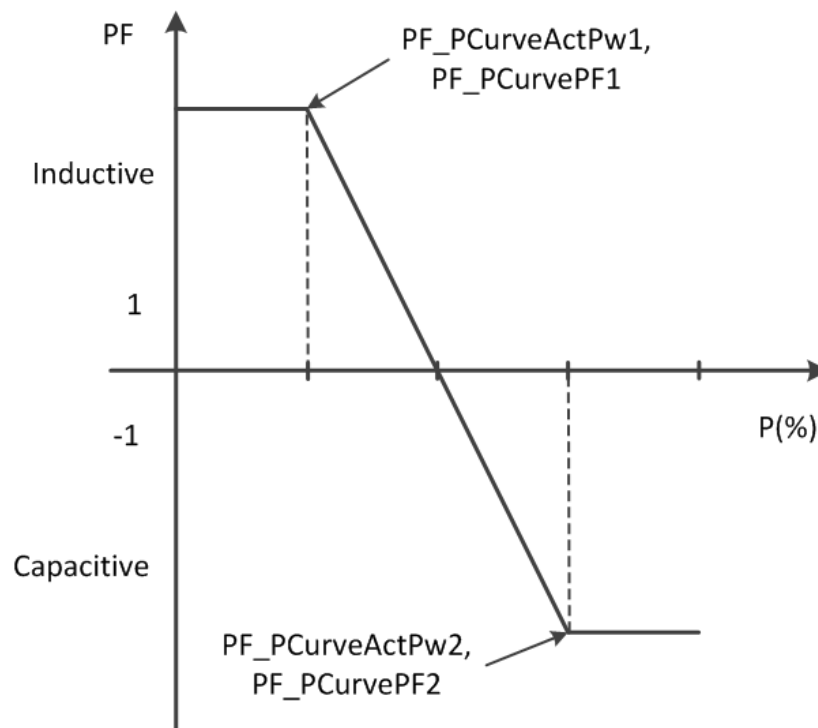
### 3.1.5 Power Factor Control Mode (PFP) (Mode 4)

The PVI 23-36TL inverters can also provide VAR by programming the Power Factor.

- PF can be a fixed value in “PF mode”. PF will be accurate up to +/- 0.01 of programmed value at load higher than 20% of its rating.
- PF can be programmed to vary with load percentage in “PFP mode”. A preset curve is implemented in the inverter.
  - Unity PF from 0% to 50% load.
  - PF changes linearly from unity to a programmed PF with respect to load from 50% to 100%.

When PF is different than 1, the inverter will automatically reduce max Real Power to keep its output current below rated value.

The inverter will produce reactive power according to the PF curve to active power. The curve is defined using registers 0x1033 - 0x1038” as shown in the figure below.

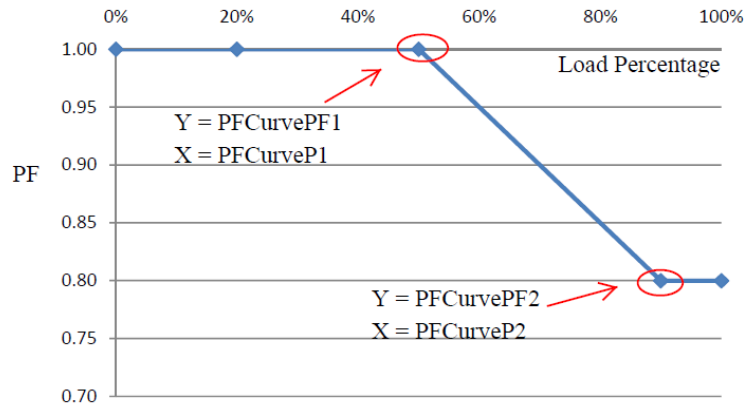


PVI 14-36TL Power Factor Terminology:

- Positive PF means exporting current lagging grid voltage (providing inductive VAR)
- Negative PF means exporting current leading grid voltage (providing capacitive VAR)

**Example:**

The curve below shows that the inverter will produce capacitive power  $PF_{CurvePF1}$  ( $PF=-0.8$ ) if the active power is greater than  $PF_{CurveP2}$  ( $80\%P$ ). If the active power is lower than  $PF_{CurveP1}$  ( $50\%P$ ),  $PF=1$ . When active power ( $P$ ) increases from  $50\%$  to  $80\%$ ,  $PF$  decreases linearly from  $1$  to  $-0.8$ .



### 3.1.6 Volt-VAr Mode (QU) (Mode 5):

The inverters can provide VAr up to 60% of its kW/kVA nameplate rating with 0.1% resolution. For example, a 36kW inverter can provide up to 21.6kVAr of either inductive or capacitive Reactive Power. When the inverter is programmed to provide VAr, the amount of Real Power exported to the Grid is reduced in order to keep the output current below its maximum rating. The relationship of VAr, W, and VA is

$$VA = \sqrt{VAR^2 + W^2}$$

For example with a 36kW inverter, at 21.6kVAr setting, inverter will provide maximum of 28.8kW of Real Power according to the calculation below.

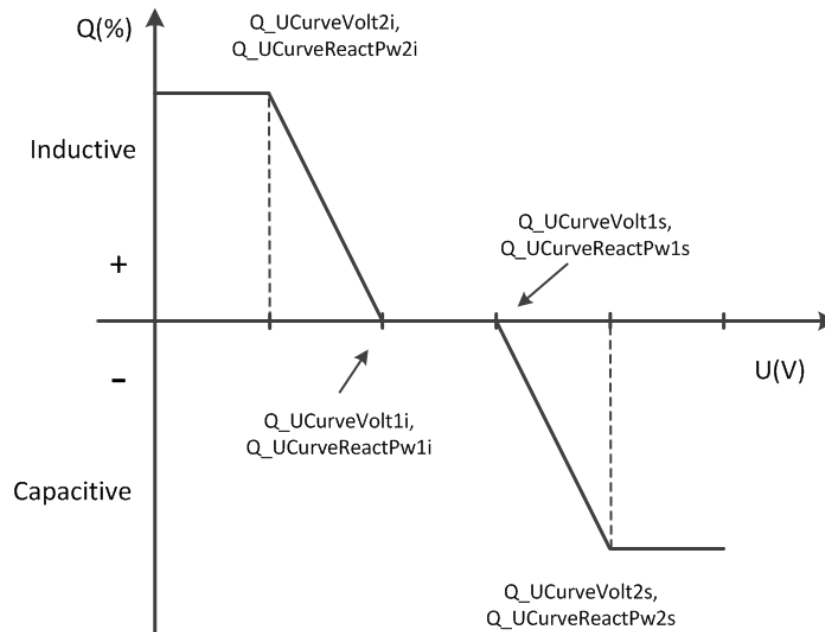
$$36 = \sqrt{21.6^2 + 28.8^2}$$

With VAr control, the inverters will maintain the programmed Reactive Power VAr while Real Power changes with sunlight condition.

PVI 14-36TL VAr Terminology:

- Inductive Reactive Power exporting to grid is denoted as Positive VAR
- Capacitive Reactive Power exporting to grid is denoted as Negative VAR

The amount of VAr can be programmed to linearly vary with grid voltage measured at the AC terminals of the inverter. The VAR curve and programmable points are shown in the Figure below. The inverter can be programmed either by using the LCD interface or Modbus communications using registers 0x1039 - 0x1042.



**Calculating the Volt-VAr Output:**

The Reactive Power output in Volt-VAr mode can be calculated in the following manner.

Reactive Power (VAr) output =  $\text{TmpQSet}/1000 * \text{Inverter Rated Power}$ .

Note that VAr is limited to 60% of the inverter nameplate power rating.

**Register Write Procedure:**

1. Write 0x5555 to register 0x1000 to turn the inverter Off.
2. Write 5 to register 0x1047
3. Write the desired Volt-VAr curve values to register 0x1039-0x1042.
4. Write 0xAAAA to register 0x1000 to turn the inverter On.

## 4 Inverter Alarms and Alarm Descriptions

This section describes the PVI 14-36TL alarm register functionalities.

The alarms can be grouped into 3 categories, Warning, Fault and Permanent Fault (PFault), as described in the table below.

Alarm Category	Description	Severity	Site Visit Required	Front Panel LED
Warning	A low severity level warning has been detected at the Inverter. The Inverter can continue to operate and generate power.	Low	No	Slow Blink
Fault	A medium severity level fault has been detected at the Inverter. The Inverter will shut down and stop generating power until the fault is cleared.	Medium	No	Fast Blink
PFault	A high severity fault level has been detected at the Inverter. The Inverter will shut down and will not restart by itself even if the fault is cleared.	High	Yes	Steady LED On

**Please note alarm mapping differences between Inverter models as indicated by the tables below.**

### 4.1 Permanent Fault Register

Any Permanent Faults (PFaults) are considered serious and the alarm will stay on permanently. The inverter will not recover from this fault by itself. A site visit is required to perform thorough site and inverter inspection to determine if it is safe to turn the inverter back on. A site visit is required to clear any PFault alarm and is done by cycling both DC and AC power off and back on again.

#### PVI 14/20/23/28/36TL: PFault Register (0x0034)

Register Address	Name/Bits	Alarm/Protection/Fault	LCD Display Readout	Description	LED Readout				
					Power	Run	Grid	Fault	
0x0034	PFault H	Bit15	15V of control board low fault	<b>Fault0160</b>	Protect0620 occurs >3 times in 5 minutes.	On	Off	On	On
		Bit14	Inverter open-loop self-test fault	<b>Fault0150</b>	Protect230 occurs >3 times in 5 minutes.	On	Off	On	On
		Bit13	Internal hardware fault	<b>Fault0140</b>	Protect0210 occurs >3 times in 5 minutes.	On	Off	On	On
		Bit12	Power module fault	<b>Fault0010</b>	Protect0120 occurs >3 times in 5 minutes.	On	Off	On	On
		Bit11	Reserved						
		Bit10	Reserved						
		Bit9	Reserved						
	Bit8	Hardware over current fault	<b>Fault0050</b>	Protect0140 occurs >3 times in 5 minutes.	On	Off	On	On	
	PFault L	Bit7	Reserved						
		Bit6	DCI fault	<b>Fault0070</b>	Protect0170 occurs >3 times in 5 minutes.	On	Off	On	On
		Bit5	Reserved						
		Bit4	Static GFCI Fault	<b>Fault0090</b>	Protect0610 occurs >3 times in 5 minutes.	On	Off	On	On
		Bit3	Grid relay fault	<b>Fault0100</b>	Protect0020 occurs >3 times in 5 minutes.	On	Off	On	On
		Bit2	Bus imbalance fault	<b>Fault0110</b>	Protect0070 occurs >3 times in 5 minutes.	On	Off	On	On
Bit1		Bus(sum) low voltage	<b>Fault0120</b>	Protect0080 occurs >3 times in 5 minutes.	On	Off	On	On	
Bit0	Bus(sum) over voltage fault	<b>Fault0130</b>	Protect0090 occurs >3 times in 5 minutes.	On	Off	On	On		



### 4.2 Inverter Warning Registers

Inverter warnings are low severity warning indications; and the inverter can continue to produce power, possibly in derating state. The inverter can resume normal operation if the warning condition clears.

**PVI 14/20/23/28/36TL: Warning Register (0x0035)**

Register Address	Name/Bits	Alarm/Protection/Fault	LCD Display Readout	Description	LED Readout				
					Power	Run	Grid	Fault	
0x0035	Warn H	Bit15	Reserved						
		Bit14	Reserved						
		Bit13	Reserved						
		Bit12	Reserved						
		Bit11	Reserved						
		Bit10	Reserved						
		Bit9	LCD EEPROM fault	<b>Warn0090</b>	Read/write to the EEPROM LCD failed.	On	On	On	Slow Blink
	Bit8	Reserved							
	Warn L	Bit7	Not used	<b>Warn0070</b>	This warning can be ignored				
		Bit6	Reserved						
		Bit5	Temperature sensor fault	<b>Warn0050</b>	Temperature reading is out of range (<-25 D.C).	On	On	On	Slow Blink
		Bit4	Not used	<b>Warn0040</b>	This warning can be ignored				
		Bit3	DSP EEPROM fault	<b>Warn0030</b>	Read/write to EEPROM failed. Parameters stored in EEPROM are reset to default.	On	On	On	Slow Blink
		Bit2	Internal communication failed	<b>CommErr</b>	SPI communication between DSP and LCD fails.	On	On	On	Slow Blink
Bit1		Internal fan error	<b>IntFanErr</b>	Internal fan failed or fan is blocked.	On	On	On	Slow Blink	
Bit0	External fan error	<b>ExtFanErr</b>	External fan failed or fan is blocked.	On	On	On	Slow Blink		

### 4.3 Inverter Fault Registers

Inverter Faults are medium severity faults which will stop the inverter from running. It is possible for the inverter to restart if the fault clears.

#### PVI 14/23/26/36TL: Fault0 Register (0x0036)

Register Address	Name/Bits	Alarm/Protection/Fault	LCD Display Readout	Description	LED Readout				
					Power	Run	Grid	Fault	
0x0036	Fault 0H	Bit15	Sampling offset of output current error	<b>Protect0010</b>	The sampling offset of output current is out of range. (>3%)	On	Off	On	Quick Blink
		Bit14	Over-temperature protection	<b>TempOver</b>	Internal over temperature is detected. (Power Module >107°C, Inner cabinet > 70°C)	On	Off	On	Quick Blink
		Bit13	Grid relay error	<b>Protect0020</b>	The voltages at both sides of grid relay do not match each other.	On	Off	On	Quick Blink
		Bit12	Loss of main	<b>GridV.OutLim</b>	One phase of grid has been lost.	On	Off	Blink	Quick Blink
		Bit11	Grid under frequency	<b>GridF.OutLim</b>	Frequency is low. (<59.3Hz)	On	Off	Blink	Quick Blink
		Bit10	Grid Over frequency	<b>GridF.OutLim</b>	Frequency is high. (>60.5Hz)	On	Off	Blink	Quick Blink
		Bit9	Inverter over current	<b>Protect0030</b>	Inverter over current detected. (>65A)	On	Off	On	Quick Blink
		Bit8	Grid phase voltage out of range	<b>GridV.OutLim</b>	One phase of the voltage is out of range. (<88%> 110%, trip point is settable)	On	Off	Blink	Quick Blink
	Fault 0L	Bit7	Grid line voltage out of range	<b>GridV.OutLim</b>	One of the line voltages is out range. (<88%,> 110%, trip point is settable)	On	Off	Blink	Quick Blink
		Bit6	PV1 over current	<b>Protect0040</b>	One boost of MPPT1 is over current. (>25A)	On	Off	On	Quick Blink
		Bit5	Reserved						
		Bit4	Inverter soft start timeout	<b>Protect0050</b>	Inverter soft start failure. (previous > 10s)	On	Off	On	Quick Blink
		Bit3	Bus soft start timeout	<b>Protect0060</b>	The soft start of boost fails. BUS could not reach the reference voltage. (previous >10s)	On	Off	On	Quick Blink
		Bit2	Bus imbalance	<b>Protect0070</b>	BUS imbalance is detected. (+/-BUS imbalance >100V)	On	Off	On	Quick Blink
Bit1		Bus(sum) low voltage	<b>Protect0080</b>	BUS voltage is low in operation (sum<100V).	On	Off	On	Quick Blink	
Bit0	Bus(sum) over voltage (firmware)	<b>Protect0090</b>	BUS over voltage (Sum of +/-BUS >925V) is detected by firmware.	On	Off	On	Quick Blink		

**PVI 20TL: Fault0 Register (0x0036)**

Register Address	Name/Bits	Alarm/Protection/Fault	LCD Display Readout	Description	LED Readout				
					Power	Run	Grid	Fault	
0x0036	Fault 0H	Bit15	Sampling offset of output current error	<b>IntProtectA</b>	The sampling offset of output current is out of range. (>3%)	On	Off	On	Quick Blink
		Bit14	Over-temperature protection	<b>TempOver</b>	Internal over temperature is detected. (Power Module >107°C, Inner cabinet > 68°C)	On	Off	On	Quick Blink
		Bit13	Grid relay error	<b>IntProtectB</b>	The voltages at both sides of grid relay do not match each other.	On	Off	On	Quick Blink
		Bit12	Loss of main	<b>GridV.OutLim</b>	One phase of grid has been lost.	On	Off	Blink	Quick Blink
		Bit11	Grid under frequency	<b>GridF.OutLim</b>	Frequency is low. (<59.3Hz)	On	Off	Blink	Quick Blink
		Bit10	Grid Over frequency	<b>GridF.OutLim</b>	Frequency is high. (>60.5Hz)	On	Off	Blink	Quick Blink
		Bit9	Inverter over current	<b>IntProtectC</b>	Inverter over current detected. (>58A)	On	Off	On	Quick Blink
		Bit8	Grid phase voltage out of range	<b>GridV.OutLim</b>	One phase of the voltage is out of range. (<88%> 110%, trip point is settable)	On	Off	Blink	Quick Blink
	Fault 0L	Bit7	Grid line voltage out of range	<b>GridV.OutLim</b>	One of the line voltages is out range. (<88%,> 110%, trip point is settable)	On	Off	Blink	Quick Blink
		Bit6	PV1 over current	<b>IntProtectD</b>	Boost Module 1 (MPPT1) over current detected. (>45A)	On	Off	On	Quick Blink
		Bit5							
		Bit4	Inverter soft start timeout	<b>IntProtectE</b>	Inverter soft start failure. (previous > 10s)	On	Off	On	Quick Blink
		Bit3	Bus soft start timeout	<b>IntProtectF</b>	The soft start of boost fails. BUS could not reach the reference voltage. (previous >10s)	On	Off	On	Quick Blink
		Bit2	Bus imbalance	<b>IntProtectG</b>	BUS imbalance is detected. (+/-BUS imbalance >130V)	On	Off	On	Quick Blink
		Bit1	Bus(sum) low voltage	<b>IntProtectH</b>	BUS voltage is low in operation (sum<260V).	On	Off	On	Quick Blink
Bit0	Bus(sum) over voltage (firmware)	<b>IntProtectI</b>	BUS over voltage (Sum of +/-BUS >840V) is detected by firmware.	On	Off	On	Quick Blink		

**PVI 14/23/28/36TL: Fault 1 Register (0x0037)**

Register Address	Name/Bits	Alarm/Protection/Fault	LCD Display Readout	Description	LED Readout				
					Power	Run	Grid	Fault	
0x0037	Fault 1H	Bit15	Leakage current sensor error	<b>Protect0100</b>	Leakage current sensor failure.	On	Off	On	Quick Blink
		Bit14	Reserved						
		Bit13	Reserved						
		Bit12	Power module protection	<b>Protect0120</b>	Power module tripped.	On	Off	On	Quick Blink
		Bit11	Inverter current imbalance	<b>Protect0130</b>	Inverter current imbalance detected. (>8%)	On	Off	On	Quick Blink
		Bit10	Reserved						
		Bit9	Grid voltage imbalance	<b>GridV.OutLim</b>	Imbalance for grid voltage detected. (>2.6%)	On	Off	On	Quick Blink
	Bit8	Inverter hardware over current	<b>Protect0140</b>	Inverter over current detected.	On	Off	On	Quick Blink	
	Bit7	MCU protection	<b>Protect0150</b>	Grid errors detected by assistant MiniMCU. (Grid error)	On	Off	On	Quick Blink	
	Bit6	Reserved							
	Bit5	Frequency detection fault	<b>Protect0160</b>	Inverter cannot identify frequency: 50/60Hz. (<55Hz, >70Hz)	On	Off	On	Quick Blink	
	Bit4	Dynamic leakage current high	<b>GFCIErr</b>	Leakage current fault. (Sudden > 30mA)	On	Off	On	Quick Blink	
	Bit3	Insulation resistance low	<b>IsolationErr</b>	Insulation resistance is low. (<250kOhm for 23/28TL) (<220kOhm for 20TL) (<220kohm for 14TL)	On	Off	On	Quick Blink	
	Bit2	DCI high	<b>Protect0170</b>	DC current injection failure. (>0.5%In, settable)	On	Off	On	Quick Blink	
	Bit1	DCI offset error	<b>Protect0180</b>	DCI sampling offset of current is out of range. (>10%)	On	Off	On	Quick Blink	
Bit0	Inverter voltage offset error	<b>Protect0190</b>	Inverter sampling voltage offset is out of range. (>5%)	On	Off	On	Quick Blink		

**PVI 20TL: Fault 1 Register (0x0037)**

Register Address	Name/Bits	Alarm/Protection/Fault	LCD Display Readout	Description	LED Readout				
					Power	Run	Grid	Fault	
0x0037	Fault 1H	Bit15	Leakage current sensor error	<b>IntProtectJ</b>	Leakage current sensor failure.	On	Off	On	Quick Blink
		Bit14	Bus overvoltage (hardware)	<b>IntProtectK</b>	BUS over voltage detected by hardware.	On	Off	On	Quick Blink
		Bit13	Reserved						
		Bit12	Power module protection	<b>IntProtectL</b>	Power module tripped.	On	Off	On	Quick Blink
		Bit11	Inverter current imbalance	<b>IntProtectM</b>	Inverter current imbalance detected. (>8%)	On	Off	On	Quick Blink
		Bit10	Reserved						
		Bit9	Grid voltage imbalance	<b>GridV.OutLim</b>	Imbalance for grid voltage detected. (>2.6%)	On	Off	On	Quick Blink
	Fault 1L	Bit8	Inverter hardware over current	<b>IntProtectN</b>	Inverter over current detected.	On	Off	On	Quick Blink
		Bit7	MCU protection	<b>IntProtectO</b>	Grid errors detected by assistant MiniMCU. (Grid error)	On	Off	On	Quick Blink
		Bit6	Reserved						
		Bit5	Frequency detection fault	<b>IntProtectP</b>	Inverter cannot identify frequency: 50/60Hz. (<55Hz, >70Hz)	On	Off	On	Quick Blink
		Bit4	Dynamic leakage current high	<b>GFCIErr</b>	Leakage current fault. (Sudden > 30mA)	On	Off	On	Quick Blink
		Bit3	Insulation resistance low	<b>IsolationErr</b>	Insulation resistance is low. (<600kohm)	On	Off	On	Quick Blink
		Bit2	DCI high	<b>IntProtectQ</b>	DC current injection failure. (120mA, settable)	On	Off	On	Quick Blink
		Bit1	DCI offset error	<b>IntProtectR</b>	DCI sampling offset of current is out of range. (>10%)	On	Off	On	Quick Blink
Bit0	Inverter voltage offset error	<b>IntProtectS</b>	Inverter sampling voltage offset is out of range. (>5%)	On	Off	On	Quick Blink		

**PVI 23/28/36TL: Fault 2 Register (0x0038)**

Register Address	Name/Bits	Alarm/Protection/Fault	LCD Display Readout	Description	LED Readout				
					Power	Run	Grid	Fault	
0x0038	Fault 2H	Bit15	Reserved						
		Bit14	Reserved						
		Bit13	Reserved						
		Bit12	Reserved						
		Bit11	Reserved						
		Bit10	PV1 over voltage	<b>PV1VoltOver</b>	MPPT1 over-voltage (>1020V)	On	Off	On	Quick Blink
		Bit9	PV1 input reverse connection	<b>PV1Reverse</b>	Negative input current of MPPT1 is detected. (<-2A)	On	Off	On	Quick Blink
		Bit8	Reserved						
	Fault 2L	Bit7	Inverter open-loop self-test error	<b>Protect0230</b>	The voltage difference between inverter voltage and command voltage >50V.	On	Off	On	Quick Blink
		Bit6	PV abnormal input	<b>Protect0260</b>	Input Mode detection failure. MPPT1/MPP2 Difference > 20V for Parallel Mode.		Off	On	Quick Blink
		Bit5	PV2 over voltage	<b>PV2VoltOver</b>	MPPT2 over-voltage (>1020V)	On	Off	On	Quick Blink
		Bit4	PV2 over current	<b>Protect0240</b>	One boost of MPPT2 over current (>25A)	On	Off	On	Quick Blink
		Bit3	PV2 input reverse connection	<b>PV2Reverse</b>	Negative input current of MPP2 detected. (<-2A)	On	Off	On	Quick Blink
		Bit2	Input and output power mismatch	<b>Protect0220</b>	The difference between input and output power is out of range. (>50%)	On	Off	On	Quick Blink
		Bit1	Internal hardware error	<b>Protect0210</b>	Inverter cannot export any running current. (<1A but required >25A)	On	Off	On	Quick Blink
Bit0	Reserved								

**PVI 20TL: Fault 2 Register (0x0038)**

Register Address	Name/Bits	Alarm/Protection/Fault	LCD Display Readout	Description	LED Readout				
					Power	Run	Grid	Fault	
0x0038	Fault 2H	Bit15	Arc Protection	<b>Arc Protect</b>	ARC detection failure ARC Fault is a “permanent” fault. Site visit is required to clear it by turning DC and AC Power On and Off.	On	Off	On	Quick Blink
		Bit14	Static GFI Protect	<b>IntProtectY</b>	Continuous leakage current fault. (Continuous > 300mA)	On	Off	On	Quick Blink
		Bit13	Arcboard abnormal	<b>ArcboardErr</b>	ARC board self-test failure	On	Off	On	Quick Blink
		Bit12	Reserved						
		Bit11	Reserved						
		Bit10	PV1 over voltage	<b>PV1VoltOver</b>	MPPT1 over-voltage (>610V)	On	Off	On	Quick Blink
		Bit9	PV1 input reverse connection	<b>PV1Reverse</b>	Negative input current of MPPT1 is detected. (<-2A)	On	Off	On	Quick Blink
	Bit8	Reserved							
	Fault 2L	Bit7	Inverter open-loop self-test error	<b>IntProtectW</b>	The voltage difference between inverter voltage and command voltage >50V.	On	Off	On	Quick Blink
		Bit6	PV abnormal input	<b>IntProtectZ</b>	Input Mode detection failure. MPPT1/MPP2 Difference > 20V for Parallel Mode.		Off	On	Quick Blink
		Bit5	PV2 over voltage	<b>PV2VoltOver</b>	MPPT2 over-voltage (>610V)	On	Off	On	Quick Blink
		Bit4	PV2 over current	<b>IntProtectX</b>	MPPT2 over current (>45A)	On	Off	On	Quick Blink
		Bit3	PV2 input reverse connection	<b>PV2Reverse</b>	Negative input current of MPP2 detected. (<-2A)	On	Off	On	Quick Blink
		Bit2	Input and output power mismatch	<b>IntProtectV</b>	The difference between input and output power is out of range. (>50%)	On	Off	On	Quick Blink
		Bit1	Internal hardware error	<b>IntProtectU</b>	Inverter cannot export any running current. (<1A but required >35A)	On	Off	On	Quick Blink
Bit0		Reserved							

**PVI 14TL: Fault 2 Register (0x0038)**

Register Address	Name/Bits	Alarm/Protection/Fault	LCD Display Readout	Description	LED Readout				
					Power	Run	Grid	Fault	
0x0038	Fault 2H	Bit15	Arc Protection	<b>Arc Protect</b>	ARC detection failure ARC Fault is a “permanent” fault. Site visit is required to clear it by turning DC and AC Power On and Off.	On	Off	On	Quick Blink
		Bit14	Static GFI Protect	<b>IntProtectY</b>	Continuous leakage current fault. (Continuous > 300mA)	On	Off	On	Quick Blink
		Bit13	Arcboard abnormal	<b>ArcboardErr</b>	ARC board self-test failure	On	Off	On	Quick Blink
		Bit12	Reserved						
		Bit11	Reserved						
		Bit10	PV1 over voltage	<b>PV1VoltOver</b>	MPPT1 over-voltage (>610V)	On	Off	On	Quick Blink
		Bit9	PV1 input reverse connection	<b>PV1Reverse</b>	Negative input current of MPPT1 is detected. (<-2A)	On	Off	On	Quick Blink
	Bit8	Reserved							
	Fault 2L	Bit7	Inverter open-loop self-test error	<b>Protect0230</b>	The voltage difference between inverter voltage and command voltage >50V.	On	Off	On	Quick Blink
		Bit6	PV abnormal input	<b>Protect0260</b>	Input Mode detection failure. MPPT1/MPP2 Difference > 20V for Parallel Mode.		Off	On	Quick Blink
		Bit5	PV2 over voltage	<b>PV2VoltOver</b>	MPPT2 over-voltage (>610V)	On	Off	On	Quick Blink
		Bit4	PV2 over current	<b>Protect0240</b>	One boost of MPPT2 over current (>45A)	On	Off	On	Quick Blink
		Bit3	PV2 input reverse connection	<b>PV2Reverse</b>	Negative input current of MPP2 detected. (<-2A)	On	Off	On	Quick Blink
		Bit2	Input and output power mismatch	<b>Protect0220</b>	The difference between input and output power is out of range. (>50%)	On	Off	On	Quick Blink
		Bit1	Internal hardware error	<b>Protect0210</b>	Inverter cannot export any running current. (<1A but required >25A)	On	Off	On	Quick Blink
Bit0		Reserved							



**PVI 23/28/36TL: Fault 3 Register (0x0039)**

ARC Fault is a “permanent” fault. Site visit is required to clear it by turning DC and AC Power On and Off.

Register Address	Name/Bits		Alarm/Protection/Fault	LCD Display Readout	Description	LED Readout			
						Power	Run	Grid	Fault
0x0039	Fault 3H	Bit15	ARC protection	<b>ARC Protect</b>	ARC failure detected	On	Off	On	Quick Blink
		Bit14	Reserved						
		Bit13	Reserved						
		Bit12	Reserved						
		Bit11	Reserved						
		Bit10	Reserved						
		Bit9	Reserved						
		Bit8	Reserved						
	Fault 3L	Bit7	Reserved						
		Bit6	Reserved						
		Bit5	Reserved						
		Bit4	Reserved						
		Bit3	Reserved						
		Bit2	Reserved						
		Bit1	Reserved						
Bit0	Reserved								

**PVI 23/28/36TL: Fault 4 Register (0x003A)**

Register Address	Name/Bits	Alarm/Protection/Fault	LCD Display Readout	Description	LED Readout				
					Power	Run	Grid	Fault	
0x003A	Fault 4H	Bit15	Reserved						
		Bit14	Reserved						
		Bit13	Reserved						
		Bit12	Reserved						
		Bit11	Reserved						
		Bit10	Reserved						
		Bit9	Reserved						
		Bit8	Reserved						
	Fault 4L	Bit7	Reserved						
		Bit6	Reserved						
		Bit5	Reserved						
		Bit4	Reserved						
		Bit3	PV Module Configuration Error	<b>Protect0590</b>	DC/AC ratio is too large.	On	Off	On	Quick Blink
		Bit2	Arc board failure	<b>Arcboard Err</b>	ARC board self-test fails	On	Off	On	Quick Blink
Bit1	Static GFCI high	<b>Protect0610</b>	Continuous leakage current fault. (Continuous > 300mA)	On	Off	On	Quick Blink		
Bit0	15V of control board low	<b>Protect0620</b>	The internal 15V power voltage is low	On	Off	On	Quick Blink		