

1. INTRODUZIONE

Alcuni strumenti FRER sono dotati opzionalmente di una interfaccia seriale RS-485, o di una interfaccia Ethernet, per trasferire dati da e verso PC, PLC, ed altri sistemi di supervisione, utilizzando il protocollo Modbus RTU (su RS-485), o Modbus TCP/IP (su Ethernet).

Fare riferimento al foglio tecnico del modello specifico, per i dettagli tecnici relativi.

1. INTRODUCTION

Some FRER instruments are optionally equipped with a serial RS-485 interface, or with an Ethernet interface, to transfer data to and from PC's, PLC's and other supervisory systems, using the Modbus RTU protocol (over RS-485), or the Modbus TCP/IP protocol (over Ethernet).

Please refer to the data sheet of the specific model, for the relevant technical details.

2. PROTOCOLLO MODBUS

Le funzioni supportate sono:

- 03 Read holding registers
- 08 Diagnostics, solo Sotto-funzione 00, Return query data
- 16 (0x10) Preset multiple holding registers

Gli strumenti agiscono come "Slave (Server)"; ed il loro "Slave Address (Unit Identifier)" può essere programmato da 1 a 247.

Nelle operazioni di scrittura, i dispositivi possono essere indirizzati anche con l'indirizzo broadcast (0x00); in questo caso tutti i dispositivi connessi al bus verranno scritti, e nessuno di loro invierà una risposta.

Temporizzazione:

- Minimo intervallo tra la fine di una risposta e l'inizio della richiesta successiva (verso lo stesso dispositivo): 150 ms.
- Minimo intervallo tra la fine di una risposta e l'inizio della richiesta successiva (verso un dispositivo differente): 15 ms.
- Minimo time-out alla risposta (da impostare sul master/client): 500 ms.

Le Exception Responses supportate sono:

- 01 Illegal function (funzione non supportata o scrittura non abilitata)
- 02 Illegal data address (l'indirizzo dei dati ricevuto non è valido)
- 03 Illegal data value (il valore dei dati ricevuto non è valido)

2. MODBUS PROTOCOL

The supported functions are:

- 03 *Read holding registers*
- 08 *Diagnostics, Sub-function 00 only, Return query data*
- 16 (0x10) *Preset multiple holding registers*

The instruments act as "Slaves (Servers)"; their "Slave Address (Unit Identifier)" can be set from 1 to 247.

In writing operations, the devices can be also addressed with the broadcast address (0x00); in this case all the devices connected to the bus will be written, and none of them will send a response.

Timing:

- *Minimum interval between the end of a response and the beginning of the next query (to the same device): 150ms.*

Rev.	Data / Date	Descrizione / Description	Preparata / Prepared	Approvata / Approved
16	09/03/26	Correzione. I registri di stato 40427/40428 diventano da solo stato di output a stato input per alcuni modelli. <i>Detailed status registers 40427/40428 change from output status to input status for some models</i>	G. Curto	L. Bertolazzi
15	18/12/25	I registri Status 427/428 diventano Digital Status / <i>427/428 Status registers change as Digital Status registers</i>	G. Curto	A. Miori
14	22/10/24	Rimossi paragrafi relativi al layer fisico / <i>Paragraphs relevant to Physical layer removed</i>	G. Curto	A. Miori
13	01/03/21	Aggiunti Registri Energia per le tariffe 1,2,3,4 per Nano e Qubo / <i>Tariff 1,2,3,4 Energy registers for Nano and Qubo added</i>	G. Curto	A. Miori
12	06/11/19	Aggiunti Registri Energia a 64 bits, angolo di sistema e di fase per Nano e Qubo / <i>64 bits Energy registers and system and phase angle registers for Nano and Qubo added</i>	E. Palazzi	A. Miori

- *Minimum interval between the end of a response and the beginning of the next query (to a different device): 15ms.*
- *Minimum response time-out (to be set on the master): 500ms.*

The supported exception responses are:

- *01 Illegal function (function not supported or writing not enabled)*
- *02 Illegal data address (the received data address is invalid)*
- *03 Illegal data value (the received data value is invalid)*

3. TABELLA REGISTRI

La seguente tabella contiene le variabili disponibili e gli indirizzi dei registri dove sono allocate; la cifra (4) iniziale nei numeri dei registri, indica solo che si tratta di "Holding Registers" (appartenenti al banco di registri 4).

I registri segnati con "R" sono di sola lettura, quelli segnati con "R/W" sono registri di lettura e scrittura.

Tutte le misure sono espresse in valori reali (primari): i rapporti dei TA e dei TV sono già inclusi.

Alcune variabili sono contenute in due registri. Questi due registri devono sempre essere letti o scritti insieme usando la funzione 03 "Read Holding registers" o 16 (0x10) "Preset multiple holding registers".

Leggere o scrivere un numero dispari di registri, o un numero pari di registri ma a cavallo di una coppia non è permesso e genera una exception response 02 "Illegal data address".

Nelle operazioni di lettura, utilizzando la funzione 03 "Read Holding registers", il numero massimo di registri che possono essere richiesti in una singola query è 124 (38 nel caso del Q15/96B4W).

La richiesta di più di 124 (38) registri in una singola query genera una exception response 03 "Illegal data value".

Le operazioni di scrittura devono essere precedute dalla scrittura del valore 0x0000 00A5 nei registri Write enable (40513 e 40514). La scrittura rimane abilitata fino a quando viene modificato tale valore o fino a quando lo strumento viene spento.

Le operazioni di scrittura eseguite mentre i registri Write enable non contengono il valore corretto generano una exception response 01 "Illegal function".

Il formato dei dati è:

- long (intero a 32 bit), big-endian, per le variabili contenute in due registri;
- word (intero a 16 bit), per le variabili contenute in un registro;
- long long (intero a 64 bit), per le variabili contenute in quattro registri.

Le variabili che possono assumere un valore negativo sono espresse in "complemento a 2".

Per le versioni monofase i registri disponibili sono quelli di sistema (Sys) o, in mancanza di questi, quelli della fase 1 (L1)

I dati della distorsione armonica totale THD (contenuti nei registri dal 40307 al 40318) e quelli delle singole armoniche (contenuti nei registri dal 41281 al 41792) sono espressi o come % del valore nominale, o come % del valore RMS o come % del valore della fondamentale, secondo come impostato nel menu di programmazione dello strumento.

Quando si leggono i valori delle energie (kWh+, kVArh+, kWh-, kVArh-, Partial kWh+), devono essere letti anche i registri del moltiplicatore delle energie (40287 e 40288).

Quindi il contenuto dei registri delle energie deve essere moltiplicato per il moltiplicatore delle energie, al fine di ottenere i valori di energia corretti (espressi in Wh o VArh).

Il valore del moltiplicatore delle energie è regolato automaticamente dagli strumenti quando i valori primari dei TA e dei TV vengono impostati, e non cambia più fino a quando non vengono nuovamente modificati

3. REGISTERS TABLE

The following table contains the available variables and the addresses of the registers where they are allocated; the leading digit (4) in the register numbers only indicates that they are "Holding Registers" (belonging to the registers bank 4).

Registers marked with "R" are read only, those marked with "R/W" are read and write registers.

All the measurements are expressed in real (primary) values: the CT's and VT's ratios are already included.

Some variables use two registers; when reading or writing these values, both registers must be read or written together using the function 03 "Read Holding registers" or 16 (0x10) "Preset multiple holding registers".

Reading or writing an odd number of registers, or an even number of registers but across a couple is not allowed and generates an exception response 02 "Illegal data address".

In reading operations, using the function 03 "Read holding registers", the maximum number of registers that can be requested in a single query is 124 (38 for Q15/96B4W).

Requesting more than 124 (38) registers in a single query generates an exception response 03 "illegal data value"

Writing operations must be preceded by writing the value 0x0000 00A5 in the Write enable registers (40513 and 40514). Writing remains enabled until this value is changed or the instrument is switched off. Writing operations performed when the content of the Write enable registers is incorrect generate an exception response 01 "Illegal function".

Data format is:

- long (32 bits integer), big-endian, for the variables using two registers;
- word (16 bits integer), for the variables using one register;
- long long (64 bits integer), for the variables using four registers.

Variables which could take a negative value, are expressed in "two's complement".

The registers available for the single-phase versions are the system ones (Sys) or, in their absence, those of the phase 1 (L1).

Registers from 40307 to 40318 (containing data of total harmonic distortion THD) and from 41281 to 41792 (containing data of individual harmonics) are expressed or as % of nominal value, or as % of RMS value, or as % of the fundamental value, according to the mode set in the programming menu of the instrument.

When reading the energy values (kWh+, kVarh+, kWh-, kVarh-, Partial kWh+), the Energy multiplier registers (40287 and 40288) must also be read.

Then the content of the energy registers must be multiplied by the Energy multiplier in order to get the correct energy values (expressed in Wh or VARh).

The Energy multiplier value is automatically adjusted by the meter when the primary values of the CT's and VT's are set, and will not change anymore as long as they are not changed again.

REGISTER	ADDRESS (HEX)	VARIABLE	UNIT	R/W	NOTES	C 15/96...L	Q 15/96 E2/U2 / MCUU	MCU	Q 15 U2H	MCUH	Q 96 U4L	Q 96 U4H	Q 15/96 B4W	C/Q 15/96 UCL	MCOU... / MC2U...	Q52... (NaNo) / Q72/96 (Quibo) / MCUP0H	Q52C3L (NaNo dc)-Q72/96C3L (Quibo dc)-MCUCOL	C18WSL040MD3A1
40001	0000																	
...	...	RESERVED																
40256	00FF																	
40257	0100	V L1-N	1mV	R			☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	
40258	0101																	
40259	0102	V L2-N	1mV	R			☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	
40260	0103																	
40261	0104	V L3-N	1mV	R			☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	
40262	0105																	
40263	0106	V L1-L2	1mV	R			☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	
40264	0107																	
40265	0108	V L2-L3	1mV	R			☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	
40266	0109																	
40267	010A	V L3-L1	1mV	R			☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	
40268	010B																	
40269	010C	I L1	1mA	R			☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	
40270	010D																	
40271	010E	I L2	1mA	R			☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	
40272	010F																	
40273	0110	I L3	1mA	R			☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	
40274	0111																	
40275	0112	F	1mHz	R	L1		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
40276	0113																	
40277	0114	P Sys	1W	R	P L1 + P L2 + P L3		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
40278	0115	(P for C/Q15/96UCL and Q52/72/96C3L)																

REGISTER	ADDRESS (HEX)	VARIABLE	UNIT	R/W	NOTES	C 15/96...L	Q 15/96 E2/U2 /MCUU	MCU	Q 15 U2H	MCUH	Q 96 U4L	Q 96 U4H	Q 15/96 B4W	C/Q 15/96 UCL	MCOU... /MC2U...	Q52...(NaNo) / Q72/96 (Qubo) / MCUP0H	Q52C3L (NaNo dc)-Q72/96C3L (Qubo dc)-MCUCOL	C18W/SLO40MD3A1
40327	0146	P L2	1W	R				☺		☺	☺	☺	☺					
40328	0147																	
40329	0148	P L3	1W	R				☺		☺	☺	☺	☺					
40330	0149																	
40331	014A	Q L1	1VAr	R				☺		☺	☺	☺	☺					
40332	014B																	
40333	014C	Q L2	1VAr	R				☺		☺	☺	☺	☺					
40334	014D																	
40335	014E	Q L3	1VAr	R				☺		☺	☺	☺	☺					
40336	014F																	
40337	0150	S L1	1VA	R	V L1 rms x I L1 rms			☺		☺	☺	☺	☺					
40338	0151																	
40339	0152	S L2	1VA	R	V L2 rms x I L2 rms			☺		☺	☺	☺	☺					
40340	0153																	
40341	0154	S L3	1VA	R	V L3 rms x I L3 rms			☺		☺	☺	☺	☺					
40342	0155																	
40343	0156	P.F. L1	0.001	R	P L1 / S L1		☺	☺	☺	☺	☺	☺	☺					
40344	0157																	
40345	0158	P.F. L2	0.001	R	P L2 / S L2		☺	☺	☺	☺	☺	☺	☺					
40346	0159																	
40347	015A	P.F. L3	0.001	R	P L3 / S L3		☺	☺	☺	☺	☺	☺	☺					
40348	015B																	
40349	015C	Cos Phi L1	0.001	R	P L1 / S L1 (Fundamentals)				☺	☺		☺						
40350	015D																	
40351	015E	Cos Phi L2	0.001	R	P L2 / S L2 (Fundamentals)				☺	☺		☺						
40352	015F																	
40353	0160	Cos Phi L3	0.001	R	P L3 / S L3 (Fundamentals)				☺	☺		☺						
40354	0161																	
40355	0162	P max Sys	1W	R/W			☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
40356	0163																	
40357	0164	P avg Sys	1W	R/W	Moving average		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
40358	0165																	
40359	0166	I max L1 (I max Sys for Q52/72/96C3L)	1mA	R/W			☺	☺	☺	☺	☺	☺	☺					
40360	0167																	
40361	0168	I max L2	1mA	R/W			☺	☺	☺	☺	☺	☺	☺					
40362	0169																	
40363	016A	I max L3	1mA	R/W			☺	☺	☺	☺	☺	☺	☺					
40364	016B																	
40365	016C	I avg L1 (I avg Sys for Q52/72/96C3L)	1mA	R/W	Moving average		☺	☺	☺	☺	☺	☺	☺					☺
40366	016D																	
40367	016E	I avg L2	1mA	R/W	Moving average		☺	☺	☺	☺	☺	☺	☺					
40368	016F																	
40369	0170	I avg L3	1mA	R/W	Moving average		☺	☺	☺	☺	☺	☺	☺					
40370	0171																	
40371	0172	THDa V L1	1mV	R	Absolute value				☺	☺		☺						
40372	0173																	
40373	0174	THDa V L2	1mV	R	Absolute value				☺	☺		☺						
40374	0175																	

REGISTER	ADDRESS (HEX)	VARIABLE	UNIT	R/W	NOTES	C 15/96...L	Q 15/96 E2/U2 /MCUU	MCU	Q 15 U2H	MCUH	Q 96 U4L	Q 96 U4H	Q 15/96 B4W	C/Q 15/96 UCL	MCOU... /MC2U...	Q52...(NaNo) / Q72/96 (Qubo) / MCUP0H	Q52C3L (NaNo dc)-Q72/96C3L (Qubo dc)-MCUCOL	C18W/SL040MD3A1
40375	0176	THDa V L3	1mV	R	Absolute value				☺	☺	☺							
40376	0177																	
40377	0178	THDa I L1	1mA	R	Absolute value				☺	☺	☺							
40378	0179																	
40379	017A	THDa I L2	1mA	R	Absolute value				☺	☺	☺							
40380	017B																	
40381	017C	THDa I L3	1mA	R	Absolute value				☺	☺	☺							
40382	017D																	
40383	017E	Phases sequence	123/132	R	123 = Correct				☺	☺	☺					☺		
40384	017F																	
40385	0180	Total hours run	0.1h	R/W					☺	☺	☺	☺						
40386	0181																	
40387	0182	Partial hours run	0.1h	R/W								☺				☺	☺	
40388	0183																	
40389	0184	Hours to maintenance	0.1h	R/W	Stops at 0							☺						
40390	0185																	
40391	0186	Temperature	0.1°C	R	Internal switchboard							☺				☺	☺	
40392	0187																	
40393	0188	Crest Factor V L1	0.001	R					☺	☺	☺							
40394	0189																	
40395	018A	Crest Factor V L2	0.001	R					☺	☺	☺							
40396	018B																	
40397	018C	Crest Factor V L3	0.001	R					☺	☺	☺							
40398	018D																	
40399	018E	Crest Factor I L1	0.001	R					☺	☺	☺							
40400	018F																	
40401	0190	Crest Factor I L2	0.001	R					☺	☺	☺							
40402	0191																	
40403	0192	Crest Factor I L3	0.001	R					☺	☺	☺							
40404	0193																	
40405	0194	Phase Angle Sys	0.001 deg.	R	-90.000° ... +89.999°											☺	☺	
40406	0195																	
40407	0196	Phase Angle L1	0.001 deg.	R	-90.000° ... +89.999°											☺	☺	
40408	0197																	
40409	0198	Phase Angle L2	0.001 deg.	R	-90.000° ... +89.999°											☺	☺	
40410	0199																	
40411	019A	Phase Angle L3	0.001 deg.	R	-90.000° ... +89.999°											☺	☺	
40412	019B																	
40413	019C	Partial kWh+ Sys	1Wh	R/W												☺	☺	
40414	019D																	
40415	019E	User Register	1	R/W												☺	☺	
40416	019F																	
40417	01A0	Ah+	1mAh	R/W								☺				☺		
40418	01A1																	
40419	01A2	Ah-	1mAh	R/W								☺				☺		
40420	01A3																	
40421	01A4	Ah Multiplier	1	R								☺				☺		
40422	01A5																	

REGISTER	ADDRESS (HEX)	VARIABLE	UNIT	R/W	NOTES	C 15/96...L	Q 15/96 E2/U2 /MCUU	MCU	Q 15 U2H	MCUH	Q 96 U4L	Q 96 U4H	Q 15/96 B4W	C/Q 15/96 UCL	MCOU... / MC2U...	Q52...(NaNo) / Q72/96 (Qubo) / MCUP0H	Q52C3L (NaNo dc)-Q72/96C3L (Qubo dc)-MCUCOL	C18W/SLO40MD3AI	
40423	01A6	Q max Sys	1var	R/W															
40424	01A7																		
40425	01A8	Q avg Sys	1var	R/W	Moving average														
40426	01A9																		
40427	01AA	Digital output status [Bitfield 31÷0] Or	---	R	Input Status: bit=0 out open, bit=1 out close bit [1] out alarm 1, bit [0] out alarm 2														
40428	01AB	Digital input status: available only on specific input equipped models Digital input status [Bitfield 31÷0]																	
40429	01AC	kWh+ Sys 64 (Most Significant)	1Wh	R															
40430	01AD																		
40431	01AE	kWh+ Sys 64 (Least Significant)	1Wh	R															
40432	01AF																		
40433	01B0	kVArh+ Sys 64 (Most Significant)	1VArh	R															
40434	01B1																		
40435	01B2	kVArh+ Sys 64 (Least Significant)	1VArh	R															
40436	01B3																		
40437	01B4	kWh- Sys 64 (Most Significant)	1Wh	R															
40438	01B5																		
40439	01B6	kWh- Sys 64 (Least Significant)	1Wh	R															
40440	01B7																		
40441	01B8	kVArh- Sys 64 (Most Significant)	1VArh	R															
40442	01B9																		
40443	01BA	kVArh- Sys 64 (Least Significant)	1VArh	R															
40444	01BB																		
40445	01BC	Current Tariff Index	---	R/W	1, 2, 3, 4														
40446	01BD																		
40447	01BE	kWh+ Sys Tariff 2	1Wh	R/W															
40448	01BF																		
40449	01C0	kVArh+ Sys Tariff 2	1VArh	R/W															
40450	01C1																		
40451	01C2	kWh- Sys Tariff 2	1Wh	R/W															
40452	01C3																		
40453	01C4	kVArh- Sys Tariff 2	1VArh	R/W															
40454	01C5																		
40455	01C6	kWh+ Sys Tariff 3	1Wh	R/W															
40456	01C7																		
40457	01C8	kVArh+ Sys Tariff 3	1VArh	R/W															
40458	01C9																		
40459	01CA	kWh- Sys Tariff 3	1Wh	R/W															
40460	01CB																		
40461	01CC	kVArh- Sys Tariff 3	1VArh	R/W															
40462	01CD																		
40463	01CE	kWh+ Sys Tariff 4	1Wh	R/W															
40464	01CF																		
40465	01D0	kVArh+ Sys Tariff 4	1VArh	R/W															
40466	01D1																		

REGISTER	ADDRESS (HEX)	VARIABLE	UNIT	R/W	NOTES	C 15/96...L	Q 15/96 E2/U2 /MCUU	MCU	Q 15 U2H	MCUH	Q 96 U4L	Q 96 U4H	Q 15/96 B4W	C/Q 15/96 UCL	MCOU... / MC2U...	Q52...(NaNo) / Q72/96 (Qubo) / MCUP0H	Q52C3L (NaNo dc)-Q72/96C3L (Qubo dc)-MCUCOL	C18W/SLO40MD3A1
40467	01D2	kWh- Sys Tariff 4	1Wh	R/W														
40468	01D3																	
40469	01D4	kVArh- Sys Tariff 4	1VArh	R/W														
40470	01D5																	
40471	01D6	kVAh Sys	1VAh	R/W														
40472	01D7																	
40473	01D8	kVAh Sys Tariff 2	1VAh	R/W														
40474	01D9																	
40475	01DA	kVAh Sys Tariff 3	1VAh	R/W														
40476	01DB																	
40477	01DC	kVAh Sys Tariff 4	1VAh	R/W														
40478	01DD																	
40479	01DE	RESERVED FOR FUTURE ADDITIONAL VARIABLES																
...	...																	
40512	01FF																	
40513	0200	WRITE ENABLE		R/W	0000 00A5 = Enabled	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
40514	0201																	
40515	0202	DEVICE LOGIC ADDRESS		R/W		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
40516	0203																	
40517	0204	SYSTEM DATA AND SETTINGS (MODEL SPECIFIC)																
...	...																	
40768	02FF																	
40769	0300	RESERVED																
...	...																	
41024	03FF																	
41025	0400	RESERVED FOR FUTURE ADDITIONAL VARIABLES																
...	...																	
41280	04FF																	
41281	0500	H1 V L1	0.1 %	R					☺	☺		☺						
41282	0501	H1 V L2	0.1 %	R				☺	☺		☺							
41283	0502	H1 V L3	0.1 %	R				☺	☺		☺							
41284	0503	H2 V L1	0.1 %	R				☺	☺		☺							
41285	0504	H2 V L2	0.1 %	R				☺	☺		☺							
41286	0505	H2 V L3	0.1 %	R				☺	☺		☺							
41287	0506	H3 V L1	0.1 %	R				☺	☺		☺							
41288	0507	H3 V L2	0.1 %	R				☺	☺		☺							
41289	0508	H3 V L3	0.1 %	R				☺	☺		☺							
41290	0509	H4 V L1	0.1 %	R				☺	☺		☺							
41291	050A	H4 V L2	0.1 %	R				☺	☺		☺							
41292	050B	H4 V L3	0.1 %	R				☺	☺		☺							
41293	050C	H5 V L1	0.1 %	R				☺	☺		☺							
41294	050D	H5 V L2	0.1 %	R				☺	☺		☺							
41295	050E	H5 V L3	0.1 %	R				☺	☺		☺							
41296	050F	H6 V L1	0.1 %	R				☺	☺		☺							
41297	0510	H6 V L2	0.1 %	R				☺	☺		☺							
41298	0511	H6 V L3	0.1 %	R				☺	☺		☺							
41299	0512	H7 V L1	0.1 %	R				☺	☺		☺							
41300	0513	H7 V L2	0.1 %	R				☺	☺		☺							
41301	0514	H7 V L3	0.1 %	R				☺	☺		☺							

REGISTER	ADDRESS (HEX)	VARIABLE	UNIT	R/W	NOTES	C 15/96...L	Q 15/96 E2/U2 /MCUU	MCU	Q 15 U2H	MCUH	Q 96 U4L	Q 96 U4H	Q 15/96 B4W	C/Q 15/96 UCL	MCOU... / MC2U...	Q52...(NaNc) / Q72/96 (Qubo) / MCUP0H	Q52C3L (NaNc dc)-Q72/96C3L (Qubo dc)-MCUCOL	C18W/SLO40MD3A1
41302	0515	H8 V L1	0.1 %	R					⊗	⊗		⊗						
41303	0516	H8 V L2	0.1 %	R					⊗	⊗		⊗						
41304	0517	H8 V L3	0.1 %	R					⊗	⊗		⊗						
41305	0518	H9 V L1	0.1 %	R					⊗	⊗		⊗						
41306	0519	H9 V L2	0.1 %	R					⊗	⊗		⊗						
41307	051A	H9 V L3	0.1 %	R					⊗	⊗		⊗						
41308	051B	H10 V L1	0.1 %	R					⊗	⊗		⊗						
41309	051C	H10 V L2	0.1 %	R					⊗	⊗		⊗						
41310	051D	H10 V L3	0.1 %	R					⊗	⊗		⊗						
41311	051E	H11 V L1	0.1 %	R					⊗	⊗		⊗						
41312	051F	H11 V L2	0.1 %	R					⊗	⊗		⊗						
41313	0520	H11 V L3	0.1 %	R					⊗	⊗		⊗						
41314	0521	H12 V L1	0.1 %	R					⊗	⊗		⊗						
41315	0522	H12 V L2	0.1 %	R					⊗	⊗		⊗						
41316	0523	H12 V L3	0.1 %	R					⊗	⊗		⊗						
41317	0524	H13 V L1	0.1 %	R					⊗	⊗		⊗						
41318	0525	H13 V L2	0.1 %	R					⊗	⊗		⊗						
41319	0526	H13 V L3	0.1 %	R					⊗	⊗		⊗						
41320	0527	H14 V L1	0.1 %	R					⊗	⊗		⊗						
41321	0528	H14 V L2	0.1 %	R					⊗	⊗		⊗						
41322	0529	H14 V L3	0.1 %	R					⊗	⊗		⊗						
41323	052A	H15 V L1	0.1 %	R					⊗	⊗		⊗						
41324	052B	H15 V L2	0.1 %	R					⊗	⊗		⊗						
41325	052C	H15 V L3	0.1 %	R					⊗	⊗		⊗						
41326	052D	H16 V L1	0.1 %	R					⊗	⊗		⊗						
41327	052E	H16 V L2	0.1 %	R					⊗	⊗		⊗						
41328	052F	H16 V L3	0.1 %	R					⊗	⊗		⊗						
41329	0530	H17 V L1	0.1 %	R					⊗	⊗		⊗						
41330	0531	H17 V L2	0.1 %	R					⊗	⊗		⊗						
41331	0532	H17 V L3	0.1 %	R					⊗	⊗		⊗						
41332	0533	H18 V L1	0.1 %	R					⊗	⊗		⊗						
41333	0534	H18 V L2	0.1 %	R					⊗	⊗		⊗						
41334	0535	H18 V L3	0.1 %	R					⊗	⊗		⊗						
41335	0536	H19 V L1	0.1 %	R					⊗	⊗		⊗						
41336	0537	H19 V L2	0.1 %	R					⊗	⊗		⊗						
41337	0538	H19 V L3	0.1 %	R					⊗	⊗		⊗						
41338	0539	H20 V L1	0.1 %	R					⊗	⊗		⊗						
41339	053A	H20 V L2	0.1 %	R					⊗	⊗		⊗						
41340	053B	H20 V L3	0.1 %	R					⊗	⊗		⊗						
41341	053C	H21 V L1	0.1 %	R					⊗	⊗		⊗						
41342	053D	H21 V L2	0.1 %	R					⊗	⊗		⊗						
41343	053E	H21 V L3	0.1 %	R					⊗	⊗		⊗						
41344	053F	H22 V L1	0.1 %	R					⊗	⊗		⊗						
41345	0540	H22 V L2	0.1 %	R					⊗	⊗		⊗						
41346	0541	H22 V L3	0.1 %	R					⊗	⊗		⊗						
41347	0542	H23 V L1	0.1 %	R					⊗	⊗		⊗						
41348	0543	H23 V L2	0.1 %	R					⊗	⊗		⊗						
41349	0544	H23 V L3	0.1 %	R					⊗	⊗		⊗						
41350	0545	H24 V L1	0.1 %	R					⊗	⊗		⊗						

REGISTER	ADDRESS (HEX)	VARIABLE	UNIT	R/W	NOTES	C 15/96...L	Q 15/96 E2/U2 /MCUU	MCU	Q 15 U2H	MCUH	Q 96 U4L	Q 96 U4H	Q 15/96 B4W	C/Q 15/96 UCL	MCOU... / MC2U...	Q52...(NaNc) / Q72/96 (Qubo) / MCUP0H	Q52C3L (NaNc dc)-Q72/96C3L (Qubo dc)-MCUCOL	C18W/SLO40MD3A1
41351	0546	H24 V L2	0.1 %	R					⊗	⊗	⊗							
41352	0547	H24 V L3	0.1 %	R					⊗	⊗	⊗							
41353	0548	H25 V L1	0.1 %	R					⊗	⊗	⊗							
41354	0549	H25 V L2	0.1 %	R					⊗	⊗	⊗							
41355	054A	H25 V L3	0.1 %	R					⊗	⊗	⊗							
41356	054B	H26 V L1	0.1 %	R					⊗	⊗	⊗							
41357	054C	H26 V L2	0.1 %	R					⊗	⊗	⊗							
41358	054D	H26 V L3	0.1 %	R					⊗	⊗	⊗							
41359	054E	H27 V L1	0.1 %	R					⊗	⊗	⊗							
41360	054F	H27 V L2	0.1 %	R					⊗	⊗	⊗							
41361	0550	H27 V L3	0.1 %	R					⊗	⊗	⊗							
41362	0551	H28 V L1	0.1 %	R					⊗	⊗	⊗							
41363	0552	H28 V L2	0.1 %	R					⊗	⊗	⊗							
41364	0553	H28 V L3	0.1 %	R					⊗	⊗	⊗							
41365	0554	H29 V L1	0.1 %	R					⊗	⊗	⊗							
41366	0555	H29 V L2	0.1 %	R					⊗	⊗	⊗							
41367	0556	H29 V L3	0.1 %	R					⊗	⊗	⊗							
41368	0557	H30 V L1	0.1 %	R					⊗	⊗	⊗							
41369	0558	H30 V L2	0.1 %	R					⊗	⊗	⊗							
41370	0559	H30 V L3	0.1 %	R					⊗	⊗	⊗							
41371	055A	H31 V L1	0.1 %	R					⊗	⊗	⊗							
41372	055B	H31 V L2	0.1 %	R					⊗	⊗	⊗							
41373	055C	H31 V L3	0.1 %	R					⊗	⊗	⊗							
41374	055D	RESERVED FOR FUTURE ADDITIONAL VARIABLES																
...	...																	
41536	05FF																	
41537	0600	H1 I L1	0.1 %	R					⊗	⊗	⊗							
41538	0601	H1 I L2	0.1 %	R					⊗	⊗	⊗							
41539	0602	H1 I L3	0.1 %	R					⊗	⊗	⊗							
41540	0603	H2 I L1	0.1 %	R					⊗	⊗	⊗							
41541	0604	H2 I L2	0.1 %	R					⊗	⊗	⊗							
41542	0605	H2 I L3	0.1 %	R					⊗	⊗	⊗							
41543	0606	H3 I L1	0.1 %	R					⊗	⊗	⊗							
41544	0607	H3 I L2	0.1 %	R					⊗	⊗	⊗							
41545	0608	H3 I L3	0.1 %	R					⊗	⊗	⊗							
41546	0609	H4 I L1	0.1 %	R					⊗	⊗	⊗							
41547	060A	H4 I L2	0.1 %	R					⊗	⊗	⊗							
41548	060B	H4 I L3	0.1 %	R					⊗	⊗	⊗							
41549	060C	H5 I L1	0.1 %	R					⊗	⊗	⊗							
41550	060D	H5 I L2	0.1 %	R					⊗	⊗	⊗							
41551	060E	H5 I L3	0.1 %	R					⊗	⊗	⊗							
41552	060F	H6 I L1	0.1 %	R					⊗	⊗	⊗							
41553	0610	H6 I L2	0.1 %	R					⊗	⊗	⊗							
41554	0611	H6 I L3	0.1 %	R					⊗	⊗	⊗							
41555	0612	H7 I L1	0.1 %	R					⊗	⊗	⊗							
41556	0613	H7 I L2	0.1 %	R					⊗	⊗	⊗							
41557	0614	H7 I L3	0.1 %	R					⊗	⊗	⊗							
41558	0615	H8 I L1	0.1 %	R					⊗	⊗	⊗							
41559	0616	H8 I L2	0.1 %	R					⊗	⊗	⊗							

REGISTER	ADDRESS (HEX)	VARIABLE	UNIT	R/W	NOTES	C 15/96...L	Q 15/96 E2/U2 /MCUU	MCU	Q 15 U2H	MCUH	Q 96 U4L	Q 96 U4H	Q 15/96 B4W	C/Q 15/96 UCL	MCOU... / MC2U...	Q52...(NaNc) / Q72/96 (Qubo) / MCUP0H	Q52C3L (NaNc dc)-Q72/96C3L (Qubo dc)-MCUCOL	C18W/SLO40MD3A1
41560	0617	H8 IL3	0.1 %	R					⊗	⊗		⊗						
41561	0618	H9 IL1	0.1 %	R					⊗	⊗		⊗						
41562	0619	H9 IL2	0.1 %	R					⊗	⊗		⊗						
41563	061A	H9 IL3	0.1 %	R					⊗	⊗		⊗						
41564	061B	H10 IL1	0.1 %	R					⊗	⊗		⊗						
41565	061C	H10 IL2	0.1 %	R					⊗	⊗		⊗						
41566	061D	H10 IL3	0.1 %	R					⊗	⊗		⊗						
41567	061E	H11 IL1	0.1 %	R					⊗	⊗		⊗						
41568	061F	H11 IL2	0.1 %	R					⊗	⊗		⊗						
41569	0620	H11 IL3	0.1 %	R					⊗	⊗		⊗						
41570	0621	H12 IL1	0.1 %	R					⊗	⊗		⊗						
41571	0622	H12 IL2	0.1 %	R					⊗	⊗		⊗						
41572	0623	H12 IL3	0.1 %	R					⊗	⊗		⊗						
41573	0624	H13 IL1	0.1 %	R					⊗	⊗		⊗						
41574	0625	H13 IL2	0.1 %	R					⊗	⊗		⊗						
41575	0626	H13 IL3	0.1 %	R					⊗	⊗		⊗						
41576	0627	H14 IL1	0.1 %	R					⊗	⊗		⊗						
41577	0628	H14 IL2	0.1 %	R					⊗	⊗		⊗						
41578	0629	H14 IL3	0.1 %	R					⊗	⊗		⊗						
41579	062A	H15 IL1	0.1 %	R					⊗	⊗		⊗						
41580	062B	H15 IL2	0.1 %	R					⊗	⊗		⊗						
41581	062C	H15 IL3	0.1 %	R					⊗	⊗		⊗						
41582	062D	H16 IL1	0.1 %	R					⊗	⊗		⊗						
41583	062E	H16 IL2	0.1 %	R					⊗	⊗		⊗						
41584	062F	H16 IL3	0.1 %	R					⊗	⊗		⊗						
41585	0630	H17 IL1	0.1 %	R					⊗	⊗		⊗						
41586	0631	H17 IL2	0.1 %	R					⊗	⊗		⊗						
41587	0632	H17 IL3	0.1 %	R					⊗	⊗		⊗						
41588	0633	H18 IL1	0.1 %	R					⊗	⊗		⊗						
41589	0634	H18 IL2	0.1 %	R					⊗	⊗		⊗						
41590	0635	H18 IL3	0.1 %	R					⊗	⊗		⊗						
41591	0636	H19 IL1	0.1 %	R					⊗	⊗		⊗						
41592	0637	H19 IL2	0.1 %	R					⊗	⊗		⊗						
41593	0638	H19 IL3	0.1 %	R					⊗	⊗		⊗						
41594	0639	H20 IL1	0.1 %	R					⊗	⊗		⊗						
41595	063A	H20 IL2	0.1 %	R					⊗	⊗		⊗						
41596	063B	H20 IL3	0.1 %	R					⊗	⊗		⊗						
41597	063C	H21 IL1	0.1 %	R					⊗	⊗		⊗						
41598	063D	H21 IL2	0.1 %	R					⊗	⊗		⊗						
41599	063E	H21 IL3	0.1 %	R					⊗	⊗		⊗						
41600	063F	H22 IL1	0.1 %	R					⊗	⊗		⊗						
41601	0640	H22 IL2	0.1 %	R					⊗	⊗		⊗						
41602	0641	H22 IL3	0.1 %	R					⊗	⊗		⊗						
41603	0642	H23 IL1	0.1 %	R					⊗	⊗		⊗						
41604	0643	H23 IL2	0.1 %	R					⊗	⊗		⊗						
41605	0644	H23 IL3	0.1 %	R					⊗	⊗		⊗						
41606	0645	H24 IL1	0.1 %	R					⊗	⊗		⊗						
41607	0646	H24 IL2	0.1 %	R					⊗	⊗		⊗						
41608	0647	H24 IL3	0.1 %	R					⊗	⊗		⊗						

REGISTER	ADDRESS (HEX)	VARIABLE	UNIT	R/W	NOTES	C 15/96...L	Q 15/96 E2/U2 / MCUU	MCU	Q 15 U2H	MCUH	Q 96 U4L	Q 96 U4H	Q 15/96 B4W	C/Q 15/96 UCL	MCOU... / MC2U...	Q52...(NaN0) / Q72/96 (Qubo) / MCUP0H	Q52C3L (NaN0 dc)-Q72/96C3L (Qubo dc)-MCUCOL	C18W/SL040MD3A1
41609	0648	H25 IL1	0.1 %	R					⊗	⊗		⊗						
41610	0649	H25 IL2	0.1 %	R					⊗	⊗		⊗						
41611	064A	H25 IL3	0.1 %	R					⊗	⊗		⊗						
41612	064B	H26 IL1	0.1 %	R					⊗	⊗		⊗						
41613	064C	H26 IL2	0.1 %	R					⊗	⊗		⊗						
41614	064D	H26 IL3	0.1 %	R					⊗	⊗		⊗						
41615	064E	H27 IL1	0.1 %	R					⊗	⊗		⊗						
41616	064F	H27 IL2	0.1 %	R					⊗	⊗		⊗						
41617	0650	H27 IL3	0.1 %	R					⊗	⊗		⊗						
41618	0651	H28 IL1	0.1 %	R					⊗	⊗		⊗						
41619	0652	H28 IL2	0.1 %	R					⊗	⊗		⊗						
41620	0653	H28 IL3	0.1 %	R					⊗	⊗		⊗						
41621	0654	H29 IL1	0.1 %	R					⊗	⊗		⊗						
41622	0655	H29 IL2	0.1 %	R					⊗	⊗		⊗						
41623	0656	H29 IL3	0.1 %	R					⊗	⊗		⊗						
41624	0657	H30 IL1	0.1 %	R					⊗	⊗		⊗						
41625	0658	H30 IL2	0.1 %	R					⊗	⊗		⊗						
41626	0659	H30 IL3	0.1 %	R					⊗	⊗		⊗						
41627	065A	H31 IL1	0.1 %	R					⊗	⊗		⊗						
41628	065B	H31 IL2	0.1 %	R					⊗	⊗		⊗						
41629	065C	H31 IL3	0.1 %	R					⊗	⊗		⊗						
41630	065D	RESERVED FOR FUTURE ADDITIONAL VARIABLES																
...	...																	
41792	06FF																	