

# IEC 101-104

Application Note - OWL User Module

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HIRSCHMANN AUTOMATION AND CONTROL GMBH  
STUTTGARTER STR. 45-51  
72654 NECKARTENZLINGEN  
GERMANY  
TEL.: +49 1805 141538

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## 2. User Module Description

IEC 60870-5-101 is a standard for power system monitoring, control & associated communications for telecontrol, teleprotection, and associated telecommunications for electric power systems. IEC 60870-5-104 protocol is an analogy to IEC 60870-5-101 protocol with the changes in transport, network, link & physical layer services to suit the complete network access: TCP/IP.

This user module does a bidirectional conversion between IEC 60870-5-101 and IEC 60870-5-104 protocols specified by the IEC 60870-5 standard. IEC 60870-5-101 serial communication is converted to the IEC 60870-5-104 TCP/IP communication and vice versa. It is possible to configure some parameters of IEC 60870-5-101 and IEC 60870-5-104.

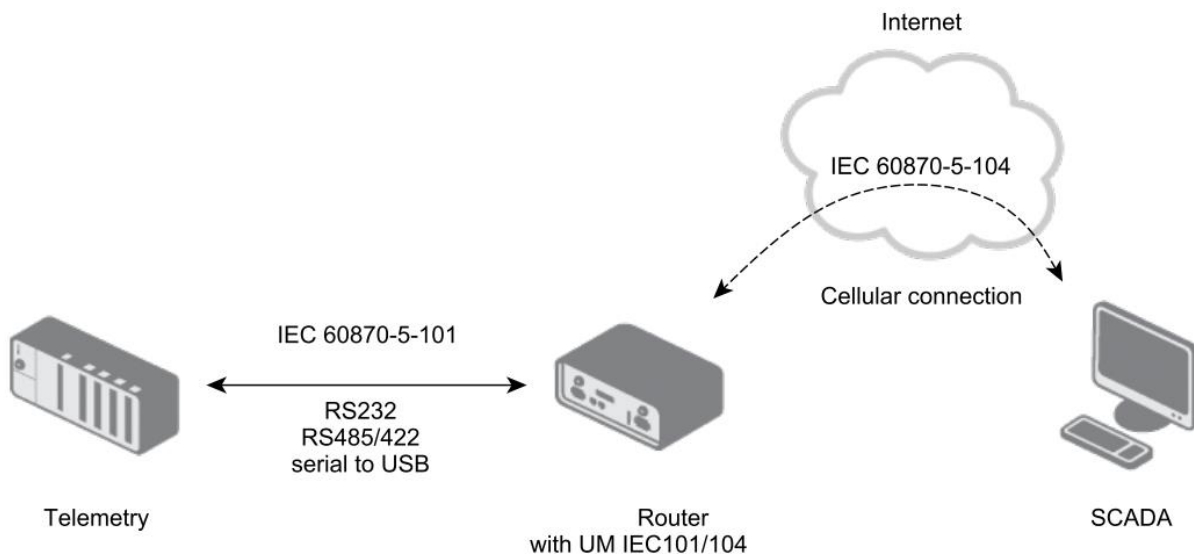


Figure 1: IEC 101/104 communication scheme

Parameters of serial communication and parameters of IEC 60870-5-101 protocol can be set separately for every serial port of the router. It is possible to use the USB port of the router with USB-serial converter. If using more serial ports in the router, there will be multiple instances of the user module running and independent IEC 60870-5-101/IEC 60870-5-104 conversions can be done. Only the TCP Port parameter can be configured on the side of IEC 60870-5-104. It is the port the TCP server listens on when conversion activated. Remote IEC 60870-5-104 application has to communicate on this port. The data for IEC 60870-5-101 side are sent as soon as they arrive from SCADA. The IEC 60870-5-101 side asks periodically for the data according to Data polling time parameter configured. Regular asking is launched when the first test frame arrives from SCADA.

Protocol IEC 60870-5-101 defines an Application Service Data Unit (ASDU). In ASDU there is ASDU identifier (with type of ASDU in it) and information objects. When converting from IEC 60870-5-104 to IEC 60870-5-101 all ASDU types defined in the IEC 60870-5-101 standard in compatible 1-127 range of ASDU types are converted accordingly. Proprietary types of ASDU in the private range 127-255 are not converted. Both commands and data (payload) in ASDUs are converted. Additionally, other ASDUs are converted by default - those for control and monitoring with time tag. These are not defined the same way in IEC 60870-5-101 and IEC 60870-5-104 protocols, so it is possible to configure the conversion of

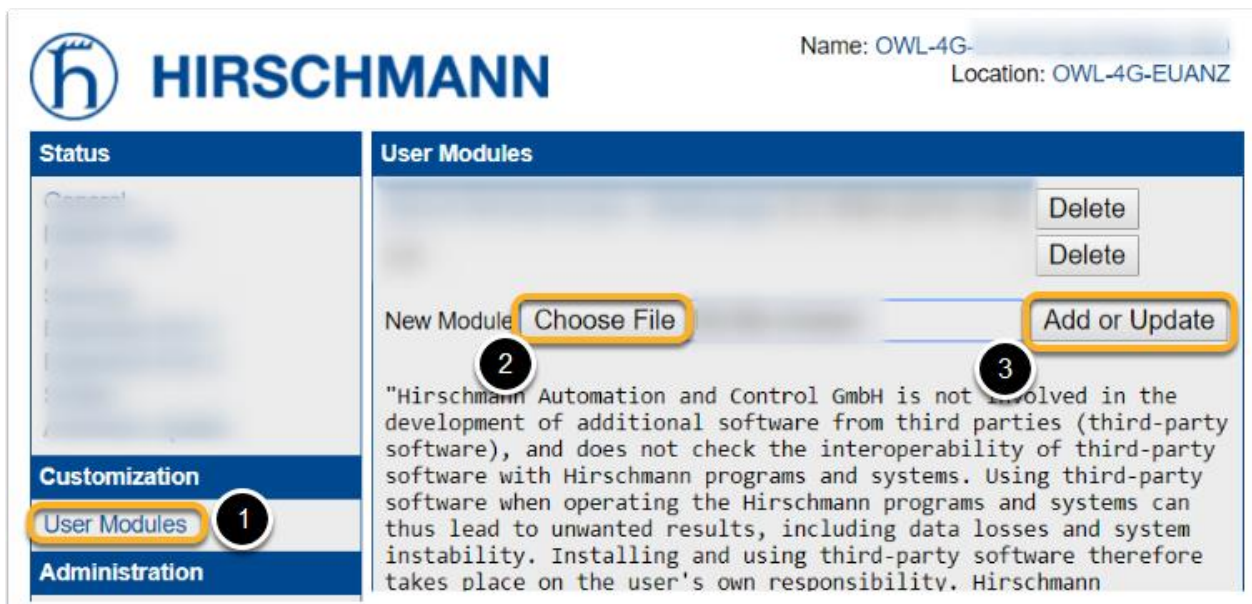
these ASDUs in the user module: either drop, or mapping to equivalent in opposite protocol, or mapping to same ASDU in opposite protocol. A number of unknown ASDUs is logged and displayed on the Module status page.

*The unbalanced serial communication mode is supported. This means the router is the master and connected IEC 60870-5-101 telemetry is a slave. SCADA initiates the first connection with router on IEC 60870-5-104 side. User module in router then asks connected IEC 60870-5-101 telemetry regularly for events and required information.*

### 3. Installation

User modules can be uploaded in as a single file in as “.tgz” or “.tar.gz”:

1. Go to the “Customization” – “User Modules” menu
2. Choose the “.tgz” or “.tar.gz” file for your user module
3. Click “Add or Update”



## 4. Quick Start

Open the Module Page



Figure 2: Menu with list of all User Modules

## Protocol IEC101/104

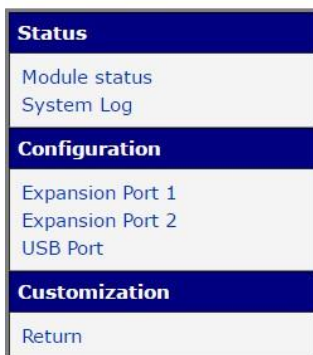


Figure 3: User module menu

## 5. Status

### Module Status

There are protocol information about running communication on this page. These are individual for every serial port of the router. Detected type of the port is displayed at the Port type parameter. Parameters of IEC 60870-5-104 and IEC 60870-5-101 are described in the tables below.

IEC 60870-5-101 / IEC 60870-5-104 module state	
Expansion Port 1	
Port type	RS232
IEC104	
IEC104 state	: Connected
I frame NS	: 2719
I frame NR	: 2490
S frame ACK	: 2719
U frame test	: 13
Unknown Inf.Objects	: 0
TCP/IP remote host	: 172.16.188.6
TCP/IP reconnect	: 44
IEC101	
IEC101 state	: Connected
Unknown frame count	: 14
Expansion Port 2	
Port type	NONE
USB Port	
Port type	EMPTY

Figure 4: Module status page

Table 1: IEC 60870-5-104 Status information

Item	Description
IEC104 state	State of connection of the superior IEC 60870-5-104 server.
I frame NS	Sent - number of last sent frame
I frame NR	Received - number of last received frame
S frame ACK	Acknowledgment - number of last acknowledged sent frame
U frame test	Number of test frames
Unknown Inf.Objects	Number of unknown information objects (thrown away)
TCP/IP remote host	IP address of the last connected IEC 60870-5-104 server.
TCP/IP reconnect	Number of TCP/IP reconnections

Table 2: IEC 60870-5-101 Status Information

Item	Description
IEC101 state	IEC 60870-5-101 connection state
Unknown frame count	Number of unknown frames



## System Log

On the System Log page there are log messages displayed. It is the same system log as the one in the main menu of the router. Messages of the user module are introduced by the iec14d string (messages from running iec14d daemon). Here you can check out the run of the user module or see the messages in troubles with configuration and connection. You can download the messages and save it to your computer as a text file clicking the Save button.

On the screenshot of a log you can see the start of the user module and messages of unknown object type detected. Other errors are logged, too. Types and number of errors/messages logged can be set for any port separately in Configuration section. It is called Debug parameters and it is located at the bottom of every configuration page.

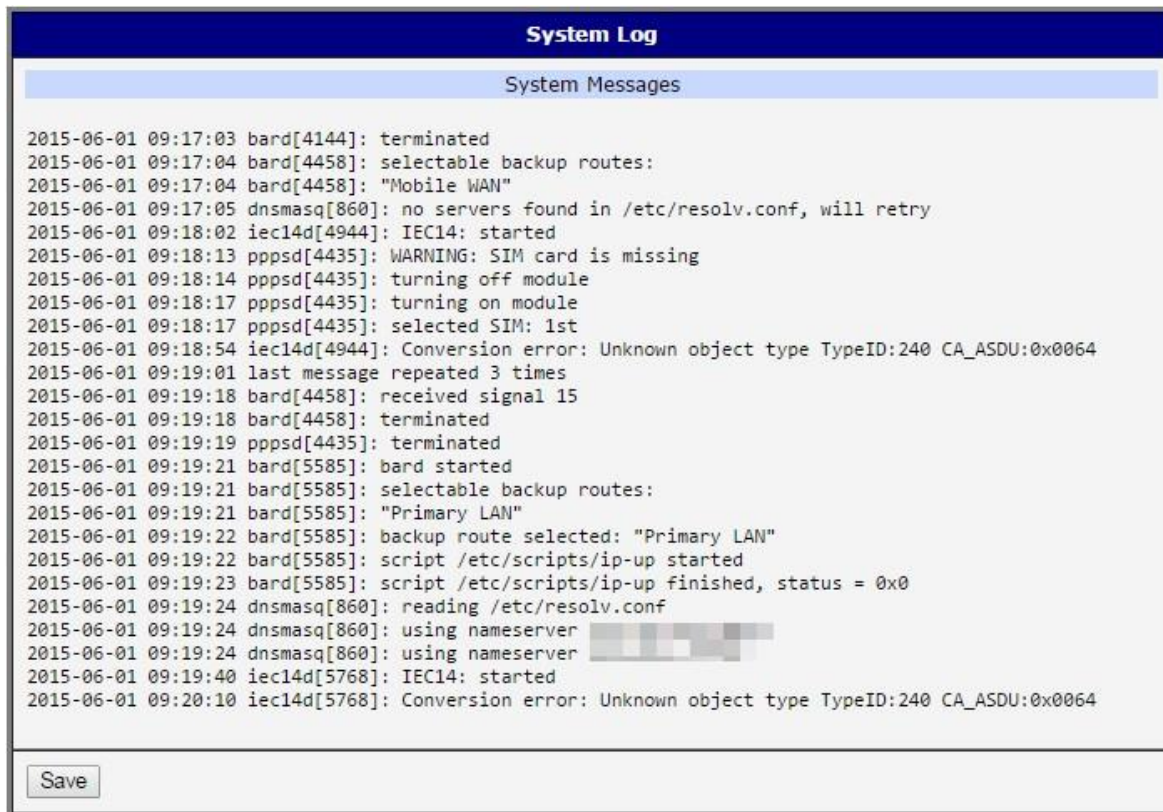


Figure 5: System Log

## 6. Conversion Configuration

Configuration of the IEC 60870-5-101 and IEC 60870-5-104 parameters is accessible in the Expansion Port 1, Expansion Port 2 and USB Port items. More separate IEC 60870-5-101/IEC 60870-5-104 conversions are possible, individual for every serial port of the router. Parameters for every expansion/USB port are the same.

Enable the conversion for the proper expansion port ticking the Enable conversion module checkbox up on the page. Any changes will take effect after clicking the Apply button. There are four parts of the conversion configuration, followed by time conversion configuration and Debug parameters parts on the configuration page. Four parts of the conversion are the following: IEC 60870-5-101 parameters, IEC 60870-5-104 parameters, ASDU converting in monitoring direction (IEC 60870-5-101 to IEC 60870-5-104)



and ASDU conversion in control direction (IEC 60870-5-104 to IEC 60870-5-101). In Debug parameters part you can set the type of messages shown and the level of messages amount on the System Log page.

### IEC 60870-5-101 Parameters

In the Port Type item there is a detected type of an Expansion Port in the router displayed. The parameters on top are for the serial line communication. The parameters for IEC 60870-5-101 itself are below. These parameters has to be configured according to the IEC 60870-5-101 telemetry used in the system. The parameters are described in the following table. The other IEC 60870-5-101 parameters are static and cannot be changed.

Table 3: IEC 60870-5-101 parameters

Number	Description
Baud rate	The speed of the communication. The range is 9600 to 57600.
Data Bits	The number of data bits. 8 only.
Parity	The control parity bit. None, even or odd.
Stop Bits	The number of stop bits. 1 or 2.
Link address length	The length of the link address. 1 or 2 bytes.
Link address	Link address is the address of connected serial device
COT transmission length	Cause Of Transmission length - the length of the "cause of transmission" information (spontaneous, periodical, etc.). 1 or 2 bytes.
COT MSB source	Cause Of Transmission - Most Significant Byte. COT is given by the code according to the type of event the transmission was caused by. Optionally the source address (of the data originator) can be added. 0 - standard address, 1 to 255 - specific address.
CA ASDU length	Common Address of ASDU (Application Service Data Unit) length. 1 or 2 bytes.
IOA length	Information Object Address length - IOAs are in the ASDU. 1 to 3 bytes.
Data polling time	The interval of regular requests from router to IEC 60870-5-101 telemetry for data. Time in milliseconds. Default value 1000 ms.
Send Delay	It is not recommended to use this delay in standard cases. This is an experimental option for additional delay in router for messages in 104 -> 101 direction (from SCADA to device). Useful only for non-standard IEC-101 devices.

### IEC 60870-5-104 Parameters

There is only one parameter available for the IEC 60870-5-104 configuration: IEC-104 TCP Port. It is a port the TCP server is listening on. The TCP server is running in the router when IEC 60870-5-101/IEC 60870-5-104 conversion is enabled. The 2404 prepared value is the official IEC 60870-5-104 TCP port reserved for this service. In the Expansion Port 2 configuration there is 2405 value prepared (not reserved by the standard). For USB Port it is 2406 TCP port.

The other IEC 60870-5-104 parameters are fixed according to standard. If the IOA lengths differ, the bytes of length are added or removed automatically. Conflict situations are always logged.

IEC 60870-5-101 / IEC 60870-5-104 Conversion Configuration	
Expansion Port 1	
<input checked="" type="checkbox"/> Enable conversion module	
<b>IEC 60870-5-101 parameters</b>	
Port Type	EMPTY
Baudrate	9600
Data Bits	8
Parity	even
Stop Bits	1
Link address length	2 bytes
Link address	100
COT transmission length	1 byte
COT MSB source	0
CA ASDU length	2 bytes
IOA length	2 bytes
Data polling time	1000 msec
Send delay	0 msec
<b>IEC 60870-5-104 parameters</b>	
IEC104 - TCP Port	2404
<b>ASDU conversions in monitoring direction (101 --&gt; 104)</b>	
Single-point information with time tag	M_SP_TA_1 (2) --> M_SP_TB_1 (30)
Double-point information with time tag	M_DP_TA_1 (4) --> M_DP_TB_1 (31)
Step position information with time tag	M_ST_TA_1 (6) --> M_ST_TB_1 (32)
Bitstring of 32 bit with time tag	M_BO_TA_1 (8) --> M_BO_TB_1 (33)
Measured value, normalised value with time tag	M_ME_TA_1 (10) --> M_ME_TD_1 (34)
Measured value, scaled value with time tag	M_ME_TB_1 (12) --> M_ME_TE_1 (35)
Measured value, short floating point value with time tag	M_ME_TC_1 (14) --> M_ME_TF_1 (36)
Integrated totals with time tag	M_IT_TA_1 (16) --> M_IT_TB_1 (37)
Event of protection equipment with time tag	M_EP_TA_1 (17) --> M_EP_TD_1 (38)
Packed start events of protection equipment with time tag	M_EP_TB_1 (18) --> M_EP_TE_1 (39)
Packed output circuit information of protection equipment with time tag	M_EP_TC_1 (19) --> M_EP_TF_1 (40)
<b>ASDU conversions in control direction (104 --&gt; 101)</b>	
Single command with time tag CP56Time2a	C_SC_TA_1 (58) --> C_SC_NA_1 (45)
Double command with time tag CP56Time2a	C_DC_TA_1 (59) --> C_SC_NA_1 (46)
Regulating command with time tag CP56Time2a	C_RC_TA_1 (60) --> C_SC_NA_1 (47)
Set point command, normalised value with time tag CP56Time2a	C_SE_TA_1 (61) --> C_SE_NA_1 (48)
Set point command, scaled value with time tag CP56Time2a	C_SE_TB_1 (62) --> C_SE_NB_1 (49)
Set point command, short floating point value with time tag CP56Time2a	C_SE_TC_1 (63) --> C_SE_NC_1 (50)
Bitstring of 32 bit with time tag CP56Time2a	C_BO_TA_1 (64) --> C_BO_NA_1 (51)
CP24Time2a to CP56Time2a Conversion Method for Hour and Date	Use fixed values
Command Period of Validity	sec
<input type="checkbox"/> Synchronize router time from C_CS_NA_1 (103) command	
<b>Debug parameters</b>	
Debug Level	Error
<input type="checkbox"/> Debug Main Operations <input type="checkbox"/> Debug IEC 60870-5-104 <input type="checkbox"/> Debug Conversions <input type="checkbox"/> Debug IEC 60870-5-101 <input type="checkbox"/> Debug Timers	
Apply	

Figure 6: Serial port conversion configuration

### ASDU Conversions in Monitoring Direction (101 to 104)

IEC 60870-5-101 to IEC 60870-5-104 conversion can be configured in this part. These ASDUs use 24 bits long time tag in IEC 60870-5-101 (milliseconds, seconds, minutes), but in IEC 60870-5-104 the 56 bits long time tags are used (milliseconds, seconds, minutes, hours, days, months, years). That's why the conversion configuration is possible - enabling different time tag handling according to specific needs of the application.

For every ASDU listed in this part, these ways of conversion can be selected: DROP, Convert to same ASDU and Convert to equivalent ASDU (default).

**DROP** When this option selected, the ASDU is dropped and conversion is not done.

**Convert to same ASDU** If this option is selected, the ASDU is mapped on the same ASDU in the opposite protocol. It means there is no conversion of time tag - IEC 60870-5-104 application receives unchanged shorter (24 bits) time tag from IEC 60870-5-101 device.

**Convert to equivalent ASDU** If this option is selected, the ASDU is mapped on the equivalent ASDU type in the opposite protocol. See the names and numbers of these opposite ASDU types. This means the conversion of time tag has to be done - the time tag has to be completed up to 56 bits. The conversion of time tag can be set via CP24Time2a to CP56Time2a Conversion Method for Hour and Date item at the bottom of the page. These are the options:

- Use fixed values - Default configuration. The time original time tag (24 bits) is completed with fixed values 0 hours, 1st day and 1st month of year 00 (2000).
- Use router time values - The time original time tag (24 bits) is completed with the hours, day, month and year taken from the router's time. It depends on the time setting on the router (Either manually or from NTP server). There is another risk - see the box below.

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*Attention! Use router time values item from CP24Time2a to CP56Time2a Conversion Method for Hour and Date - is risky. Use it at your own risk, because unintentional jumps in data can appear when converted this way. This can happen at the edges of time units (days, months, years). Let's have a situation when the monitoring ASDU is sent at 23 hours, 59 minutes, 59 seconds and 95 milliseconds. Due to network latency it will pass the router just after midnight - on the next day. And the completed time tag is now 0 hours, 59 minutes, 59 seconds and 95 milliseconds of the next day - there is unintentional one hour jump in the converted time tag.*

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**Note:** If the IEC 60870-5-101 device supports long (56 bits) time tags for IEC 60870-5-104, it will send the ASDUs readable by IEC 60870-5-104, so the time tag is not converted and will be delivered to SCADA directly from the device.

### ASDU Conversions in Control Direction (104 to 101)

IEC 60870-5-104 to IEC 60870-5-101 conversion can be configured in this part. Again it is related to different time tag length, but here the long time tags are just cut for the IEC 60870-5-101 device. For every ASDU listed in this part on Figure 5, these ways of conversion can be selected:

- DROP, Convert to same ASDU and Convert to equivalent ASDU (default).
- DROP When this option selected, the ASDU is dropped and conversion is not done.

**Convert to same ASDU** If this option is selected, the ASDU is mapped on the same ASDU in the opposite protocol. It means there is no conversion of time tag - IEC 60870-5-101 device receives unchanged long time tag from IEC 60870-5-104 application (some IEC 60870-5-101 devices support long time tags).

**Convert to equivalent ASDU** If this option is selected, the ASDU is mapped on the equivalent ASDU type in the opposite protocol. See the names and numbers of these opposite ASDU types on Figure 5. Conversion of time tag is done by cutting its length from 56 bits to 24 bits - only minutes, seconds and milliseconds are kept.

It is possible to synchronize the router time from SCADA IEC-104 telemetry. Just enable the checkbox Synchronize router time from C\_CS\_NA\_1 (103) command. This will set the real time clock in router to same time as in SCADA by incoming IEC-104 command. Additional check of command validity regarding of time can be done when the item Command Period of Validity is filled-in. No check for validity is done by default (field empty), but if you fill-in e.g. 30 seconds of validity, the time tag received from SCADA will be compared with time in the router. If the difference of time is bigger than period of validity (e.g. 30 seconds), the command will be irrelevant and will not be sent to IEC-101 side.

All configuration changes will take effect after pressing Apply button.

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### EULA

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This does not apply to the extent that Hirschmann is liable under mandatory law, e.g. in the case of (i) personal injury or damage to privately-used property pursuant to the German Product Liability Act, (ii) due to loss of life, personal injury or damage to health which is due to a negligent or intentional breach of duty by Hirschmann or one of Hirschmann's legal representatives or one of Hirschmann's vicarious agents, (iii) insofar as the cause of damage or loss is due to intentional behaviour or gross negligence by Hirschmann or a legal representative or a vicarious agent of Hirschmann, (iv) if the Customer asserts rights due to a deficiency under a quality guarantee or the particular duration of a quality, (v) Hirschmann negligently breaches a fundamental contract obligation whose fulfilment is what makes the due performance of the contract possible at all and on whose compliance the Customer may regularly rely (cardinal obligation), or (vi) claims for recourse in the customer goods purchase supply chain (§ 478 of the German Civil Code (BGB)) are concerned.

Hirschmann is not liable for the replacement of data unless Hirschmann wilfully or through gross negligence caused the data's destruction and the Customer has determined that that data can be reconstructed at reasonable cost from data material which is available in machine-readable form.

All claims directed against Hirschmann due to a quality defect or a defect in title become time-barred 12 months after the statutory warranty commencement, unless the German Product Liability Act or other legislation, particularly § 479.1 of the BGB (recourse claims in the consumer goods purchase supply chain) prescribe longer periods. The period of limitations for claims based on liability for damage and loss arising out of loss of life, personal injury or damage to health which is due to a negligent or intentional breach of duty by Hirschmann or a legal representative or vicarious agent of Hirschmann, and for other damage and loss which is due to an intentional or grossly negligent breach of duty by Hirschmann or a legal representative or vicarious agent of Hirschmann, shall be determined in accordance with the statutory provisions.

The provisions set out in these Software Conditions - Embedded Software concerning the exclusion of liability (section 10) shall apply only if the Customer is a businessperson (§ 14 of the BGB), a legal entity under public law or a public-law special fund.

#### 11. Return of the Program

If the program delivered based on this contract is partially or wholly exchanged within the framework of the warranty performance, then the Customer is obligated to verifiably destroy the original of the program or to return it to Hirschmann.

#### 12. Termination of the Contract

The Customer is able to terminate the contract at any time in whole or in part. The. In the event of the termination of this contract, the Customer is obliged to return to Hirschmann or verifiably destroy the original as well as all copies and partial copies of the programs concerned and also modified copies of the pertinent programs associated with other software materials. This applies correspondingly for program documentation and other delivered literature. Retention of an archive copy for back-up reasons requires a separate, written agreement. The license fee paid - insofar as nothing to the contrary is agreed - will not be refunded.

#### 13. Written Form

Supplementary agreements and modifications must be in written form. This applies also to a waiver of this written-form requirement.

14. Choice of Law, Legal Venue

The application of German law is hereby agreed. For any disputes which should arise as a result of the contractual relationship when the Customer is a fully-qualified merchant, a legal entity under public law or a special fund under public law, then the court at the place of Hirschmann's headquarters will have jurisdiction.

15. Partial Invalidity

If a condition of this contract should be or become invalid, the validity of the remaining conditions shall not be affected thereby. In such an event, the invalid condition is to be understood, interpreted or replaced so that the economic purpose pursued through it is achieved.

16. Export

The Customer will comply with the German and American export regulations when exporting the embedded software.

## Product Beta Test Agreement

This is an agreement between Hirschmann Automation and Control GmbH ("Company") and the Beta Testing Customer ("Tester"), in which Tester agrees to test a hardware and/or software beta product (the "Product") and keep Company aware of the test results.

### **§1. Company's Obligations**

Company is owner of a prototype product identified (list name of product) which it desires to have tested by a prospective user in what is commonly referred to as "Test". The Product contains valuable, confidential, trade secret information owned by Company.

Company shall provide Tester with a Product and any necessary documentation and instruct Tester on how to use it and what test data is desired by Company.

### **§2. Tester's Obligations**

Tester desires to test and evaluate the Product for suitability for use in its business.

Tester shall test Product under normally expected operating conditions in Tester's test environment during the test period. Tester shall evaluate the Product and gather and report test data with respect to the usefulness and functionality of the Product as agreed upon with Company. Tester shall allow Company access to Product during normal working hours for inspection, modifications and maintenance. Tester shall report to Company, as soon as practical, any perceived defect in the Product and, following the discovery of any material defect, shall terminate its use of the Product. At the conclusion of the test, Tester shall provide to Company an evaluation of the Product, including both positive and negative aspects.

Tester is aware that the Product represents a prototype product that may be faulty and/or not fit for use and that Company uses this Test to find out the fitness and bugs of its Product. Therefore Tester also understands and hereby explicitly accepts that Company is warranting nothing with respect to the Product and fully excludes any liability in this respect (see Sections 7 and 8).

### **§3. Product a Trade Secret**

a) Product is proprietary to, and a valuable trade secret of, Company. It is entrusted to Tester only for the purpose set forth in this Agreement. Tester shall maintain Product in the strictest confidence. Tester will not, without Company's prior written consent:

(a) Disclose or use for own purposes (other than the test described herein) any information about Product, its design and performance specifications, its code, and the existence of the beta test and its results to anyone other than Tester's employees who are performing the testing and who shall be subject to written nondisclosure restrictions at least as protective as those set forth in this Agreement (the disclosure to other persons than Tester's employees (e.g. consultants etc.) requires the prior written consent of Company and is only permitted after such consent if the other requirements mentioned in this paragraph are met;

(b) Copy any portion of Product or documentation, except to the extent necessary to perform beta testing; or

(c) Reverse engineer, decompile or disassemble Product or any portion of it.

(d) Disclose or use for own purposes (other than the test described herein) any other information – no matter what kind and related to what – about the Company or Product without prior written consent of the Company.

b) Tester has the obligation to hand over any test results, observations and any other findings that are a result of the testing to Company.

c) The nondisclosure obligation does not end with the termination/end of this agreement but will continue for a term of 5 (five) years after the termination / end of this agreement.

d) Tester has to return or destroy (at the choice of Company) all information including all copies after the effective date of the termination / end of this agreement to the Company. Tester has to confirm in writing that all information has been returned or destroyed and that neither he nor his employees or consultants etc. has any information (or part of it) left in his possession.

e) Tester will be liable for any damage of the Company resulting out of the breach of this confidentiality clause caused by himself or his employees or consultants etc.

#### **§4. Security Precautions**

Tester shall take reasonable security precautions to prevent Product from being seen by unauthorized individuals. This includes software whether stored on Tester's hard drive or on physical copies such as CD-ROMS, diskettes or other media. Tester shall lock all copies of Product and associated documentation in a desk or file cabinet when not in use.

#### **§5. Term of Agreement**

The test period shall last from receipt of Product by Tester, until Product is released for general sale. This Agreement shall terminate at the end of the test period or when Company asks Tester to return Product, whichever occurs first. Company may terminate this Agreement upon notice to Tester, subject to Tester's obligation to return (or destroy – as the case may be) the Product, Confidential Information and all copies thereof.

The restrictions and obligations contained in Clauses 3, 4, 7, 8, 9 and 10 shall survive the expiration, termination or cancellation of this Agreement, and shall continue to bind Tester, its successors, heirs and assigns.

#### **§6. Return of Product and Materials**

Upon the conclusion of the testing period or at Company's request (e.g. after termination of this agreement), Tester shall within 10 days return the hardware, original and all copies of software and all related materials to Company and delete all portions of software from device electronic memory. At the choice of Company Tester can be obliged to destroy and confirm destruction of Product and all related confidential information (including any copies of it). Section 3 d) is fully applicable.

#### **§7. Disclaimer of Warranty**

Product is a test product and its accuracy and reliability are not guaranteed. Tester shall not rely exclusively on Product for any reason. Tester waives any and all claims Tester may have against Company arising out of the performance or nonperformance of Product.

PRODUCT IS PROVIDED AS IS, AND COMPANY DISCLAIMS ANY AND ALL REPRESENTATIONS OR WARRANTIES OF ANY KIND, WHETHER EXPRESS OR IMPLIED, WITH RESPECT TO IT, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

#### **§8. Limitation of Liability**

Insofar as nothing is stipulated to the contrary in this § 8, claims of the Tester based on breaches of an obligation arising from contractual obligations and/or on material defects or defects in title - for whatever legal reason - are hereby excluded. The Company shall not be liable for damage which has not occurred to the Product itself. In particular, the Company shall not be liable for loss of profits or other pecuniary loss suffered by the Tester in this respect.

The foregoing no-liability declaration shall not apply in circumstances where the Company is compulsorily liable, for example (1) pursuant to the German Product Liability Act, (2) due to loss of life, personal injury or damage to health which is attributable to a negligent or intentional breach of obligation by the Company or one of the Company's legal representatives or vicarious agents, (3) if the cause of damage or loss was due to intentional behaviour or gross negligence by the Company or one of

the Company's legal representatives or vicarious agents, (4) if the Tester asserts rights based on a defect arising from a guarantee regarding the product qualities or the particular duration of a product quality, (5) the Company negligently breaches a fundamental contractual obligation whose fulfilment is what makes the due performance of the contract possible at all and whose fulfilment may be usually relied upon by the Tester (cardinal obligation), (6) recourse claims in the consumer goods purchase delivery chain (§ 478 of the German Civil Code (BGB)) are involved.

If the Company negligently breaches a cardinal obligation, its obligation to pay damages is limited to the contract-typical, foreseeable loss, if no intentional or grossly negligent behaviour is involved, and/or the Company is not liable due to loss of life, personal injury or damage to health.

#### **§9. No Rights Granted**

This Agreement does not constitute a grant or an intention or commitment to grant any right, title or interest in Product or Company's trade secrets to Tester. Product and all related trade secrets and other rights stay in the ownership of Company. Tester may not sell or transfer any portion of Product to any third party or use Product in any manner to produce, market or support its own products. Tester shall not identify Product as coming from any source other than Company.

#### **§10. No Assignments**

This Agreement is personal to Tester. Tester shall not assign or otherwise transfer any rights or obligations under this Agreement.

#### **§11. General Provisions**

(a) Relationships: Nothing contained in this Agreement shall be deemed to constitute either party a partner, joint venturer or employee of the other party for any purpose.

(b) Severability: If a court finds any provision of this Agreement invalid or unenforceable, the remainder of this Agreement shall be interpreted so as best to affect the intent of the parties.

(c) Integration: This Agreement expresses the complete understanding of the parties with respect to the subject matter and supersedes all prior proposals, agreements, representations and understandings. This Agreement may not be amended except in a writing signed by both parties.

(d) Waiver: The failure to exercise any right provided in this Agreement shall not be a waiver of prior or subsequent rights.

(e) Attorney Fees and Expenses: In a dispute arising out of or related to this Agreement, the prevailing party shall have the right to collect from the other party its reasonable attorney fees and costs and necessary expenditures.

(f) Governing Law: This Agreement shall be governed in accordance with the laws of the Federal Republic of Germany.

(g) Jurisdiction: The parties consent to the exclusive jurisdiction and venue of the federal and state courts located in Stuttgart Germany in any action arising out of or relating to this Agreement. The parties waive any other venue to which either party might be entitled by domicile or otherwise.