Kraftelektronik AB

Three-phase thyristor charger type UNIQ with monitoring unit

SAFETY INSTRUCTION

The manual must be read **before** installation, usage or work in the product.

This product contains dangerous voltage that when touched can cause electrical chock, burn or death.

The product must be installed by qualified personnel and according to the installation instructions. Service may only be performed by authorized service personnel. **The power must always be disconnected** in a safe way before any service/maintenance work begins.

WARNING! Multiple power sources. Dangerous voltage is possible even with mains power shut off.

Manual 9-1537-D
Stock.no 0001020

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PREFACE

This manual contains a complete description of thyristor rectifier type UNIQ with monitoring unit type KraftMaster. The description is divided into different sections ranging from a simple block diagram to more detailed functional description on the circuit board level. The chart shown below indicates which sections should be read by different categories of readers. Good luck with your new rectifier system!

	Chapter																
User	1	2	3	4	5	6	7	8	9	10	11	12	13	A	B	C	D	E
Those who wish to acquire a general view	X	X	X	X														
Those who install the system	X			X	X	X										X		X
Those who put it into operation	X	X		X	X		X							X		X		X
System user	X	X		X				X	X					X				X
Those who wish to know more about the charger										X				X	X	X		X
Those who wish to know more about the monitoring unit											X			X	X	X		X
Servicemen												X	X	X	X	X	X	X

NOTE! The word "fuse" as used in this manual can refer to either a fuse or a miniature circuit breaker.

We retain the rights to make changes to these specifications without further notice.

CONTENTS

APPENDIX

1 PRESENTATION

1.1 UNIQ

UNIQ is a three-phase thyristor controlled rectifier with an avostat regulation system and a built-in microcomputer controlled monitoring unit. It represents an entirely new generation of battery chargers which provides unmatched reliability in all types of DC systems.

DC systems are created to take over in situations in which other sources of power fails. In DC system applications, continuous operation is often a matter of life and dead on the few occasions when the regular mains voltage fails. In these situations power circuit breakers must still be operated, computers must finish all jobs already in progress, doctors must continue to operate, air traffic controllers must continue to supervise traffic, and so forth.

The reliability of a DC system is closely related to the way in which the battery is maintained and monitored. This is basically why the new charger generation designated UNIQ, is created.

The charging unit in this charger has been supplemented with a monitoring unit from the KraftMaster concept which has the ability to monitor all major parts of a complete DC system. The voltage monitored is obtained directly from the battery or from the distribution busbar. Power for the monitoring unit is supplied from the battery to still obtain operation at mains power fail.

1.2 KRAFTMASTER

KraftMaster is a total concept for control and monitoring of uninterruptible power applications. A flexible design based on a communication bus system gives unique possibilities to support still unknown future demands.

The duty of **K**raft**M**aster, (**KM**), is to monitor chargers, batteries and remaining components in the system in order to ensure the ability to deliver uninterruptible power. Furthermore, the system is expected to facilitate and minimize the time needed for running maintenance.

The brain in KM is the unit *KM-BAS* which is equipped with an operators interface in shape of an alphanumeric display and buttons. Standalone, the *KM-BAS* provides a complete unit to handle one charger, two batteries, distribution, internal and external alarm inputs and alarm outputs. There is also a serial communication port to connect printer or modem for remote operation.

If KM-BAS is the brain then *KraftNet* is the nervous system in KraftMaster. *KraftNet* is a local bus for communication with remaining units such as additional chargers, battery voltage monitoring at block or cell level, etc. This gives the system a powerful development potential with flexibility and vital force far into the future because new units and functions can be incorporated at any time.

1.3 KM-BAS

KM-BAS is used either as a complete unit for control and monitoring of a DC system with chargers, battery and distribution, or as a central unit in a bigger system where it communicates with local interface modules.

A number of functions are built in already in the base model, further functions is available as options. Beyond this, most desires can be provided for because the software are written in a high level language. This in turn makes changes and additions go fast and with a maximum of reliability.

The main functions are:

Monitoring of system parameters (voltage, current, earth fault leakage, temperature, etc...), rectifier circuit test, battery circuit test, battery check by analysis of load response, midvoltage measure, block voltage measure, etc.

Alarm handling by response from external units and calculation of internal measure data.

Alarm indication by alarm message on display, LED for general alarm and relay outputs for external alarm handling.

Control of the charging process by equalizing charging, temperature controlled float charging and deep discharge protection by disconnection of battery or load.

Operator communication by menu system with text en clair display and buttons together with remote control by a serial channel.

Statistics for analysis of system load, battery temperature, battery test result, etc...

Some important functions

* Earth fault resistance are measured to both plus- and minus branch. Displayed directly in kΩ.
* The mean load of the system is controlled and alarm is given if it exceeds installed capacity.
* Five different voltage level alarms.
* Alarm for tripped fuse, mains failure (built in detector for 1-phase, external needed for 3-phase), battery fanflow failure, two inputs for external alarm equipment, etc.
* Every alarm has individually selection of delay, acknowledge and alarm output.
* Equalizing charging can be done manually or automatically.
* Battery test can be done manually or automatically.
* Abnormal battery temperature can give alarm and interrupt the equalizing charging.
* Float charge voltage can be controlled by battery temperature.
* Load or battery can be disconnected in danger of deep discharge.
* Regular automatic test of battery and rectifier circuits.
* Mid voltage measure to detect battery unbalance, for instance by means of disrupted cell.
* Monitoring of separate battery blocks or cells by expansion module KM-BI.
* Handling of double battery strings (mid voltage, current, block voltage).
* Handling of several parallel chargers by expansion module KM-RI.
* Serial channel for connection of printer for printouts or modem for remote control.

1.4 KM-RI

KM-BAS alone can handle only one charger. If a DC system has more than one charger, one KM-RI is needed as an interface to each of them.

KM-RI provides an interface between KM-BAS and a charger through the local bus, KraftNet. Its duty is to measure rectifier current, set the temperature compensated charge voltage and select charge voltage level for float charge, battery test and equalizing charging.

KM-RI occurs where appropriate as an integrated part of a charger.

1.5 KM-BI

KM-BI provides an interface to the battery in a DC system where it is appropriate to monitor each cell or block separately.

KM-BI is connected to KM-BAS by the local bus, KraftNet. Its duty is to measure the cell or block voltage levels and thereby maintain maximum control of the battery.

1.6 KRAFTNET

KraftNet is a local network for connection of the units that is a part of the KraftMaster concept. The connection is performed in shape of a serial bus, in this case a simple two wire cable. Units can be connected in parallel on the cable wherever you wish. By this you get a simple installation and high reliability by avoiding a closed loop where a fault in some unit would stop all communication. The electrical interface is a current loop type for maximum interference immunity.

2 TECHNICAL DATA

2.1 GENERAL DATA

Type of regulation: . . . . . Thyristor control

Power requirements: . . . . . 3 x 400V, +10/-15%, 47-63Hz

Effect factor: . . . . . About 0,8 at 1/1 load

Cooling: . . . . . At rated current <75A the cooling is performed by self ventilation. Beyond 75A the thyristor unit is equipped with a fan cooler. In case of fan failure the current limit is reduced.

Voltage regulation accuracy: . . . . . The static DC variation remains equal to or less than ±0,5% of the preset DC level during the following simultaneous variations: AC between +10/-15%, frequency between 47-63 Hz, load within the 0-100% range of the chargers rated current and temperature between 0-40°C.

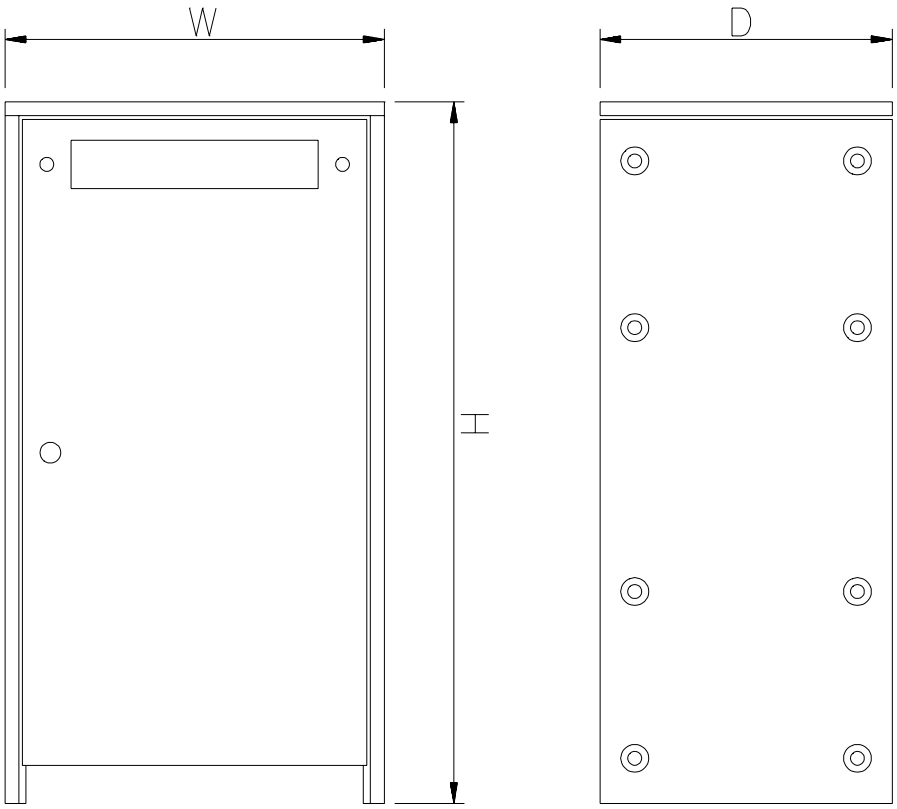
Current regulation accuracy: . . . . . The current limit of the charger can be adjusted between 50-105% of rated current and are then kept constant within ±2% of preset value. On demand the chargers can be equipped with a separate battery output with a battery current limit adjustable between 5-50% of the charger´s rated current

Alarm level resolution: . . . . . The resolution at setup is 0,01 V/cell.

Measure resolution: . . . . . All measurements are performed with 10 bits A/D conversion which gives about 0.1% resolution.

Terminal connections: . . . . . The terminals on the connection board for connection of output relays, measure inputs, etc are intended for a maximum conductor area of 2,5 mm^2. The size of mains terminals and battery connections are specified in the table following. The cables can be brought in from either the bottom or the back of the closure.

2.2 DIMENSION DRAWING



Type of enclosure / Dimensions in mm	Floor model enclosure			
	G11	G12	G13	G22
Height H	1200	1650	1650	2100
Width W	650	650	1000	800
Depth D	500	500	500	800

Dimension drawing floor model. Drawing no: 4-7867, rev. B

2.3 DATA AND ORDERING INFORMATION

See next page...

Part number	UNIQ type	DC data				Connection data for 400V 3-phase 50-60Hz			Maximum AC current component in DC output (A eff)	Max. pulsation voltage		Thyristor rectifier unit							Monitoring unit		Mains terminal (mm^2)	Battery terminal (mm^2)	Enclosure	Net weight (Kg)
												Losses at				Efficiency at								
		Rated volt. (V)	Rated curr. (A)	Qty. battery cells		Mains power (VA)	Mains current (A)	External fuse (A slow)		V rms	V p-p	0-load (W)	1/4-load (W)	1/2-load (W)	1/1-load (W)	1/4-load (%)	1/2-load (%)	1/1-load (%)	Power consumption (W)	Max required current (mA)				
				Lead	Alkaline																			
S928270	24/50	24	50	11-13	17-21	2450	3.5	6	5	0.5	1.2	25	35	75	130	90	90	91	6	250	10	35	G11	115
S928270	24/75		75			3800	5.5	10	7.5			35	55	110	200	90	90	91	6	250	10	70	G11	122
S928270	24/100		100			4850	7	10	10			50	75	130	265	90	91	91	6	250	10	70	G11	130
S928270	24/150		150			7300	10.5	16	15			65	110	225	400	90	90	91	6	250	10	150	G11	142
S928270	24/200		200			9700	14	20	20			70	150	300	600	90	90	90	6	250	10	150	G11	166
S928270	24/300		300			14900	21.5	25	30			85	250	450	890	89	90	90	6	250	10	240	G11	195
S928270	24/400		400			19800	28.5	35	40			95	330	600	1060	89	90	91	6	250	16	240	G12	230
S928470	48/50	48	50	22-26	35-40	4500	6.5	10	5	1	2.4	45	75	150	265	90	90	91	8	170	10	35	G11	130
S928470	48/75		75			6600	9.5	16	7.5			55	115	220	400	90	90	91	8	170	10	70	G11	142
S928470	48/100		100			9000	13	20	10			65	150	300	530	90	90	91	8	170	10	70	G11	156
S928470	48/150		150			13150	19	25	15			75	225	450	800	90	90	91	8	170	10	150	G11	182
S928470	48/200		200			17700	25.5	35	20			90	300	600	1060	90	90	91	8	170	16	150	G12	221
S928470	48/300		300			27000	39	50	30			100	400	795	1590	91	91	91	8	170	16	240	G12	340
S928470	48/400		400			36000	52	63	40			115	530	930	2120	91	92	91	8	170	35	240	G12	410
S928670	110/25	110	25	52-54	78-85	4500	6.5	10	2.5	2.2	5.5	50	75	130	265	91	92	92	7	70	10	35	G11	135
S928670	110/50		50			9000	13	20	5			68	130	230	450	92	93	93	7	70	10	35	G11	160
S928670	110/75		75			13500	19.5	25	7.5			81	195	340	680	92	93	93	7	70	16	70	G11	195
S928670	110/100		100			17700	25.5	35	10			92	260	385	900	92	94	93	7	70	16	70	G11	220
S928670	110/150		150			26700	38.5	50	15			110	340	575	1360	93	94	93	7	70	16	150	G12	250
S928670	110/200		200			35350	51	63	20			140	460	770	1810	93	94	93	7	70	35	150	G12	335
S928670	110/250		250			45050	65	100	25			150	655	1130	1920	92	93	94	7	70	150	240	G22	450
S928670	110/300		300			54050	78	100	30			185	785	1360	2310	92	93	94	7	70	150	240	G22	570
S928670	110/400		400			72050	104	125	40			260	1030	2020	3080	92	93	94	7	70	150	240	G22	650
S928770	125/25	125	25	55-60	86-92	4850	7	10	2.5	2.5	6.2	55	83	145	290	91	92	92	7	70	10	35	G11	140
S928770	125/50		50			9700	14	20	5			70	145	250	505	92	93	93	7	70	10	35	G11	165
S928770	125/75		75			14550	21	35	7.5			85	220	375	755	92	93	93	7	70	16	70	G11	200
S928770	125/100		100			19400	28	35	10			95	290	430	1000	92	94	93	7	70	16	70	G11	225
S928770	125/150		150			29450	42.5	50	15			120	380	640	1510	93	94	93	7	70	16	150	G12	260
S928770	125/200		200			39150	56.5	63	20			150	505	850	2010	93	94	93	7	70	35	150	G12	350
S928770	125/300		300			58900	85	100	30			195	875	1510	2560	92	93	94	7	70	150	240	G22	580
S928770	125/400		400			78300	113	125	40			260	1160	2010	3420	92	93	94	7	70	150	240	G22	660
S928870	220/25	220	25	102-112	156-184	9000	13	20	2.5	4.4	11	70	95	190	385	94	94	94	10	45	10	35	G11	158
S928870	220/50		50			18400	26.5	35	5			95	160	315	765	95	95	94	10	45	16	35	G11	217
S928870	220/75		75			27400	39.5	50	7.5			105	240	475	950	95	95	95	10	45	16	70	G11	275
S928870	220/100		100			36400	52.5	63	10			130	315	635	1265	95	95	95	10	45	35	70	G12	335
S928870	220/150		150			54400	78.5	100	15			180	475	950	1850	95	95	95	10	45	70	150	G22	520
S928870	220/200		200			72750	105	125	20			240	560	1120	1960	95	95	96	10	45	70	150	G22	570
S928870	220/250		250			92850	134	160	25			300	960	1590	2510	94	95	96	10	45	150	240	G22	680
S928870	220/300		300			110850	160	200	30			350	1150	1900	3010	94	95	96	10	45	150	240	G22	730

3 STANDARDS AND ENVIRONMENTAL DATA

3.1 ENVIRONMENTAL DATA

Class of enclosure: . . . . . Complies with SS EN 60529, klass IP21
Ambient temperature: . . . . . 0-40°C (For higher temperatures, see section 3.3)

3.2 STANDARDS COMPLIED WITH

SS EN 50081-1 (rated current <30A) . EMC. Generic emission standard, light industry
SS EN 50081-2 (rated current ≥30A) . EMC. Generic emission standard, industrial environment
SS EN 50082-2 . . . . . EMC. Generic immunity standard, industrial environment
SS EN 60439-1 . . . . . Type tested assemblies (except dielectric test)
SS EN 60146-1-1:4.2.1 . . . . . Semiconductor converters, dielectric test

3.3 HIGH AMBIENT TEMPERATURES

Normally, the charger's ambient temperature should be 0-40°C. However, if the current limitation is lowered, the ambient temperature can be permitted to rise to 55°C. The maximum load current must be reduced to 92% at 45°C, 85% at 50°C and 75% at 55°C.

3.4 ENHANCED ENVIRONMENTAL PROTECTION

A charger that is to be operated in an environment that is more severe can, on request, be provided with enhanced corrosion protection. Chargers intended for operation in tropical climates can be delivered in special enclosures witch complies with protection class IP43. Further information is available on request.

4 GENERAL DESCRIPTION WITH BLOCK DIAGRAM

4.1 GENERAL

See fig 4-1. The charger consists of two units which operate independently of each other. One is the charging unit (blocks 1-8). It keeps the battery fully charged within very close limits. The second is a microcomputer controlled monitoring unit (9-11) which measures voltage and current levels continuously, compares them with preset alarm levels and issues an alarm whenever necessary.

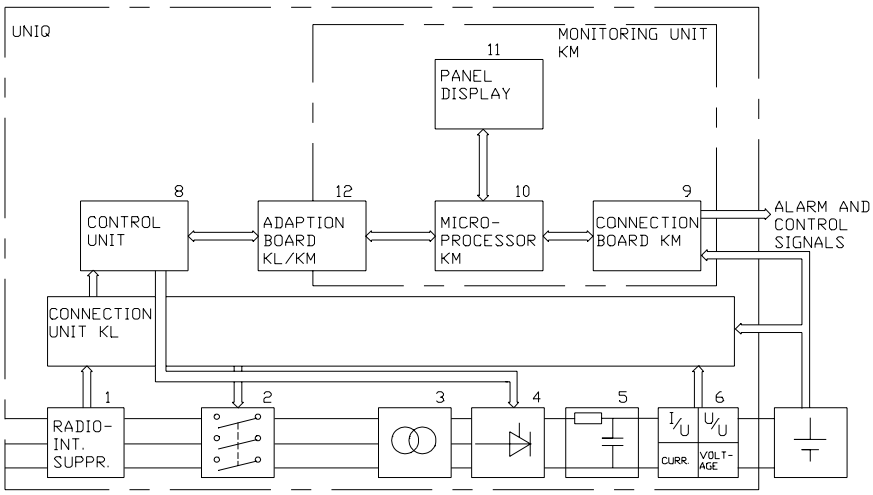
4.2 CHARGING UNIT

The mains voltage applied to the rectifier unit is supplied via a radio interference suppression unit (1) and a contactor unit (2) to a transformer (3). This provides isolation from the mains voltage and adapts the secondary voltage to the battery ratings. The voltage is rectified and regulated in the thyristor unit (4) to the correct value in response to a command from the control unit (8). The rectified voltage is smoothed in filter (5). The voltage and current response from measurement device (6) are put via the connection unit KL (7) to the control unit.

4.3 MONITORING UNIT

The monitoring unit is supplied with power from the battery. Its DC/DC converter adapts the battery voltage to the supply and reference voltages. Current and voltage outputs from the charging unit are converted to microcomputer-compatible levels which, together with other input data such as earth fault current and signals from panel buttons, are sent to the microcomputer board (10). Calculations for alarms and other functions are performed and the information are transmitted to the panel (11) and to 4 output relays placed on connection board KM (9). For monitoring and some control of the charging unit, the charging unit and the monitoring unit communicates through adaption board KL/KM (12).

4.4 BLOCK DIAGRAM



Block diagram UNIQ. Drawing no: 4-10263A

5 INSTALLATION INSTRUCTIONS

5.0 SAFETY INSTRUCTION

WARNING! This product contains dangerous voltage that when touched can cause electrical chock, burn or death.
Protective earth must **always** be properly connected. In the connection terminal, the protective earth wire should be at least 2cm longer than the phase wires.
Check carefully that no cables or wires are caught when you swing the panel in and out.
The protective coverings are designed for installation in IT-system (according to ELSÄK-FS 1994.7, which is based on IEC 364-4-41). For IT systems where the DC voltage level can exceed 120V (rectifier for 110V nominal voltage and higher) the following applies:
• The DC part may **not** be directly connected to earth.
• The DC part must be provided with earth fault detection system.
If the DC part still should be directly connected to earth., the rectifier must be provided with additional protective coverings. Please contact Kraftelektronik AB in Växjö, Sweden, for more information.

WARNING! Due to a fall, the device can cause physical injury and damage on property. Always use safe lifting equipment. Assure that the wall mounting bolts are correctly dimensioned.
Look out for sharp edges inside the enclosure.
Check both before and after setting-up that the product does not have any mechanical damages.
Cables for incoming and outgoing power must be correctly dimensioned to avoid fire hazard.
A fault in the rectifier can cause excessively high output voltage with damage on batteries and other connected equipment as result. Prevent these damages by using an over voltage detection system.

The product must be installed by qualified personnel, that is personnel that has electrical education and adequate experience to avoid the dangers that electricity can cause.

5.1 GENERAL

All connections named X and jumpers named S refer to connection board KM if nothing else is stated. Contact rating for relay outputs are 6A 250V AC rating and 75W resistive, 25W inductive DC rating.

Pull out the female connectors X6, X7 and X8 on the connection board KM before installation. Keep them disconnected until starting up is taken place.

5.2 MOUNTING

The charger is intended for mounting indoors in premises that are not excessively humid. The temperature in the premises must not exceed +40°C when the charger is delivering rated current continuously. Temperatures of up to +55°C can be permitted if the current limitation on the regulator board is reduced as described in section *Standards and environmental data, Ambient temperature*. Settings are to be made according to section *Operation - Charging unit, Regulator board adjustments*. Unobstructed passage of cooling air is necessary. This means that air flowing through the vents in the enclosure must not be hindered by, for example, draping clothing over the enclosure or positioning the charger too close to some object.

The dimensions of the different chargers are shown in section *Technical data*.

5.3 CONNECTION TO MAINS VOLTAGE

The charger nameplate indicates the primary voltage for which it is intended. To ascertain which primary fuse is required if the charger has non-standard primary data, consult the table in section *Technical data* or appendix E. Then connect the mains voltage to the terminals marked L1, L2, L3 and N. Make sure that the phase sequence of the mains corresponds to the markings on the terminals.

5.4 CONNECTION TO DC SYSTEM

Read the charger nameplate to ascertain the DC output voltage. The battery or the load to be supplied with DC can then be connected to terminals L+ and L-.

Select cables dimensioned to handle the charger's rated current. The DC output is protected by two fuses.

5.5 CONNECTION OF LOAD SHARE FUNCTION

If parallel chargers are to be used, you should take the advantage of the load share function. Use a single core shielded cable and connect to terminal X6:47, shield to X6:48. Also check that the DIP-switch SW1:1 located on the motherboard for the control unit is in proper position. This is described in more detail in section *Functional description - Charging unit* under the headline *Parallel operation*.

5.6 CONNECTION OF MONITORING UNIT POWER

The monitoring unit is getting its power from the battery through separate wires to terminals X6:45(+) and X6:46(-).

5.7 CONNECTION OF MONITORED VOLTAGE

All voltages that are to be monitored must be collected from a point as close to the source as possible, in this case the battery and distribution unit. This avoids lack of accuracy by means of voltage drop in the measure wirings.

Umeas- is a shared minus pole for all voltage measures. It is collected from the minus pole of the battery and is connected to terminal X7:2.

Usystem measures the total system voltage. It is collected from the plus pole of the battery and is connected to terminal X7:5.

Ubatt1+ measures the mid voltage of the battery in battery string no 1. It is collected from the midpoint of the battery. At uneven number of blocks, the midpoint is selected so that the lower half closest to the minus pole gets one block less than the upper half. It is connected to terminal X7:3. Can only be used if the function for midvoltage measurement is installed, i.e. it is no compulsory.

Ubatt2+ measures the mid voltage of the battery in battery string no 2. It is collected from the midpoint of the battery. At uneven number of blocks, the midpoint is selected so that the lower half closest to the minus pole gets one block less than the upper half. It is connected to terminal X7:4. Can only be used if the function for midvoltage measurement is installed, i.e. it is no compulsory.

Note that the difference in voltage between terminals L- and Umeas- must not exceed 5V if monitoring is to function properly.

5.8 CONNECTION OF EXTERNAL CURRENT SHUNTS

It is possible to measure the current from two batteries in parallel strings and the system current to the load. All shunts must be mounted in the minus branch, be of 60mV-type and should not be less accurate than 0.5%. Connection of external shunts are not a compulsory. Check if the system is configured for external shunts.

Isyst measures total system current flowing out of the system. It is connected to X8:23(+) and X8:24(-).

Ibatt1 measures battery current in battery string no 1. It is connected to X8:25(+) and X8:26(-).

Ibatt2 measures battery current in battery string no 2. It is connected to X:27(+) and X:28(-).

5.9 CONNECTION OF TEMPERATURE SENSOR

A temperature sensor can be installed to monitor the battery temperature and to regulate the float charge voltage due to battery temperature. Connection of temperature sensor is not a compulsory. Check if the system is configured for temperature measurement.

The temperature sensor has a shielded 4 conductor cable. If it must be extended, shielded cable type LIYCY 4*0.25 should be used. It is connected with white conductor to terminal X:10(+12V), brown conductor to terminal X:11(Utemp+), green conductor to terminal X:12(Utemp-), yellow conductor to terminal X:13(0V) and shield to terminal X:14.

5.10 CONNECTION FOR EARTH FAULT MEASUREMENT

The earth point to be monitored for earth fault measurement is connected to terminal X7:1.

5.11 CONNECTION FOR BATTERY COMPARTMENT FAN AND FLOW MONITOR

The battery compartment fan can be started automatically in case of equalizing charging. Connection is done to terminal X10:39-40. With jumper S5, you can select between normally closed (NC) or normally open (NO) switch. On delivery, it is set in position NO.

After completed equalizing charging, the fan is operating for another 5 minutes.

A zero-potential contact activated from a flow monitor (closed when fan is operating) is connected to terminal to X:17 and 18.

5.12 CONNECTION OF INTERNAL MAINS VOLTAGE MONITOR

There is a mains voltage monitor built in that can handle 240V single-phase. Connection of the mains voltage to be monitored is done to terminals X9:29-30.

5.13 CONNECTION OF EXTERNAL MONITORS

Signals from external monitors in the DC-system can be monitored by KraftMaster. Connections are made from external zero-potential switch to connection board KM as described below. Open switch gives alarm.

* Fuse monitor to . . . . . X:15 and 16
* External mains voltage monitor to . X:19 and 20
* External monitor 1 to . . . . . X:21 and 22
* External monitor 2 to . . . . . X:6 and 7 (Not available if remote controlled battery test is used!)

5.14 CONNECTION FOR ALARM RELAYS

With jumper S1-S4, you can select the alarm relays to be either normally closed (NC) or normally open (NO). At delivery, they are in position NC and will then open in case of alarm. Terminal connections are done as follows:

* Alarm relay A to X10:31-32
* Alarm relay B to X10:33-34
* Alarm relay C to X10:35-36
* Alarm relay D to X10:37-38

5.15 CONNECTION FOR TEST LOAD

When a battery test is initiated, a relay for external load control is activated. With jumper S6 you can select between normally closed (NC) or normally open (NO) relay switch. At delivery, it is set in position NO. Connection is done to terminal X10:41-42.

Not available if remote controlled battery test is used!

5.16 CONNECTION FOR DEEP DISCHARGE PROTECTION

The deep discharge protection is intended to disconnect battery or load when the system voltage run the risk of reaching a damaging low level. This output is normally connected to a trip coil in a circuit breaker. With jumper S7 you can select between normally closed (NC) or normally open (NO) relay switch. At delivery, it is normally set in position NO so that the switch is closing to disconnect battery or load. Connection is done to terminal X10:43-44.

5.17 CONNECTIONS FOR DOUBLED SYSTEMS

In doubled systems where operating conditions with galvanic connection between the system halves occurs, only one monitoring unit at a time is permitted to have its earth fault monitoring connected during this operating condition. If it should be possible to perform battery test and battery circuit test, the option "Remote battery test" must be switched on, see *Operation - Monitoring Unit, Setup functions*.

The simplest solution of the problem with earth fault monitoring is to use an external switch that can break the connection from earth to the earth fault measuring input, X7:1, of one of the two monitoring units.

Remote battery test is achived by crosswise connection of the testload output, X10:41-42, of one of the monitoring units to the input for "external monitor 2", X7:6-7, of the other monitoring unit. Check that the jumper S6 is set in position normal open (NO). When starting up the system, be sure to set the battery test option to *Remote+Manual* or *All*, see *Operation - Monitoring unit* section *Setup menu, Battery test*. See also block diagram no 4-10479 in the separate manual for the monitoring unit.

NOTE: If two temperature regulated DC systems are connected together for parallel operation, the system that gives the highest voltage (measures the lowest temperature) will determine the total system voltage.

5.18 CONNECTION FOR KRAFTNET

KraftNet (SIOX) is the internal databus that interconnects external modules (KM-RI, KM-BI, etc.) with KM-BAS. Is not used in basic model.

Shielded cable, for instance type LIYCY 2*0.25, must be used. Connection is done to terminal X7:8-9 without demands on polarity. Connect the shield to terminal X7:14.

5.19 CONNECTION OF PRINTER OR MODEM

Printer or modem can be connected through a standard 9-pin female D-SUB. The communication is done using RS232 with handshaking DTR/DSR, the baudrate is normally 9600 baud. D-SUB pinning as follows:

* RxD to . . . . . pin 2
* TxD to . . . . . pin 3
* DTR to . . . . . pin 4
* GND to . . . . . pin 5
* DSR to . . . . . pin 6
* Shield to . . . . . contact housing

To comply with the EMC regulations the connection cable must be wound at least one turn through a ferrite core of type Amidon FB-43-1020 or equal, close to the D-SUB contact.

6 STARTING UP

6.0 SAFETY INSTRUCTION

WARNING! This product contains dangerous voltage that when touched can cause electrical chock, burn or death.

WARNING! Check both before and after setting-up that the product does not have any mechanical damages.

The product must be started up by qualified personnel, that is personnel that has electrical education and adequate experience to avoid the dangers that electricity can cause.

When the installation of the charger according to chapter 5 is performed and starting up is going to be taken place, please follow the instructions below.

6.1 STARTING

Normally, the battery should first be connected to L- and L+ (begin with L-) by connecting for example a line in the battery circuit that contains a fuse. Note that a starting current surge occurs when the filter capacitors in the rectifier charge up when the battery is connected. Then connect the terminal blocks X6-X10 (begin with X6) on connection board KM. Close a possible external switch or fuse for the monitoring unit power supply, starting with minus. The monitoring unit should now start up. Next connect the mains voltage and set the mains ON/OFF switch to position 1.

Note that the monitoring unit (X6-X10) should not be connected until connections have been made to L+ and L-.

Battery charging now commences. If the battery was deeply discharged, charging will commence at the rated current, and this will continue until the float charging level is reached. Some battery types needs an initial equalizing charging. Always follow the instructions made by the battery manufacturer.

6.2 CHECKING OF THE CHARGING UNIT SETTINGS

Follow the instructions in section *Operation - Charging unit*.

6.3 CHECKING OF THE MONITORING UNIT SETTINGS

Check that the measurement results on the display are correct. Check that alarm settings and other parameters agrees with intended way of operation (see section *Operation - Monitoring unit*).

6.4 CHECKING THE RELAY OUTPUT STATES

The alarm relays A-D can be manually operated for checking of external circuits connected to the alarm output relays, see section *Operation - Monitoring unit* below the headline *Control menu, Additional tests*.

7 OPERATION - CHARGING UNIT

7.0 SAFETY INSTRUCTION

WARNING! This product contains dangerous voltage that when touched can cause electrical chock, burn or death.
Service/maintenance work that means work with opened enclosure may only be performed by authorized service personnel.
The power should always be disconnected in a safe way (both mains and battery) before any service/maintenance work begins. After switching off, always allow the capacitors 5 minutes to discharge. It is a good practise to check (with a voltage indicating instrument) that the discharge in fact is complete before work begins.

7.1 GENERAL

The charging unit features possibilities for setting of voltage levels and alarm limits. Measurement results can be read on the monitoring unit display. For further checking of the system voltage, there is a voltmeter terminal on the front panel.

7.2 PRESENTATION OF OUTPUT VOLTAGE AND CURRENT

The distribution busbar voltage, connected via separate control lines, and the charger or system output current appears on the display in its basic mode. Additionally, the voltage can be measured via the voltmeter terminals on the front panel.

7.3 CHECKING AND SETTING OF VOLTAGE LEVELS AND CURRENT LIMITATION

7.3.1 Float charging

The float charging voltage is displayed if the current output of the charger is below the current limitation and the display shows operating condition *Floatcharge*.
Adjustment of the float charging voltage is done with potentiometer P2 located on the regulator board. The potentiometer can be reached through a hole in the panel marked *NORMAL/FLOAT*.

NOTE: If the float charging voltage is regulated by temperature, it is advisable to turn off the regulation during adjustment because recommended float charging voltage is normally specified at 20°C, see section *Operation - Monitoring unit, Setup ratings, Temperature*.

External voltmeter should be used when the float charge voltage is adjusted. The voltmeter terminals on the front is suitable for this.

7.3.2 Equalizing charging

Equalizing charging is initiated from the monitoring unit, see section *Operation - Monitoring unit.*
Adjustment of the equalizing charging voltage is done with potentiometer P1 located on the regulator board. The potentiometer can be reached through a hole in the panel marked *UTJÄMN/EQ*.

External voltmeter should be used when the equalizing charge voltage is adjusted. The voltmeter terminals on the front is suitable for this.

7.3.3 Battery test

The lowering of the charging voltage at battery test can be selected to 10% and 15%, alternatively by the setting of jumper S1 located on the adaption board KL/KM. Note that the battery test alarm level (see section *Operation - Monitoring unit, Setup functions, Battery test*) must be higher than the battery test charging voltage.
The battery test charging voltage is normally set to 15% at delivery.

7.3.4 Current limitation setting

Raise the load until the voltage level sinks and read the rectifier output current on the display. If the rectifier output current is not shown in the initial display mode, select mode *Control menu, Rectifier* to read out the rectifier output current.
Adjustment of current limitation limit is done with potentiometer P5 located on the regulator board. The potentiometer can be reached through a hole in the panel marked *STRÖMGRÄNS/CURRENT LIMIT*.

7.4 CHECKING AND SETTING OF ALARM LEVELS

When there is a fault in the rectifier, a sum alarm is created on the adaption board KL/KM. The alarm is transferred to the monitoring unit which generates the alarm "Rectifier fault". The sum alarm is created from following conditions:

1. Charging interrupted:	Low output voltage U< and load current <90% of rated current.
2. Overvoltage:	High output voltage U>> and load current >10% of rated current.

The alarm levels for U< and U>> can be checked and adjusted on the adaption board KL/KM located as the third board from the left in the card subrack behind the front panel.
Factory settings are normally 2.15V/cell and 2.45V/cell, respectively.

1. Charging interrupted

Open the front panel.
Connect the plus terminal of a voltmeter to the red measure terminal marked GND and the minus terminal of the voltmeter to the black terminal marked <. The voltmeter will then show the alarm level.
Note 1: The alarm level is shown divided by a factor K, where K=10 for chargers rated for 24 and 48V and K=100 for chargers rated for 110 and 220V. E.g: For a 24V-charger, 2.58V is shown when the charging interrupt alarm level setting is 25.8V.
Note 2: To get an alarm indication, the output current must be less than 90% of rated current.

To set a new alarm limit, adjust potentiometer P2 (marked <) on the adaption board KL/KM so that the voltmeter shows "new alarm limit"/K.

2. Overvoltage

Raise the load current until it is >10% of rated current, e.g. by forcing the charger into equalizing charging.
Open the front panel.
Connect the plus terminal of a voltmeter to the red measure terminal marked GND and the minus terminal of the voltmeter to the black terminal marked >>. The voltmeter will then show the alarm level.

Note 1: The alarm level is shown divided by a factor K, where K=10 for chargers rated for 24 and 48V and K=100 for chargers rated for 110 and 220V. E.g: For a 24V-charger, 2.58V is shown when the charging interrupt alarm level setting is 25.8V.

To set a new alarm limit, adjust potentiometer P1 (marked >>) on the adaption board KL/KM so that the voltmeter shows "new alarm limit"/K.

Note 2: If the overvoltage alarm level is adjusted to a level below the charging voltage and STS is activated (jumper B12 on connection board KL open), the charger will be turned off if the output current exceeds 10% of rated current. The charger can then be restarted by turning off the mains power for a moment with the mains power switch on the front panel, after the alarm level has been adjusted to a higher level.

Fig. 7 - 1 The location of the potentiometers on the adaption board KL/KM 10202

7.5 ADJUSTING THE CONTROL UNIT

The adjustments of the control unit are located on the front edge of the regulator board. Three of the potentiometers can be adjusted through holes in the panel; two are used for voltage levels and one for current limitation. By opening the panel the levels of the battery current limit and reduced current limit (i.e. at fan failure) can be set. The RI-compensation is normally set at the factory, and must only be changed if it is impossible to connect the voltage-sensing cables sufficiently close to the battery. Adjustment is made by turning the single-turn potentiometer P3, placed in the middle of the regulator board.

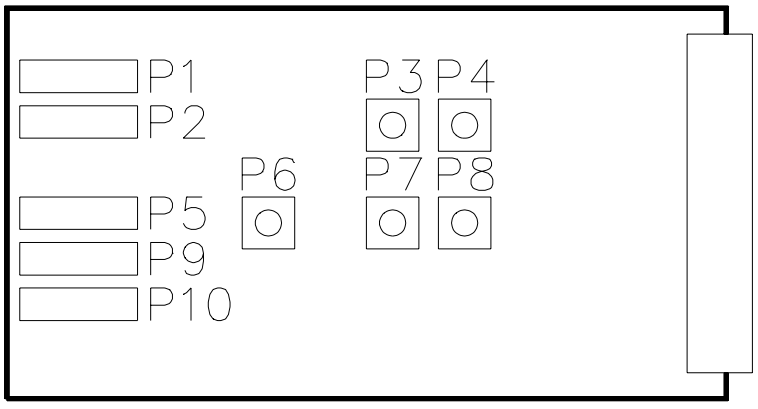


Fig. 7 - 2 The location of the potentiometers on the regulator board 7357

8 OPERATION - MONITORING UNIT

See separate manual *Monitoring unit type KraftMaster*.

9 FUNCTIONAL DESCRIPTION - CHARGING UNIT

9.1 GENERAL

This charger is performed with a 6-pulse thyristor regulation. The output voltage is kept constant until the load exceeds rated load, after which current is kept constant. Voltage regulation is mainly made at two levels, float charging and equalizing charging.

9.2 CHARGING VOLTAGES

9.2.1 Float charging

The charger normally operates with constant voltage regulation at a level of 2.23V/cell for lead batteries. This is the level which battery experts believe is most suitable for maximum battery life. At higher voltages, gas generation increases, this causing greater wear on the cell plates. At lower voltages there are some risk that individual cells will be poorly charged.

NOTE: Some types of valve regulated batteries should be charged at 2.27V/cell. Always follow the recommendations from the battery manufacturer.

9.2.2 Equalizing charging

After a mains failure, it may be advisable to charge the battery to a higher voltage level, and this is called equalizing charging. Equalizing charging is operated from the monitoring unit, and a closer description of the operation is therefore found in section *Functional description - Monitoring unit*.

9.2.3 Battery test

When the monitoring unit demands a battery test, the charging voltage is regulated down to a level that has been preset in the charger according to section *Operation - Charging unit*.

9.2.4 Charging circuit test

If the charger does not leave any output current, the cause could be either that the system is running with no load or that the charging circuit is defective. To decide whether the condition is normal or not, the monitoring unit performs a charging circuit test. It means that the charging voltage is raised about 2.5% while the charger is supposed to leave output current if the circuit is ok. The test is stopped immediately as soon as current begins to flow. In other case the test is stopped after 10 seconds. The test is only performed during no load conditions.

9.2.5 Temperature regulation

If the system is equipped with temperature regulation it means that the float charging voltage is regulated for battery temperature compensation. The slope of the regulation curve varies for different battery types and the settings are made on the monitoring unit, see section *Operation - Monitoring unit, Setup ratings, Temperature*.

By affecting only the float charging voltage by temperature, the risk of unexpected voltage levels to appear in the system is eliminated. Other charging voltages and alarm levels maintain unaffected, i.e. they appear as the temperature was 20°C.

NOTE: If two temperature regulated DC systems are connected together for parallel operation, the system that gives the highest voltage (measures the lowest temperature) will determine the total system voltage.

9.3 CURRENT LIMITATION

The charging current is limited automatically, to provide effective protection of the charger and the battery against possible overloads. The current limitation is kept constant within ±2% at an output voltage ranging down to 0V with simultaneous mains voltage variation of 340-440V, frequency variation of 47-63Hz and ambient temperature variation of 0-40°C. On request the charger can be provided with a separate battery output with a current limit adjustable between 5-50% of the charger's rated current.

9.4 FILTERING THE OUTGOING DC VOLTAGE

As standard, the charger is provided with a smoothing device. It is dimensioned so that the AC component of the output does not exceed 10% of the rated current. For normal battery operation, the rms value of the superimposed AC voltage is a maximum of 0.5% of the rated voltage. The peak value is less than 2% of rated voltage. Chargers with a rated voltage of up to 48V can, on request, be provided with a filter which reduces the psophometric disturbance to less than 4mV.

9.5 RI-COMPENSATION

The charger is provided with a potentiometer that can be used to compensate for the resistive voltage drop in the lines between the charger and the battery. You can compensate for up to 3% of the rated voltage. Since the charger is provided with connectors for external lines, and these must be connected in order to maintain the monitoring functions, the RI-compensation is 0-set when the charger is delivered.

9.6 EXTERNAL CONTROL LINES

The charger is also provided with connectors for external control lines (in common with measure lines), so that it will be possible to compensate for a voltage drop between the charger and the battery. The maximum voltage drop that can be compensated for is 5V. When the external control lines are connected, the charger automatically regulates the voltage carried by them, and the display also presents this voltage. If an open circuit occurs in any of the external control lines, the actual value of the voltage is automatically obtained from the DC terminal. However, the monitoring unit still measures the voltage carried by the external control lines and issues alarms in the event of undervoltages.

9.7 MEASURING INSTRUMENTS AND MEASUREMENT TERMINALS

The panel contains an alfanumeric LCD-display that presents, among other things, the battery voltage and charging current. In addition, there is a voltmeter terminal for connection of an accurate external voltmeter used to check the display. The voltmeter terminal is protected against short circuit by means of a PTC resistor and shows the regulation voltage to the regulator board, i.e. measured system voltage. When the display is checked, the external control lines must be connected to the unit. If an open circuit occurs in these, the display presents the lowest voltage in the measurement range, while the control unit is automatically reconnected for internal regulation.

9.8 CHARGER CONTROL UNIT

The control unit is connected to the power parts of the charger via connection board KL.

The purpose of the connection board is to, in an early state, separate the electronic circuits from hazardous voltages and currents in the power supply unit. The board contains current limiting resistors in current and voltage sensing lines as well as circuits for automatic selection of external or internal controlling lines.

The control unit consists of motherboard, trig regulator board, regulator board and gate pulse amplifier board. The unit regulates the charger in accordance with the VI characteristic, i.e. the voltage is kept constant until a preset current level is reached, after which the current is regulated. See block diagram further on.

The control unit is supplied with ±24V from the connection board KL. These voltages are stabilized to ±12V by two regulators placed on the mother board.

When the contactor is switched on, a starting command is sent to the control unit. If all the operating conditions are fulfilled, the trig control unit is started and the power stage of the gate pulse amplifier is connected to the power supply. Simultaneously, a gentle start up circuit is activated, in order to avoid unnecessary voltage and current surges.

A DC voltage (about 10V), proportional to the output voltage, is reached from the connection board. This voltage is subtracted from a preset value, V_{set}, and the difference forms the regulating voltage, V_s, which through the trig regulator board regulates the firing point of the thyristors and with that the output voltage.

The connection board also provides the control unit with a DC voltage proportional to the chargers output current. It is compared with a preset value and if the current reaches its preset level, a voltage is fed to the regulator, reducing V_s. The regulator then regulates the current instead of the voltage.

The charger output current also gives an adjustable contribution, RI, to the regulator in order to compensate the voltage drop in the connection cables of the battery.

A transformer unit provides the trig control board with six phase-different sine waves, which are phase shifted by filtering. The firing pulse timing is established by comparing V_s with the sine waves. This produces six 120° long pulses that are positioned 60° from one another. The start point of the pulses decides the firing point of each thyristor.

The gate pulse amplifier converts the pulses into high frequency firing bursts which are amplified and, through isolating pulse transformers, sent to the thyristors.

The control unit also includes protection circuits that will stop the charger at mains failure or overcurrent.

For the monitoring unit to be able to monitor the charger, there is an adaption board between the charging unit and the monitoring unit. The board monitors the battery voltage and charger output current and in the following cases generates a fault indication signal to the monitoring unit:

1. The battery voltage is too low (<2.15V/cell) and charger current <50% of rated current.

2. The battery voltage is too high (>2.45V/cell) and charger current >10% of rated current.

In case no 2, a non-resetting signal is also activated that can be used to shut off the charger (STS).

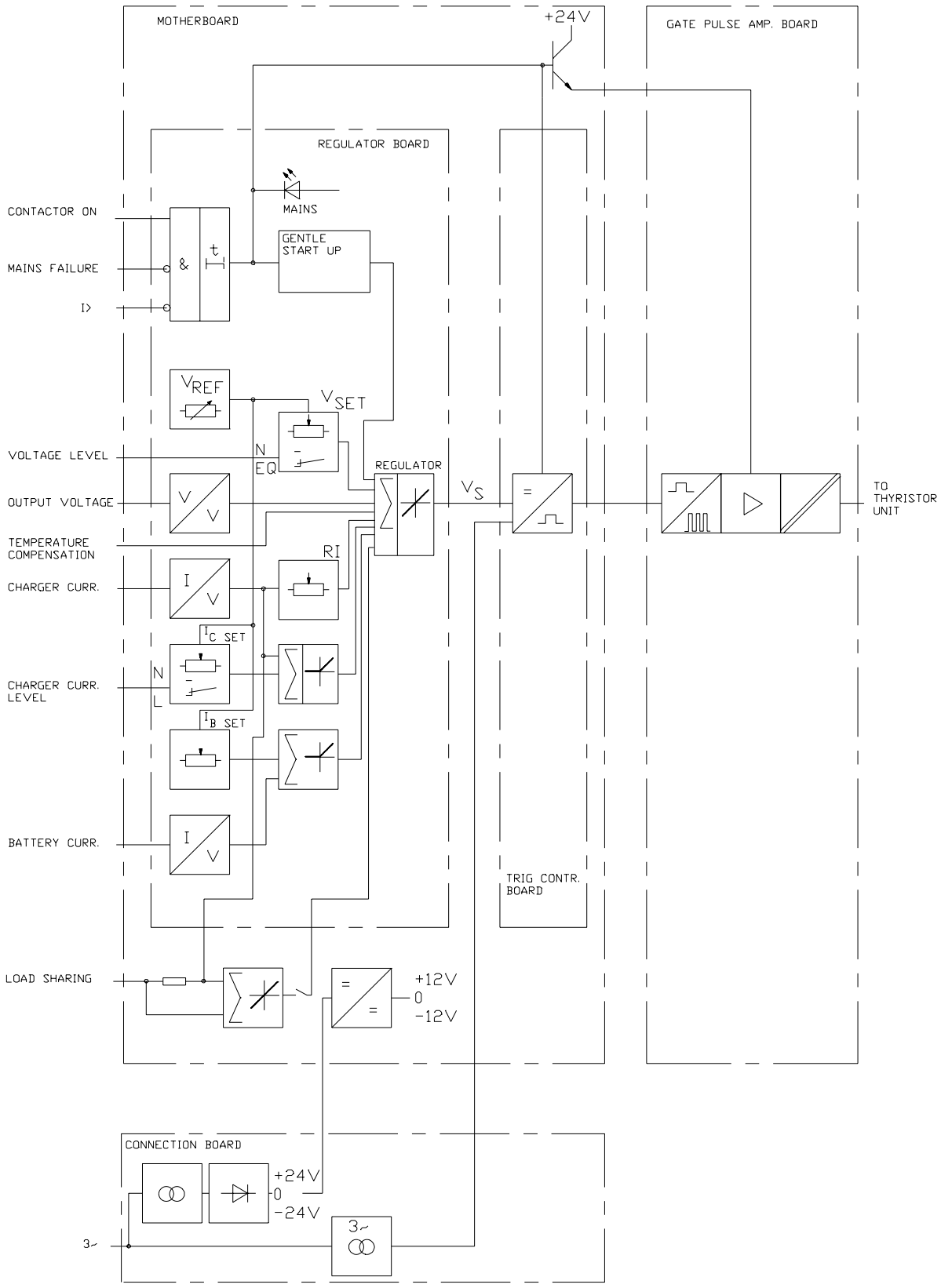


Fig. 9 - 1 Drawing no 3-7866

9.9 PARALLEL OPERATION

Several chargers of the same type can operate in parallel without any tendency towards oscillation. The charger is provided with an active load sharing function which makes all chargers in the system take an equal share of the load. To activate the active load sharing, the terminal X6:47 (shield to X6:48) of all chargers has to be connected (see figure below). The load sharing function must also be switched on by the DIP-switch SW1:1 on the motherboard of the control unit.

In each charger, the delivered current is compared with the average charger current in the system. If the current deviates from the average, the output voltage is regulated until the current is equal to the average. Should, for some reason, a charger not take its share of the load, the loadsharing function will automatically be disconnected. This feature prevents a faulty charger from adding a false contribution to the average current, thus reducing or increasing the system voltage. The faulty charger will be disconnected if its own current deviates from the average current with more than 15% for more than 2 minutes. The charger will remain disconnected from the load sharing system until it is reset by means of the mains switch.

All charger's current will deviate from the average when one of them gives a false contribution, and therefore the charger that deviates most (=the faulty charger) will be disconnected first, by that removing the faulty condition.

In the faulty charger, a red LED is lit on the motherboard for the control unit, indicating that the load sharing function has been disconnected. (Note: In a system with only two chargers the deviation will be the same in both chargers, which means that it is not necessarily the faulty charger that gets disconnected).

Generally, the charger can also be connected in parallel with other chargers (without load sharing). In such case it is advisable to adjust the voltage levels in each individual charger sufficiently accurately to make certain that the load will be distributed approximately evenly, and adjust the RI-compensation to obtain a slightly falling characterization. This is done by turning the potentiometer P3 on the regulator board in counter clockwise.

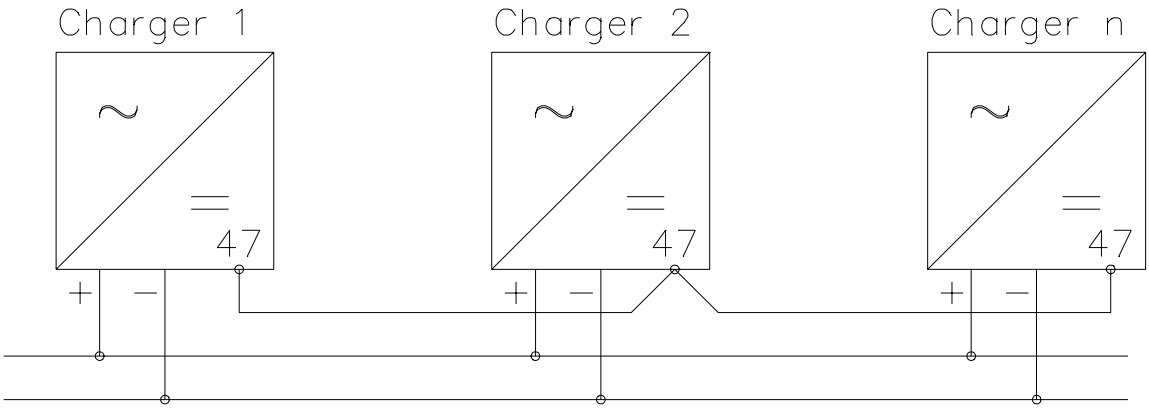


Fig. 9 - 2 Connection of active load sharing signal (drawing no: 4-10345, rev. B)

10 FUNCTIONAL DESCRIPTION - MONITORING UNIT

See separate manual *Monitoring unit type KraftMaster*.

11 MAINTENANCE INSTRUCTIONS

11.0 SAFETY INSTRUCTION

WARNING! This product contains dangerous voltage that when touched can cause electrical chock, burn or death.
Service/maintenance work that means work with opened enclosure may only be performed by authorized service personnel.
The power should always be disconnected in a safe way (both mains and battery) before any service/maintenance work begins. After switching off, always allow the capacitors 5 minutes to discharge. It is a good practise to check (with a voltage indicating instrument) that the discharge in fact is complete before work begins.

11.1 GENERAL

Checking of the charger UNIQ should be done once every year. The main purpose of the test is to detect any voltage changes due to temperature changes. Follow the instructions below.

11.2 ANNUAL TEST

11.2.1 Testing the voltage display

Connect a reference instrument to the measurement terminal in the panel. Check that the display shows the same value as the reference instrument.

11.2.2 Testing the alarm circuits

The alarm output relays can be manually controlled without disturbing other operation. See *Operation - Monitoring unit*, section *Control menu, Additional tests*.

11.2.3 Testing the alarm and control settings

Check preset level in the charging unit. Follow the instructions in section *Operation - Charging unit*.

11.3 5-YEAR TEST

11.3.1 Basic test

Follow the instructions set forth above for the annual test.

11.3.2 Supplementary test

Every 5 years, the wiring and cabling should be checked. Make sure that the charger has not accumulated too much dust or dirt. Use a vacuum cleaner and other cleaning methods if necessary.

11.4 10-YEAR TEST

Follow the instructions set forth above for the 5-year test. To make sure that the charger will also function properly throughout the next 10-year period, it is recommended that the memory package is replaced. *This will also provide you with any modifications incorporated during the elapsed 10-year period.*

12 FAULT TRACING INSTRUCTIONS

12.0 SAFETY INSTRUCTION

WARNING! This product contains dangerous voltage that when touched can cause electrical chock, burn or death.
Service/maintenance work that means work with opened enclosure may only be performed by authorized service personnel.
The power should always be disconnected in a safe way (both mains and battery) before any service/maintenance work begins. After switching off, always allow the capacitors 5 minutes to discharge. It is a good practise to check (with a voltage indicating instrument) that the discharge in fact is complete before work begins.
Fault tracing with power applied must always be done according to the provisions that is stipulated for work with applied power.

WARNING! Overvoltage can cause explosion of electrolytic capacitors and varistors. If service/maintenance work is to be done with power applied, a splinter screen therefore must be used (safety goggles or shielding).

12.1 CHARGING UNIT

Primary fuses blow when power is turned on (or a few seconds later)

Action: 1) Check that the correct fuses are provided as set forth in the instructions in section *Technical data.* Remember that slow-burn fuses are usually required.

2) Disconnect the secondary cables of the transformer at the thyristor unit.

3) Turn on the mains voltage. If the primary fuses still blow, the fault is probably in the transformers. If the fuse failure is irregular, the mains voltage may be a little high thus causing excessive initial current surges. In such case, the fuse value must be increased one step. If the fuse does not blow when power is turned on, the fault is probably in the thyristor bridge. Measure the resistance of the thyristors using an AVO meter. They must have high resistance in both directions. Any short-circuited thyristor must be replaced.

No charger output

Action: 1) Check that the primary and the secondary fuses are intact.

2) Check that the fuses on the RFI board and the connection board are intact.

3) Check that all phases are present at the transformers. If so, the control unit is probably faulty. Replace, in turn, the trig control board and the regulator board.

4) If the charger is supplied with an over voltage protection device (STS), it may be this device that has tripped. Reset by turning the charger off and on using the mains power switch.

Charger output voltage is too high

Action: 1) Check that the voltage between X7:2, X7:5 on connection board KM is the same as between L+, L- when the charger is shut off.

2) Check to see whether the voltage can be adjusted on the regulator board.

3) If not, remove the regulator board from the connector. If the charger still provides current that is too high, there is a short circuit in the thyristor bridge. If the charger provides no output, the fault is probably in the control unit. Replace, in turn, the trig control board and the regulator board.

Charger provides current that is too high

Action: 1) Check to whether the current limitation can be adjusted on the regulator board.

2) If not, remove the regulator board from the connector. If the charger still provides current that is to high, there is a short circuit in the thyristor bridge. If the charger provides no output, the fault is probably in the control unit. Replace, in turn, the trig control board and the regulator board.

Charger provides too much ripple

Action: 1) The probably cause is an open circuit in the thyristor bridge. Check the thyristors. If they are functioning properly, the fault is in filter L1, C1 (L2, C2), which must be replaced.

12.2 MONITORING UNIT

Dead display

Action: 1) Check the power supply voltages.

2) Replace the CPU board.

No pushbutton response, display presents nonsense or other sign of a hang up computer

Action: 1) Disconnect the power supply to the monitoring unit for a while to force a restart.
NOTE: Disconnect by pulling out terminal block X6 on connection board KM, or by external switch that supports terminal block X6. Never disconnect directly on the CPU-board!!

2) Replace the CPU board.

12.3 KRAFTNET

Alarm: UNIT x DOESN'T ANSWER

Cause: Communication to external unit no x is broken.
Communication to charger no x broken if x is between 0-31. The first rectifier in the system has the number 0 (for a UNIQ, no 0 is where the KM-BAS resides).
Communication to the first KM-BI is broken if x=32, and to the second if x=33.

Action: 1) Check the communication cabling between the units.

2) Check that both the yellow and green LED on both the KM-BAS-board and the remote KM-RI and KM-BI boards are flashing.

3) Replace the KM-BAS board, KM-RI board or KM-BI board respectively.

WARNING: At KM-BAS board replacement, the terminal block X6 on connection board KM must be disconnected before any other disconnections are done. After that, disconnect remaining terminals from connection board KM to make the KM-BAS board completely dead.

Appendix A
SETTINGS

Settings, adaption board KL/KM

Potentio-meter	Notation	Unit	Description	Setting limits: System voltage 24V	48V	110V	125V	220V	Normal settings: Lead cells	Alcaline cells	Special settings
P2	U>>	V	Overvoltage (STS)	23-33 (28.8)	46-66 (57.6)	102-151 (129.5)	114-168 (144.0)	206-302 (259.0)	2.4V/cell	1.75V/cell	
P3	I=0	V	Charging interrupt, voltage range	16-28 (25.8)	32-57 (51.8)	70-129 (116.0)	78-144 (129.0)	141-258 (232.0)	2.15V/cell	1.35V/cell	

Settings, regulator board

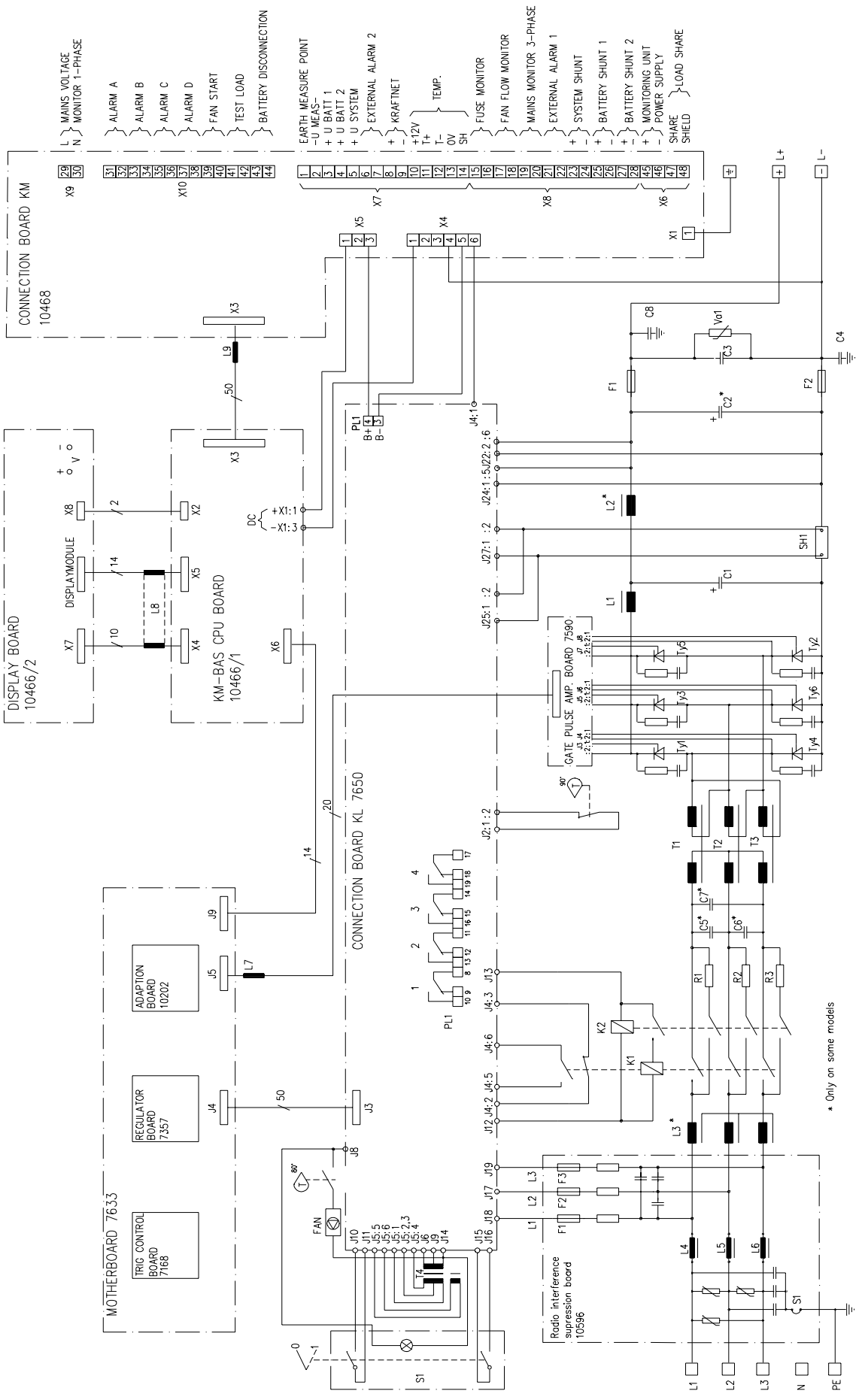
Potentio-meter	Notation	Unit	Description	Setting limits: System voltage 24V	48V	110V	125V	220V	Normal settings: Lead cells	Alcaline cells	Special settings
P1	Utjämn./ Eq	V	Equalizing charging	24.0-32.2 (27.84)	48.1-64.6 (55.68)	109-146 (125.3)	120-161 (139.2)	218-292 (250.6)	2.32V/cell	1.55V/cell	
P2	Normal/ Float	V	Float charging	24.0-27.8 (26.76)	48.2-56.0 (53.52)	109-126 (120.4)	120-139 (133.8)	218-253 (240.8)	2.23V/cell	1.41V/cell	
P3		%	RI-compensation	-0.5 - +3% (0.0)					0%		
P4		%	Current monitor	60-110% (90)					90% of rated current		
P5	Current limit	%	Current limit	50-105% (100)					Preset to current limit		
P6		%	Over current level	180-300 (200)					200%		
P7		V	Reference voltage	4.6-5.5 (5.00)					5.0V±0.005		
P8		%	Mains failure level	80-100 (85)					85%		
P9		%	Reduced current limit	40-75 (50)					50%		
P10		%	Battery current limit	5-50 (25)					Battery Ah * 0.1 / I_N		

Settings, connection board KL

Potentio-meter	Notation	Unit	Description	Setting limits	Setting limits	Special settings
P1		mV	Charger current limit trim	20-60 (30)	30mV	

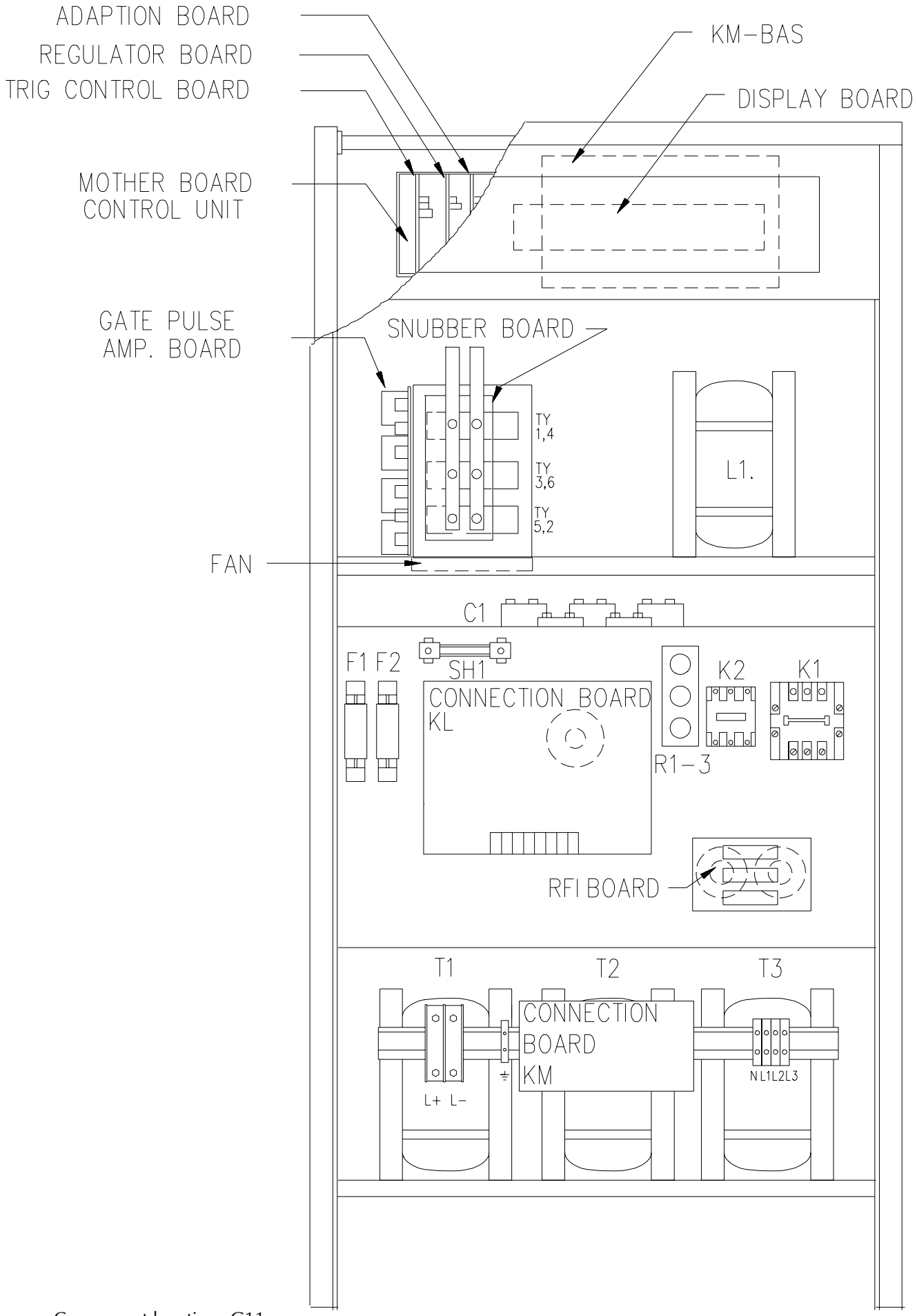
Settings for the monitoring unit are found in the separate manual *Monitoring untit type KraftMaster*.

Appendix B
CIRCUIT DIAGRAMS

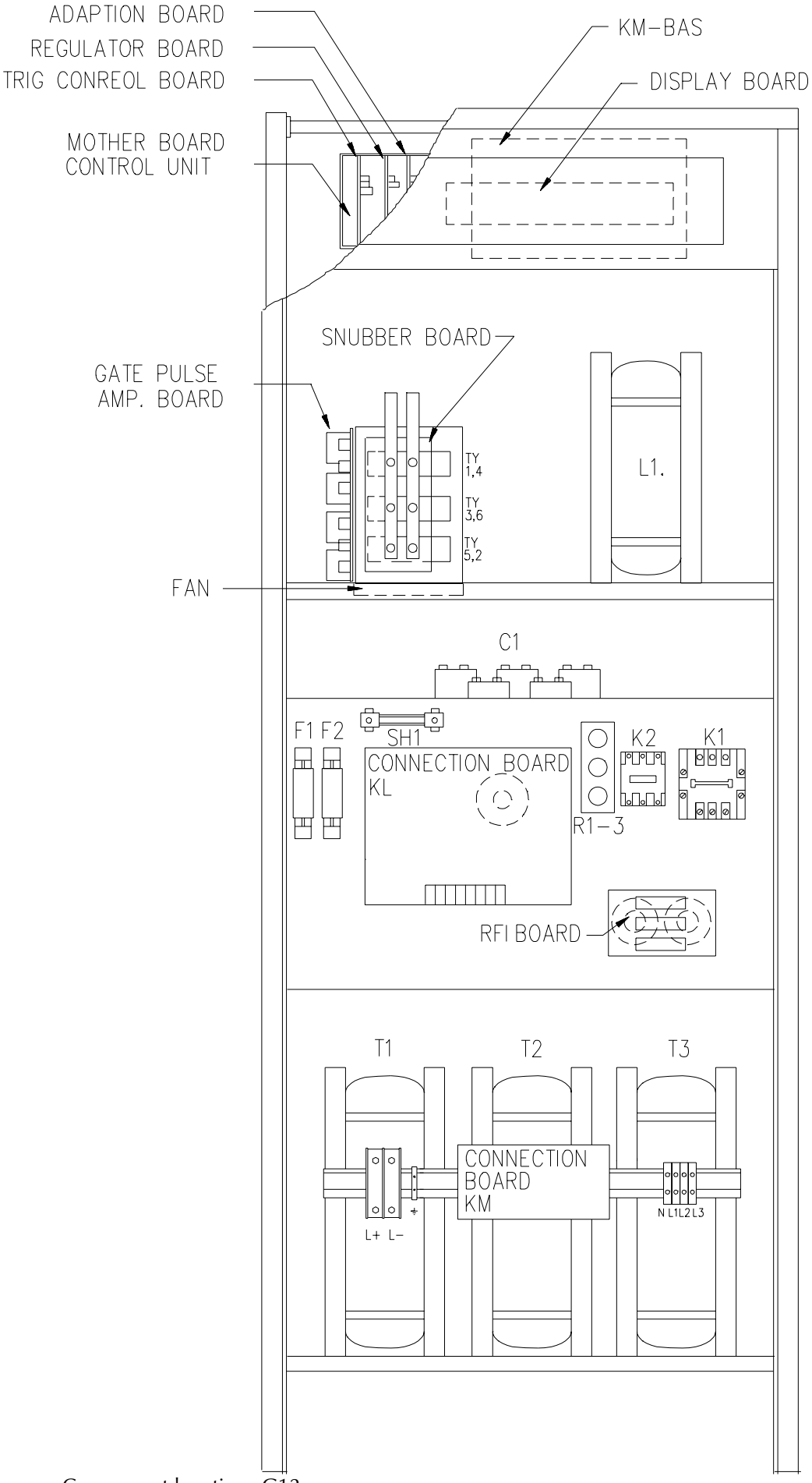


Circuit diagram, UNIQ
Drawing no: 2-10255, rev. D

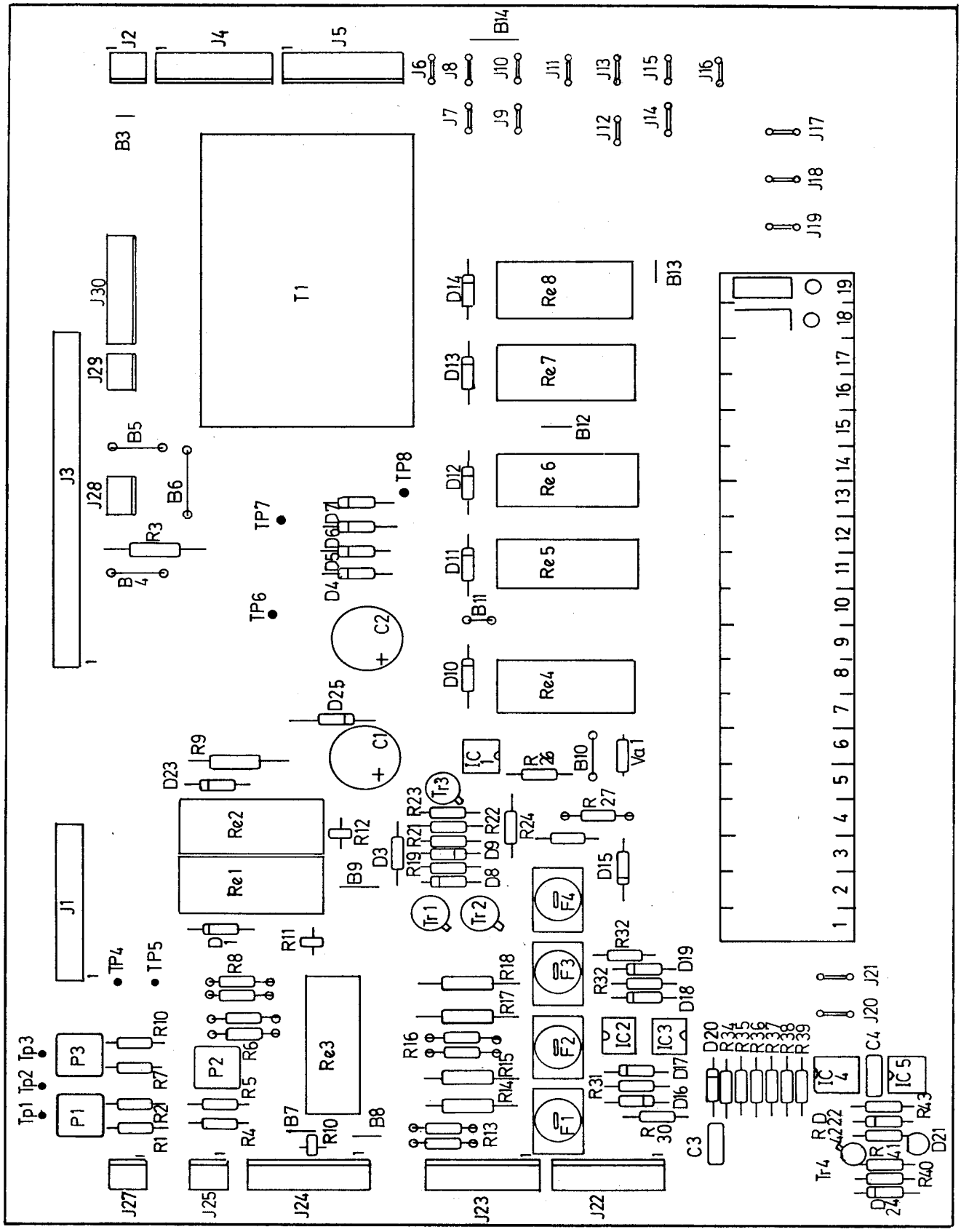
Appendix C
COMPONENT LOCATIONS, page 1



Component locations G11
Drawing no: 4-10261



Component locations G12
Drawing no: 4-10260



Component locations, connection board KL
Drawing no: 4-8032

TEST REPORT

Date..... Tested by.....

Your purchase no.....

Your art. no.....

Order no..... Type.....

Art. no..... Serial no.....

Input voltage.....V AC Frequency.....Hz

Outputvoltage.....V DC Output current.....A

No.	Step	Approved result
1	Vacuum-cleaned.	☐
2	Visual inspection (components, connections, soldered joints, nameplates, markings)	☐
3	Insulation tests according to SS EN 60146-1-1:4.2.1.	☐
4	Test control board settings.	☐
5	Regulation of DC during load variations and mains variations.	☐

	Mains voltage		
Current	85%	100%	110%
0			
100			

6	Test maxiumum ripple voltage with resistive load and maximum ripple current with capacitive load.	☐
7	Test maximum primary current of rated load.	☐
8	Test dynamic characteristics during mains failure and load variations.	☐
9	Test regulation with open circuit in sensing cables.	☐
10	Using a reference instrument, test the display presentation for voltage measurement and current measurement.	☐
11	Control and adjustment of alarm level and alarm delay settings.	☐
12	Test of the output relays.	☐
13	Fill in the test report and attach the "TESTED" nameplate. Write in the date and your initials.	☐
14	Notes.....	☐
	.....	
	.....	
15	Approved. Signature...../.....Date.....	

Appendix E
Additions and changes