

3 Series RETRO COMPATIBILITY

Firmware Version 2.20 and higher

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Purpose

This document describes the backward compatibility of the 3 Series relay platform, including all changes made in version 2.20 FW. Overall, due to new 3 Series features, the platform now provides a flexible solution for the event recorder and other functionalities across all 3 Series family products.

This document clearly defines the backward compatibility of version 2.20 FW to previous firmware versions issued by the company.

Scope

This document applies to:

- 3 Series platform (339, 345, and 350 relays)
- Version 2.20 FW and higher.

Description

Release 2.20 discontinues some existing order codes.

The 3 Series event recorder table has changed in release 2.20 as follows:

- Expand increments of the voltage range up to 550kV
- Change power unit from kW to MW
- Standardize Modbus register addresses among 3 Series family products

Order code modifications

350 current protection:

Discontinued order code option:

- S** Standard configuration: 50P(1), 50G(1), 50SG(1), 50N(1), 51P(1), 51G(1), 50SG(1), 51N(1)

Suggested replacement order code option:

- E** Extended configuration: User selectable 49, 50P(2), 50G/SG(2), 50N(2), 51P(1), 51G/SG(1), 51N(1)

For backward compatibility, option “S” continues to appear on the relay HMI and in the Enervista Setup Software, so firmware and software can be updated. Selecting an order code with option “S” results in the internal use of option “E”.

345 current protection:

Discontinued order code option:

- E** Extended configuration: 87T, 87T-50, 51P(1), 51G(1), 51N(1), 50P(1), 50G(1), 50N(1), 50BF(1), RGF(1), 49P

Suggested replacement order code option:

- M** Advanced: 87T, 87T-50, 51P(2), 51N(2), 51G(2), 50P(2), 50G(2), 50N(2), 49P, 46 (51_2/50_2), 86, 50BF(2), 87G/RGF(2)

For backward compatibility, option “E” continues to appear on the relay HMI and in the Enervista Setup Software, so firmware and software can be updated. Selecting an order code with option “E” results in the internal use of option “M”.

Event Recorder changes

Voltage range changes

For the 2.20 release, the voltage measurement range has been expanded to three digits to cover a wider voltage range. In addition the upper limit of the VT ratio has been extended.

PHASE/AUX VOLTAGE INPUTS	
Source VT:	0.12 to 65 kV / 50 to 220 V
VT secondary range:	50 to 240 V
VT ratio:	1.0 to 1500.0 in steps of 0.1
Nominal frequency:	50/60 Hz
Relay burden:	<0.25 VA at 120 V
Accuracy:	±1.0% throughout range
Voltage withstand:	260 VAC continuous

Figure 1: Previous voltage inputs

PHASE/AUX VOLTAGE INPUTS	
Source VT:	0.15 to 550 kV / 50 to 220 V
VT secondary range:	50 to 240 V
VT ratio:	1.0 to 5000.0 in steps of 0.1
Nominal frequency:	50/60 Hz
Relay burden:	<0.25 VA at 120 V
Accuracy:	±1.0% throughout range
Voltage withstand:	260 VAC continuous

Figure 2: 2.20 voltage inputs (changes highlighted)

The voltage changes are transparent in most places, however, the impact of changing the voltage values is apparent in the event recorder. The 16 bits allocated per event is no longer sufficient; 32 bits are required to record the increased voltage values.

Changing the increment of the registers of voltages to 32 bits would affect to the actual structure of the event. Consequently, other measurements included in the event have been removed to allocate space to the larger voltages. Changes to the memory map are shown in the following tables.

Previous Memory Map Addresses:

VOLTAGE METERING (1 word) --> 65kV									
Modbus Address	Hex Address	Description	Min	Max	Step	Units	Format Factory Default	Code	Size in Words
30358	165	Vab	0	65535	1	V	F1	---	1
30359	166	Vbc	0	65535	1	V	F1	---	1
30360	167	Vca	0	65535	1	V	F1	---	1
30361	168	Average Line Voltage	0	65535	1	V	F1	---	1
30362	169	Van	0	65535	1	V	F1	---	1
30363	16A	Vbn	0	65535	1	V	F1	---	1
30364	16B	Vcn	0	65535	1	V	F1	---	1
30365	16C	Average Phase Voltage	0	65535	1	V	F1	---	1
30366	16D	Freq	0	12000	1	Hz	F3	---	1
30367	16E	Vn	0	65535	1	V	F1	---	1

New Memory Map Addresses:

VOLTAGE METERING (2 words) --> 550kV									
Modbus Address	Hex Address	Description	Min	Max	Step	Units	Format Factory Default	Code	Size in Words
31746	6D1	Vab	0	550000	1	V	F1		2
31748	6D3	Vbc	0	550000	1	V	F1		2
31750	6D5	Vca	0	550000	1	V	F1		2
31752	6D7	Van	0	550000	1	V	F1		2
31754	6D9	Vbn	0	550000	1	V	F1		2
31756	6DB	Vcn	0	550000	1	V	F1		2
31758	6DD	Vn	0	550000	1	V	F1		2
31760	6DF	Vaux	0	550000	1	V	F1		2
31768	6E7	Average Line Voltage	0	550000	1	V	F1		2
31770	6E9	Average Phase Voltage	0	550000	1	V	F1		2

User-selectable power unit (kW to MW)

The 2.20 FW release provides a user-selectable power unit of either kW or MW, selected by means of a setting. The power of the event is given in W, VAR and VA. This change must be reflected in the event recorder.

Modbus register mismatch among 3 Series products

Each event recorded by the 3 Series family of relays uses the same amount of space (38 registers of 16 bits). However, the same measurement is expressed in a different way for each of the 350, 345, and 339.

For instance, the register '**Event Ia**' takes up to 32 bits in 350 and 339 while '**Event W1 Ia**' takes up to 16 bits for 345. The first is expressed in '**A**' units in primary values whereas the second one is in '**xCT**' units. Thus each measurement value takes up the same space: 16 bits.

Previous Event registers

The next table shows the event registers previous to the 2.20 release for the 350, 345, and 339 relays. The number of valuable data entries stored for each relay is:

350: 29 measurements

339: 28 measurements

345: 38 measurements

350 old event register

Modbus Address	Description	Units	Size in words
SR350 EVENT RECORDER DETAILS			
30659	Event Recorder Last Reset 2 words	---	2
30660			
30661	Total Number of Events Since Last Clear	---	1
30662	Event Cause	---	1
30663	Event Time	---	2
30664			
30665	Event Date	---	2
30666			
30667	Event Ia	A	2
30668			
30669	Event Ib	A	2
30670			
30671	Event Ic	A	2
30672			
30673	Event Ig / In	A	2
30674			
30675	Event Ia Angle	°	1
30676	Event Ib Angle	°	1
30677	Event Ic Angle	°	1
30678	Event Ig Angle	°	1
30679	In Angle	°	1
30680	Event Vab	V	1
30681	Event Vbc	V	1
30682	Event Vca	V	1
30683	Event Va Angle	°	1
30684	Event Vb Angle	°	1
30685	Event Vc Angle	°	1
30686	Event Van	V	1
30687	Event Vbn	V	1
30688	Event Vcn	V	1
30689	Frequency	Hz	1
30690	Event Power Factor	---	1
30691	Event Real Power	kW	2
30692			
30693	Event Reactive Power	kvar	2
30694			
30695	Event Apparent Power	kVA	2
30696			
30697	Phase A Thermal Capacity	%	1
30698	Phase B Thermal Capacity	%	1
30699	Phase C Thermal Capacity	%	1
30700	Not Used		
30701	Event Neutral Current	A	2
30702			
30703	Event Self-Test Event	---	2
30704			
30705	Event Sensitive Ground Current	A	2
30706			

339 old event register

Modbus Address	Description	Units	Size in words
SR339 EVENT RECORDER DETAILS			
30659	Event Recorder Last Reset 2 words	---	2
30660			
30661	Total Number of Events Since Last Clear	---	1
30662	Event Cause	---	1
30663	Event Time	---	2
30664			
30665	Event Date	---	2
30666			
30667	Event Ia	A	2
30668	Event Ib	A	2
30669			
30670	Event Ic	A	2
30671			
30672	Event Ig / In	A	2
30673			
30674	Event Ia Angle	°	1
30675			
30676	Event Ib Angle	°	1
30677	Event Ic Angle	°	1
30678	Event Ig Angle	°	1
30679	In Angle	°	1
30680	Event Vab	V	1
30681	Event Vbc	V	1
30682	Event Vca	V	1
30683	Event Va Angle	°	1
30684	Event Vb Angle	°	1
30685	Event Vc Angle	°	1
30686	Event Van	V	1
30687	Event Vbn	V	1
30688	Event Vcn	V	1
30689	Frequency	Hz	1
30690	Event Power Factor	---	1
30691	Event Real Power	kW	2
30692			
30693	Event Reactive Power	kvar	2
30694			
30695	Event Apparent Power	kVA	2
30696			
30697	Event Thermal Capacity	%	1
30698	Event Motor Load	x FLA	1
30699	Event Unbalance	%	1
30700	Event CBCT Current	A	1
30701	Event Neutral Current	A	2
30702			
30703	Event Self-Test Event	---	2
30704			
30705	Event Sensitive Ground Current	A	2
30706			

**345 old event register**

Modbus Address	Description	Units	Size in words
SR345 EVENT RECORDER DETAILS			
30659	Event Recorder Last Reset 2 words	---	2
30660			
30661	Total Number of Events Since Last Clear	---	1
30662	Event Cause	---	1
30663	Event Time	---	2
30664			
30665	Event Date	---	2
30666			
30667	W1 Ia	x CT	1
30668	W1 Ib	x CT	1
30669	W1 Ic	x CT	1
30670	W1 Ig	x CTg	1
30671	W1 Igd	x CT	1
30672	W1 Igr	x CT	1
30673	W1 I_2	x CT	1
30674	W1 Ia Angle	°	1
30675	W1 Ib Angle	°	1
30676	W1 Ic Angle	°	1
30677	W1 Ig Angle	°	1
30678	W1 In	x CT	1
30679	W1 In Angle	°	1
30680	W2 Ia	x CT	1
30681	W2 Ib	x CT	1
30682	W2 Ic	x CT	1
30683	W2 Ig	x CTg	1
30684	W2 Igd	x CT	1
30685	W2 Igr	x CT	1
30686	W2 I_2	x CT	1
30687	W2 Ia Angle	°	1
30688	W2 Ib Angle	°	1
30689	W2 Ic Angle	°	1
30690	W2 Ig Angle	°	1
30691	W2 In	x CT	1
30692	W2 In Angle	°	1
30693	Ph A Diff.	x CT (W1)	1
30694	Ph B Diff.	x CT (W1)	1
30695	Ph C Diff.	x CT (W1)	1
30696	Ph A Restr.	x CT (W1)	1
30697	Ph B Restr.	x CT (W1)	1
30698	Ph C Restr.	x CT (W1)	1
30699	2nd Harm Ph A diff	% fo	1
30700	2nd Harm Ph B diff	% fo	1
30701	2nd Harm Ph C diff	% fo	1
30702	Phase A Thermal Capacity	%	1
30703	Phase B Thermal Capacity	%	1
30704	Phase C Thermal Capacity	%	1
30705	Event Self-Test Event	---	2
30706			

New Event Register format

In order to accommodate the changes to voltage range and storage of user-selectable power units, release 2.20 has changed the event register to store all data included in the event in a per unit format. This follows the existing format of the 345 event recorder, standardizing among the 3 Series family, and leaves some registers free for future expansion.

All event data is stored in a 16 bit format. Headers in the Event Recorder register have been enlarged to contain additional data (CT ratio, VT ratio, Ground CT ratio, and power unit of events). This additional header data does not affect the accuracy of the stored event data.

The Enervista software can show the event registers in either per unit or primary values. The 'power unit' in address 30658 reflects the power unit selection of either kW or MW. Using the expanded header data and power unit, Enervista or other SCADA programs can change the visualization of data events by means of a setting, and the primary values for each event can be calculated.

Backwards compatibility has not been maintained in the event registers for release 2.20.

New units added for 339 and 350 are as follows:

xCT – per Phase CT (Phase currents)

xCTg – per ground CT (ground currents)

xVT – per Voltage VT (Phase voltages)

xVTx – per Voltage VTx (Auxiliary voltage)

xCTVT VA – per Phase VT and CT (App. Power VA)

xCTVT VAR – per Phase VT and CT (Rective. Power VAR)

xCTVT W – per Phase VT and CT (Real Power W)

New event register formats are shown for 350 and 339 on the following pages. (The 345 is not shown because it has not changed.)

350 new event register

Modbus Address	Description	Units	Size in words	Modbus Address	Description	Units	Size in words
SR350 EVENT RECORDER DETAILS				SR 350 EVENT RECORDER DETAILS			
30654				30654	CT Primary	A	1
30655				30655	Ground CT Primary	A	1
30656				30656	VT Ratio	---	1
30657				30657	Aux VT Ratio	---	1
30658				30658	Power Unit	---	1
30659	Event Recorder Last Reset 2 words	---	2	30659	Event Recorder Last Reset 2 words	---	2
30660				30660			
30661	Total Number of Events Since Last Clear	---	1	30661	Total Number of Events Since Last Clear	---	1
30662	Event Cause	---	1	30662	Event Cause	---	1
30663	Event Time	---	2	30663	Event Time	---	2
30664				30664			
30665	Event Date	---	2	30665	Event Date	---	2
30666				30666			
30667	Event Ia	A	2	30667	Event Ia	x CT	1
30668				30668	Event Ib	x CT	1
30669	Event Ib	A	2	30669	Event Ic	x CT	1
30670				30670	Event Ig/Isg	x CTg	1
30671	Event Ic	A	2	30671	Event In	x CT	1
30672				30672	Event Ia Angle	°	1
30673	Event Ig / In	A	2	30673	Event Ib Angle	°	1
30674				30674	Event Ic Angle	°	1
30675	Event Ia Angle	°	1	30675	Event Ig/Isg Angle	°	1
30676	Event Ib Angle	°	1	30676	Event In Angle	°	1
30677	Event Ic Angle	°	1	30677	Event Vab	x VT	1
30678	Event Ig Angle	°	1	30678	Event Vbc	x VT	1
30679	In Angle	°	1	30679	Event Vca	x VT	1
30680	Event Vab	V	1	30680	Event Van	x VT	1
30681	Event Vbc	V	1	30681	Event Vbn	x VT	1
30682	Event Vca	V	1	30682	Event Vcn	x VT	1
30683	Event Va Angle	°	1	30683	Event Vaux	x VTx	1
30684	Event Vb Angle	°	1	30684	Event Va Angle	°	1
30685	Event Vc Angle	°	1	30685	Event Vb Angle	°	1
30686	Event Van	V	1	30686	Event Vc Angle	°	1
30687	Event Vbn	V	1	30687	Event Vc Angle	°	1
30688	Event Vcn	V	1	30688	Frequency	Hz	1
30689	Frequency	Hz	1	30689	Event Power Factor	---	1
30690	Event Power Factor	---	1	30690	Event Real Power	x CTxVT W	1
30691	Event Real Power	kW	2	30691	Event Reactive Power	x CTxVT VAR	1
30692				30692	Event Apparent Power	x CTxVT VA	1
30693	Event Reactive Power	kvar	2	30693	Phase A Thermal Capacity	%	1
30694				30694	Phase B Thermal Capacity	%	1
30695	Event Apparent Power	kVA	2	30695	Phase C Thermal Capacity	%	1
30696				30696	Event Self-Test Event	---	2
30697	Phase A Thermal Capacity	%	1	30697			
30698	Phase B Thermal Capacity	%	1	30698			
30699	Phase C Thermal Capacity	%	1	30699			
30700	Not Used			30700			
30701	Event Neutral Current	A	2	30701			
30702				30702			
30703	Event Self-Test Event	---	2	30703			
30704				30704			
30705	Event Sensitive Ground Current	A	2	30705			
30706				30706			

339 new event register

Modbus Address	Description	Units	Size in words	Modbus Address	Description	Units	Size in words
SR339 EVENT RECORDER DETAILS				SR 339 EVENT RECORDER DETAILS			
30654				30654	CT Primary	A	1
30655				30655	Ground CT Primary	A	1
30656				30656	VT Ratio	---	1
30657				30657		---	
30658				30658	Power Unit	---	1
30659	Event Recorder Last Reset 2 words	---	2	30659	Event Recorder Last Reset 2 words	---	2
30660	Total Number of Events Since Last Clear	---	1	30660	Total Number of Events Since Last Clear	---	1
30661				30661			
30662	Event Cause	---	1	30662	Event Cause	---	1
30663	Event Time	---	2	30663	Event Time	---	2
30664				30664			
30665	Event Date	---	2	30665	Event Date	---	2
30666				30666			
30667	Event Ia	A	2	30667	Event Ia	x CT	1
30668				30668	Event Ib	x CT	1
30669	Event Ib	A	2	30669	Event Ic	x CT	1
30670				30670	Event Ig/Isig	x CTg	1
30671	Event Ic	A	2	30671	Event In	x CT	1
30672				30672	Event Ia Angle	°	1
30673	Event Ig / In	A	2	30673	Event Ib Angle	°	1
30674				30674	Event Ic Angle	°	1
30675	Event Ia Angle	°	1	30675	Event Igrd Angle	°	1
30676	Event Ib Angle	°	1	30676	Event In Angle	°	1
30677	Event Ic Angle	°	1	30677	Event Vab	x VT	1
30678	Event Ig Angle	°	1	30678	Event Vbc	x VT	1
30679	In Angle	°	1	30679	Event Vca	x VT	1
30680	Event Vab	V	1	30680	Event Van	x VT	1
30681	Event Vbc	V	1	30681	Event Vbn	x VT	1
30682	Event Vca	V	1	30682	Event Vcn	x VT	1
30683	Event Va Angle	°	1	30683	Event Va Angle	°	1
30684	Event Vb Angle	°	1	30684	Event Vb Angle	°	1
30685	Event Vc Angle	°	1	30685	Event Vc Angle	°	1
30686	Event Van	V	1	30686	Event Vc Angle	°	1
30687	Event Vbn	V	1	30687	Frequency	Hz	1
30688	Event Vcn	V	1	30688	Event Power Factor	---	1
30689	Frequency	Hz	1	30689	Event Real Power	x CTxVT W	1
30690	Event Power Factor	---	1	30690	Event Reactive Power	x CTxVT VAR	1
30691	Event Real Power	kW	2	30691	Event Apparent Power	x CTxVT VA	1
30692				30692	Event Thermal Capacity	%	1
30693	Event Reactive Power	kvar	2	30693	Event Motor Load	x FLA	1
30694				30694	Event Unbalance	%	1
30695	Event Apparent Power	kVA	2	30695	Event CBCT Current	A	1
30696				30696	Event Self-Test Event	---	2
30697	Event Thermal Capacity	%	1	30697			
30698	Event Motor Load	x FLA	1	30698			
30699	Event Unbalance	%	1	30699			
30700	Event CBCT Current	A	1	30700			
30701	Event Neutral Current	A	2	30701			
30702				30702			
30703	Event Self-Test Event	---	2	30703			
30704				30704			
30705	Event Sensitive Ground Current	A	2	30705			
30706				30706			

Example:

Supposing the following configuration of the 350:

CT primary: 500 CT secondary: 5 A
 VT Ratio: 11000:110 V nominal: 110 v

And these are the values measured by the relay:

Channel	Magnitude	Angle
Ia	345 A	0 °
Ib	452 A	120 ° Lag
Ic	1854 A	240 ° Lag
Va	12345 V	0 °
Vb	12452 V	120 ° Lag
Vc	4500 V	240 ° Lag
P	-2726,6 KW	
Q	-2351 KW	

The event recorder will show:

Channel	Magnitude	Angle
Ia	0.69 xCT	0 °
Ib	0.904 xCT	120 ° Lag
Ic	3.708 xCT	240 ° Lag
Va	1.122 xVT	0 °
Vb	1.132 xVT	120 ° Lag
Vc	0.409 xVT	240 ° Lag
P	-0.496 xCTVT W	
Q	-0.427 xCTVT VAR	

The event header will contain:

CT Primary : 500
 VT Ratio: 11000 (In this case similar to primary VT)
 Power unit: kW

Channel	Magnitude	Magnitude (Primary)	Error
Ia	0.69 xCT	345 A	0 %
Ib	0.904 xCT	452 A	0 %
Ic	3.708 xCT	1854 A	0 %
Va	1.122 xVT	12,342 KV	0.024 %
Vb	1.132 xVT	12,452 KV	0 %
Vc	0.409 xVT	4,499 KV	0.022 %
P	-0.496 xCTVT W	-2728 KW	0.051 %
Q	-0.427 xCTVT VAR	-2348,5 KVAR	0.1 %

As can be seen, by using xCT and xVT magnitudes with a format of 3 decimal digits the error can be negligible.

Appendix

GE VERNOVA technical support

GE VERNOVA Grid Solutions - Multilin contact information and call center for product support is shown below:

GE VERNOVA Grid Solutions
650 Markland Street
Markham, Ontario
Canada L6C 0M1

Telephone: 905-927-7070 or 1-800-547-8629 (North America), +34 94 485 88 00 (Europe)

Fax: 905-927-5098 (North America), +34 94 485 88 45 (Europe)

E-mail: multilin.tech@gevernova.com

Home Page: <https://www.gevernova.com/grid-solutions/multilin>