

Minisemi D

V4.X

Order No. 029.222 809

Issue 09/06 AE02

Frequency converter



Operating Manual



Safety and Operating Instructions for Frequency Converters

according to Low Voltage Directive 73/23/EEC

1. General

During operation, frequency converters can have live, rotating or moving parts and their surfaces may become hot, depending on the protection class involved.

There is a risk of severe physical injury or material damage if any of the covers are removed or the unit is installed, used or operated incorrectly.

Further details are given in the documentation.

All system design, transport, installation, commissioning and maintenance work must be carried out by qualified specialist personnel (according to IEC 60364, CENELEC HD 384 or DIN VDE 0100 and IEC 60664 or DIN VDE 0110 and national safety regulations).

Qualified specialist personnel in the sense of these safety instructions are persons who are experienced in the system design, installation, erection, commissioning and operation of the product and have the qualifications required for such work.

2. Correct use

Converters are intended for installation in electrical plant or machinery.

When installed in machines the converter may not be commissioned (i.e. operation of the converter may not be started) until it is evident that the machine complies with EC directive 98/37/EC (Machine Directive) (formerly 89/392/EEC). Also EN 60204 must be observed.

Commissioning (i.e. operation) is only permitted in compliance with the EMC directive (89/336/EEC).

Our converters satisfy the requirements of low voltage directive 73/23/EEC. The standards of the series EN 50178 / DIN VDE 0160 in conjunction with EN 60439-1 / VDE 0660 Part 500 and EN 60146 / VDE 0558 are applicable to drive converters.

The technical data and the connection conditions are shown on the rating plate and in the documentation. They must be observed.

3. Transport and storage

The instructions for transport, storage and correct handling must be observed.

Climatic conditions are to be maintained according to EN 50178.

4. Installation

The installation and cooling must be in accordance with the relevant documentation.

All converters must be protected against undue mechanical shocks or stress. In particular no components may be bent and/or no insulation spacing may be altered during transport and handling. Do not touch electronic components or contacts.

Converters contain components susceptible to electrostatic discharge (ESD) which are easily damaged by static electricity or incorrect handling. Do not damage mechanically or destroy electrical components (health hazard possible).

5. Electrical connection

The appropriate national safety regulations (e.g. BVG A2) must be observed when working on converters which are connected to the electricity supply.

The electrical installation must be executed in accordance with the relevant regulations (e.g. cable cross-sections, fuses, earthing). Additional instructions are given in the documentation.

Instructions on EMC compliant installation, such as screening, earthing, filters and cable routing, are also given in the converters documentation. These also apply to converters bearing the CE mark. Compliance with the limits specified in EMC legislation is the responsibility of the plant or the machinery manufacturer.

6. Operation

If necessary, plant or machinery in which converters are fitted must be equipped with additional monitoring and safety facilities in accordance with the relevant regulations, e.g. the law on technical equipment, the appropriate safety regulations etc.

Do not touch any parts of the equipment which may be live or any power connections even after the converter has been isolated from the electricity supply, as capacitors may remain charged. Follow the instructions given on warning labels.

All covers and doors must be kept closed during operation.

7. Service and maintenance

All instructions given in the documentation must be observed.

KEEP THESE SAFETY INSTRUCTIONS IN A SAFE PLACE

Contents

1	Unit description	1
1.1	General.....	1
1.2	Safety instructions	2
1.3	Main characteristics.....	3
1.4	Options.....	3
1.5	Operating principle.....	4
2	Technical data	5
2.1	Key to types	5
2.2	Series of units	5
2.3	Unit data	7
2.4	Commutation chokes	10
2.4.1	Key to types of commutation chokes.....	10
2.4.2	Single phase chokes for field supply.....	11
2.4.3	Single phase chokes for power connection	11
2.4.4	3-phase chokes for power connection	12
2.5	Semiconductor fuses and fuse bases	13
2.5.1	Semiconductor fuses for the 3-phase power circuit.....	13
2.5.2	Semiconductor fuses for the DC power circuit	14
2.5.3	Semiconductor fuses for field the power circuit.....	14
2.5.4	Fuse bases and isolators.....	15
2.6	Power loss	15
2.7	Dimension drawings	16
2.7.1	Unit dimensions	16
2.7.2	IMRA96K layout drawing	17
2.7.3	DC interface layout drawing	18
2.7.4	Layout Drawings field converters.....	19
2.8	Block circuit diagrams	20
2.8.1	Speed control	20
2.8.2	Torque control	22
2.8.3	Field current	24
3	Transport, installation, connection and terminal wiring	25
3.1	Safety instructions, installation and storage.....	25
3.1.1	Installation.....	25
3.1.2	Storage	27
3.1.3	Stopping and starting the clock with option „clock“	27
3.2	Connection notes.....	28
3.3	Connection drawings	31
3.3.1	Control electronics, power only for Minisemi D 40 ... 275 A.....	31
3.3.2	Minisemi D power stacks	32
3.4	Terminal wiring.....	33
3.5	Terminal description.....	35
3.5.1	Inputs.....	35
3.5.2	Outputs	36

4	Handling	39
4.1	Software structure	39
4.2	Control panel	40
4.3	Operation of the keypad	41
4.4	Parameter adjustment	42
4.4.1	Move the display position	42
4.4.2	Check, adjust and save parameters	42
4.5	Setting the date and time with option "clock"	44
4.6	Load defaults and execute restart	45
4.7	Switching to the extended menu	45
4.7.1	Closing the menu levels	47
4.7.2	Disable changes	47
4.8	Reassignment of inputs and outputs	47
4.9	General system messages	49
5	Commissioning	51
5.1	Safety instructions	51
5.2	Commissioning procedure	52
5.2.1	Preparation	54
5.2.2	Control structures	54
5.2.3	Type data	55
5.2.4	Control structures and settings for user applications	56
5.2.5	Terminating work	57
5.3	Supply voltage matching	58
5.4	Field current matching	59
5.4.1	Entering of type data and fine adjustment	60
5.5	Speed feedback generator matching	60
5.5.1	Digital encoder connection	60
5.5.2	Analog tachometer generator connection	62
5.6	Optimization of control circuits	64
5.6.1	Automatic optimization	64
5.6.2	Checking control response and manual optimization	67
5.7	Armature voltage dependent field weakening	70
5.7.1	Armature voltage dependent field weakening with EMF calculation from flux table	71
5.7.2	Armature voltage dependent field weakening with measurement of the armature voltage	73
5.8	Field bus coupling	77

6	Control and monitoring system	79
6.1	Logic Control	79
6.1.1	General.....	79
6.1.2	Switching on	80
6.1.3	Switching off	80
6.1.4	Controller enable armature circuit	80
6.1.5	Demand enable	81
6.1.6	Disable.....	81
6.1.7	Fast stop.....	82
6.1.8	Control structure	83
6.2	Monitor	84
6.2.1	Shutdown sequence in the event of an error	84
6.2.2	Start-up sequence after an error shutdown	85
6.2.3	Event and first value log	85
6.3	Structure of monitor system.....	87
6.4	Error messages	88
7	Maintenance	91
7.1	Maintenance and replacement of battery RAM chips (only with option "clock").....	91
8	Recommended spare parts	93
9	Function diagrams of software modules	97

Status: 27.09.06

Converteam, the logo Converteam and their frameworks are trademarks and service trademark applications of Converteam. The other names mentioned, registered or not, are the property of their respective companies.

1 Unit description

1.1 General

The compact unit Minisemi D is a fully digital converter. The functions of the internal control, the inputs and outputs, the control system and the tasks of the firing circuit are handled by a 16-bit microprocessor. The unit includes a control panel for the input and display of unit and motor data as well as general parameter adjustment and status indication, so that commissioning is also possible without additional programming units.

This operating manual is valid for Minisemi D units with the hardware components described in this manual and that in the following specified firmware versions:

Firmware Version 4.x

	Ref. No.
V 4.0	EPROM D10 German 029.228 585
	EPROM D11 German 029.228 586
	EPROM D10 English 029.228 588
	EPROM D11 English 029.228 589
V 4.1	EPROM D10 German 029.352 214
	EPROM D11 German 029.352 215
	EPROM D10 English 029.352 217
	EPROM D11 English 029.352 218

1.2 Safety instructions

Electrical equipment represents a risk to life.

The equipment described here carries dangerous electrical voltages and controls rotating mechanical parts. Death, severe physical injury and extensive material damage may result if the instructions given in this operating manual are not observed.

Only suitably qualified personnel may work on this equipment and before starting such work must read and understand this operating manual and all the safety instructions it contains.

Qualified personnel must have had electrical training or be electrical technicians in the sense of DIN VDE 0105.

It is essential that the applicable safety regulations be observed when working on plant and equipment.

Protect the unit against unnecessary shocks or stress.

For reasons of safety and in order to maintain the documented system data and operation, any repairs to the unit or its components may only be carried out by the manufacturer.

The equipment is covered by the warranty conditions of the manufacturer applicable at the time of purchase.

No liability whatsoever is accepted for any inaccurate or incorrect manual or automatic setting of the parameters for the drive.

Any unauthorised modification of the equipment including any installation of supplementary equipment can affect the system data, documentation and the operating manual. No liability will be accepted in such cases and our warranty will be void.

1.3 Main characteristics

- Continuous series of units from 40 A to 1250 A or 18 kW to 700 kW respectively with supply voltages of 3 AC 380, 400 (415) V and 3AC 500 V
- High operational reliability through:
 - Self-testing of microprocessor and peripheral modules on start-up
 - Program sequence monitor
 - Constant monitoring of drive functions
- Error analysis with first value and event log
- Commissioning using integral display and parameter adjustment unit or PC via V.24 (RS 232C) interface
- Program-controlled start-up and shutdown
- Connection to higher level automation systems through field bus couplers interface (option)
- Matching the unit to the motor after inputting the motor type data
- Self-optimization of armature current, exciter current and speed controller and creation of a field flux table
- Detection of the polarity of the speed actual value encoder
- Variable control structures
- Additional software modules for different technology applications
- Precise data reproducibility
- No battery for the storage of the parameter settings
(Exception: Option „clock“)

1.4 Options

	Ref. No.
- Voltage supply for digital speed encoder	on request
- Optocoupler for logic outputs	see section 3.5.2.2
- Field bus coupler ¹⁾	see section 5.8
- Commutation chokes	see section 2.4
- Semiconductor fuses and fuse bases	see section 2.5
- DC isolating transformer for armature voltage dependent field weakening	see section 5.7.2
- Option „clock“ ¹⁾ : RAMs with internal battery and clock	see section 7.1
A2-D13 Timekeeper RAM	029.350 412
A2-D14 Zero Power RAM	029.350 413
- PC handling software for parameter adjustment, saving, loading and documenting data on a PC, 3.5" diskette, German and English manual	029.141 052
- Unit specific files, necessary for using PC Handling Software in connection with unit software (EPROMs) V4.X	029.233 191
- Adaptor cable to connect the PC with the unit	029.118 472

¹⁾ Please quote upon ordering

1.5 Operating principle

Speed adjustment is possible by varying the armature voltage in the armature range (constant torque) and by varying the exciter current in the field range (constant power).

The variable armature voltage is produced by rectifying the AC mains voltage through a 3-phase thyristor bridge and adjusting the mean value through phase angle control. Two fully-controlled 3-phase thyristor bridges are connected in an antiparallel (GO) circuit for drives which must drive and brake in both directions.

The exciter current is regulated by a semi-controlled single phase thyristor bridge and a field current control circuit.

When operating with armature voltage dependent field weakening a voltage regulator is superimposed on the field current control.

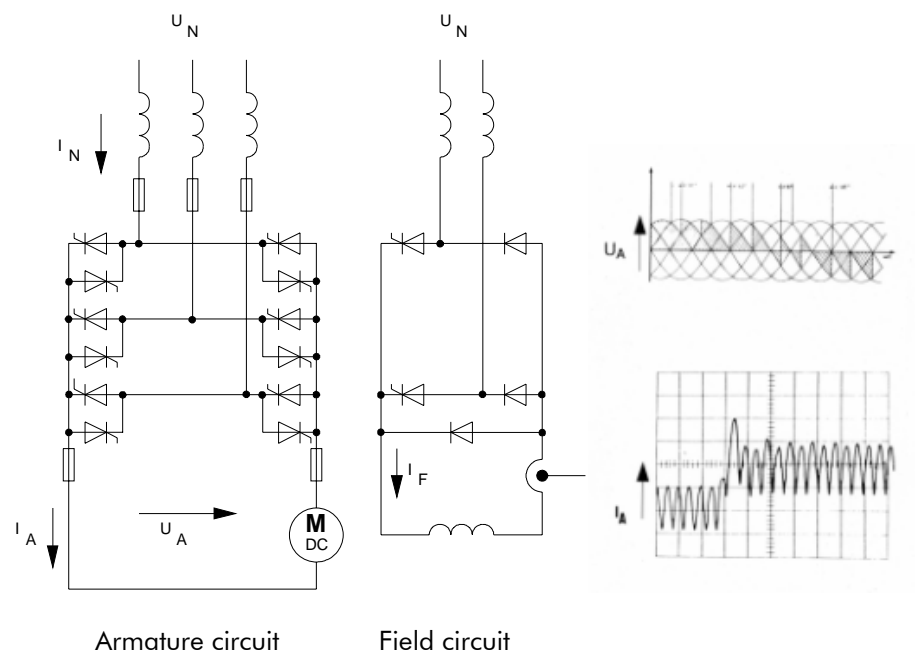
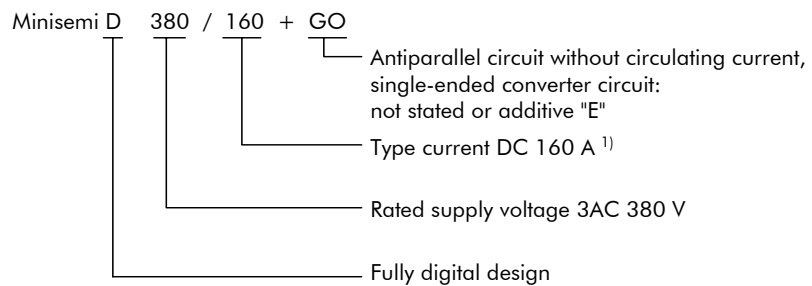


Fig. 1: Circuits, voltages and currents in the Minisemi D

2 Technical data

2.1 Key to types



¹⁾ Temporary overload above type current needs a temperature calculation of the thyristor bridge (on request)

2.2 Series of units

Minisemi D 380 (415)/ ... E:

Type current [A]	Rating [kW]	Weight [kg]	Ref. No. 029.
40	18 (20)	8	228 510
60	28 (30)	11	228 511
100	46 (50)	11	228 512
160	74 (80)	13	228 513
200	92(100)	14	228 514
275	126(137)	14	228 515
320	147(160)	48	228 516
420	195(210)	48	228 517
500	230(250)	48	228 518
760	350(380)	72	228 519
875	402(437)	75	228 520
1100	506(550)	90	228 521
1250	575 (625)	93	351 699

Values in brackets for 415 V supply voltage.

Minisemi D 380 (415)/ ... +GO:

Type current [A]	Rating [kW]	Weight [kg]	Ref. No. 029.
40	16 (17)	9	228 522
60	24 (26)	12	228 523
100	40 (44)	14	228 524
160	64 (70)	14	228 525
200	80 (88)	14	228 526
275	110 (121)	16	228 527
320	128 (140)	49	228 528
420	168 (185)	49	228 529
500	200 (220)	49	228 530
760	304 (335)	107	228 531
875	350 (385)	110	228 532
1100	440 (484)	125	228 533
1250	500 (550)	128	350 168

Values in brackets for 415 V supply voltage.

Minisemi D 500/ ... E:

Type current [A]	Rating [kW]	Weight [kg]	Ref. No. 029.
40	24	8	228 534
60	36	11	228 535
100	60	11	228 536
160	96	13	228 537
200	120	13	228 538
275	165	14	228 539
320	192	48	228 540
420	252	48	228 541
500	300	48	228 542
760	456	72	228 543
875	525	75	228 544
1100	660	90	228 545
1160 ¹⁾	696	93	351 700

Minisemi D 500/ ... +GO:

Type current [A]	Rating [kW]	Weight [kg]	Ref. No. 029.
40	21	8	228 546
60	31	12	228 547
100	52	14	228 548
160	83	14	228 549
200	104	14	228 550
275	143	16	228 551
320	166	49	228 552
420	218	49	228 553
500	260	49	228 554
760	395	107	228 555
875	455	110	228 556
1100	572	125	228 557
1160 ¹⁾	603	128	232 175

¹⁾ This unit type can be overloaded for 60 s every 600 s with an overload current of 1250 A. For higher overload currents a temperature calculation is necessary.

2.3 Unit data

Power stack

Supply voltage with tolerances : 3AC 380 V, 400 V (+10 %, -5 %)
 according to DIN 40030 for : 3AC 415 V (+6 %, -5 %)
 operation without reduction of type : 3AC 500 V (+10 %, -5 %)
 rating : Phase L1, L2, L3 clockwise rotation

Recommended motor supply voltage : With single-ended converter circuit
 with mains tolerances according to : Mains supply 380 V : 460 V
 DIN 40030 400 V : 470 V
 415 V : 500 V

Mains supply 500 V : 600 V

For antiparallel circuit,
 Mains supply 380 V : 400 V
 400 V : 420 V
 415 V : 440 V
 Mains supply 500 V : 520 V

Electronics

Supply voltage : 3AC 380 V, 400 V (+10 %, -15 %)
 : 3AC 415 V (+6 %, -15 %)
 : 3AC 500 V (+10 %, -15 %)
 : Phase L1, L2, L3 clockwise

Power consumption : Approx. 50 mA for all units

Max. power loss IMRA96K and
 DC interface : Approx. 40 W

Excitation

Supply voltage : 2AC 380 V (+10 %, -5 %),
 2AC 400 V (+10 %, -10 %)
 : 2AC 415 V (+6 %, -10 %)
 Phase L1, L3
 An autotransformer with a 380 V
 Secondary must be used with the
 Minisemi and a 500 V supply.

Recommended motor exciter voltage : DC 200 V
 Max. available motor exciter voltage : DC 310 V

Unit type exciter currents, regulated :
 Minisemi D /40 ... 275 A : Max. 10 A
 /320 ... 1250 A : Max. 25 A

Fan

Supply voltage
 Minisemi D 380 V
 100 A GO/ 160 A ... 500 A E/GO : 2AC 380 V, 400 V (+10 %, -15 %)
 2AC 415 V (+6 %, -15 %)
 760 A ... 1250 A E/GO : 3AC 380 V, 400 V (+10 %, -15 %),
 3 AC 415 V (+6 %, -15 %)

	Minisemi D 500 V	
	100 A GO/ 160 A ... 500 A E/GO	: 2AC 500 V (+10 %, -15 %)
	760 A ... 1250 A E/GO	: 3AC 500 V (+ 10 %, -15 %)
	Power consumption	: units up to 1100 A: approx. 0,2 A units 1160 A and 1250 A: approx. 0,4 A
Unit	Mains frequency	: 48 ... 60 Hz \pm 5 %
	Speed adjustment range	: 1 : 100
	Resolution of control and reference variables	: 1 : 800 with analog tachometer : 1 : 5000 with digital encoder
	Speed accuracy	: 0,2 %
	Battery life (data back-up) with option „clock“	: see section 7.1
Temperatures	Temperature range for demand preset	: 0,006 %/°C
	Temperature range for voltage divider with analog speed control value	: 0,001 %/°C
	Storage	: -20 ... +65 °C
	Operation	: 0 ... +45°C Temperature contact in power stack Switches at 65 °C
	Maximum coolant temperature	: +45 °C for units without fan : +35 °C with fan
	Cooling	: Air cooling: Convection/fan
	Air volume	: 100 ... 275 A +GO and 160 ... 275 A E 150 m³/h : 320 ... 500 A 160 m³/h : 760 ... 1100 A 660 m³/h : 1160 ... 1250 A 930 m³/h
Type current reduction	At full drive level	: Units without fan above 45 °C: 1,2 %/°C up to max. 55 °C : Units with fan above 35 °C: 1,2 %/°C up to max. 55 °C
	On installation above 1000 m mean sea level	: 1 %/100 m up to max. 2200 m
	Climatic resistance	: Humidity class F to DIN 40040
	Insulation class	: DIN VDE 0110 Group C
	Protection class	: IP 00 to DIN 40050

Inputs**Demand values**

1 differential input	:	0 ... ± 10 V, 0,5 mA or 0 ... 20 mA, 4 ... 20 mA
2 additional inputs	:	Each 0 ... ± 10 V, 1 mA
1 free analog input	:	0 ... ± 10 V, 0,2 mA

Feedback value

1 pulse encoder input for speed actual value	:	2 squarewave pulse tracks offset through 90° electrical and their complimentary signals < 70 kHz, 10 mA per puls
1 analog speed actual value input	:	DC >36 V ... <240 V at n_{\max}

Control signals

8 binary control inputs	:	DC 24 V, 4 mA $U_{\text{low}} = < \text{DC } 5 \text{ V}$ $U_{\text{high}} = > \text{DC } 12 \text{ V}$
5 interrupt inputs	:	DC 24 V, 4 mA $U_{\text{low}} = < \text{DC } 5 \text{ V}$ $U_{\text{high}} = > \text{DC } 12 \text{ V}$
8 control inputs and 2 demand inputs through field bus coupler (option)		

PC-Interface

V.24 interface (RS 232 C)	:	X10 pin	:	1 PE 2 TXD 3 RXD 4 RTS 5 CTS 7 SG
---------------------------	---	---------	---	--

Resolution of A/D converters

Current actual value	:	10 bit
Free analog input Terminal :39	:	9 bit + sign
Speed demand Terminals :34, :35, :36, :37	:	10 bit + sign
Speed actual value Terminal :11, :12	:	10 bit + sign

Resolution of D/A converter

Pulse width modulated output Terminal :44	:	7 bit + sign
--	---	--------------

Outputs

- 2 Analog outputs for test units X_{IA} , X_{IF} (± 10 V, 1 mA, directly from the hardware)
- 1 Analog output for test unit X_N , (± 10 V, 1 mA, directly from the hardware, only if analog tacho is connected)
- 1 Analog output, freely assignable, PWM (± 10 V, 1 mA, controlled in software))
- 4 Potential-free relay outputs with LED indicator (500 mA, 60 V)
- 3 Logic outputs with LED indicator for external extension with optocouplers
- 11 Status indicators }
- 32 Individual error indicators } via field bus coupler (option)
- 4 Actual values }

2.4 Commutation chokes

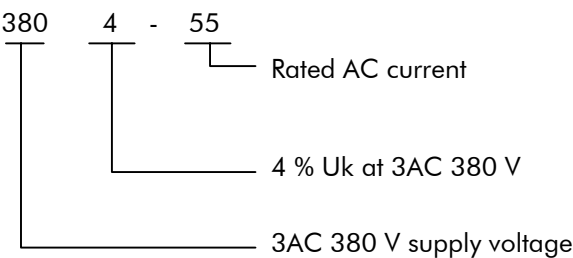
Minisemi D units are suitable for direct connection to the mains supply. Commutation chokes are to be connected in the power inputs to the Minisemi D to reduce mains feedback effects. These chokes are single-phase or 3-phase, depending on rated current. Each unit needs either three single-phase chokes or one 3-phase choke. Two single-phase commutation chokes are required for the field supply.

The commutation choke is selected generally in such a way that its rated DC is equal or only little higher than the rated motor current.

The commutation chokes specified following have an induction range, that they keep their function up to a double of their rated current. In case of overload operation it is to be noted that for thermal reasons the RMS current for a duration of 10 minutes may not exceed the rated current of the choke in any section of the load cycle.

AC chokes are suitable for a supply voltage of max. 660 V. The rating of the commutation chokes complies with DIN VDE 0160.

2.4.1 Key to types of commutation chokes



2.4.2 Single phase chokes for field supply

Type	Max. DC current	Dimensions (in mm)					Weight	Ref. No.
3804-	[A]	a	b	c	d	e	[kg]	029.
7	7	83	54	41	50	66	0,8	043 227
17	17	93	75	61	64	85	2	043 228
25	25	120	84	50	60	80	2	298 809
35	35	151	100	64	73	86	3	023 253

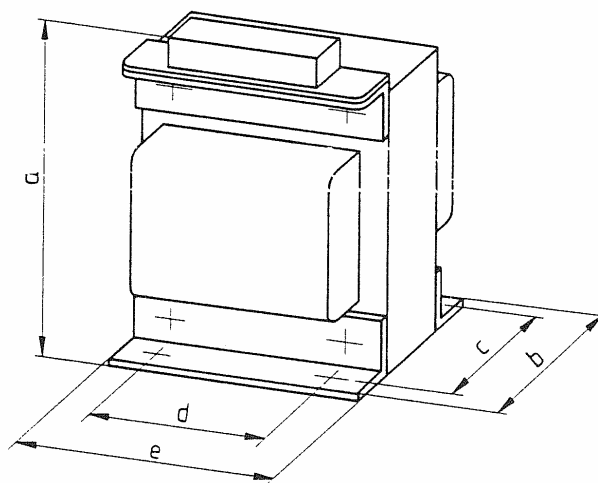


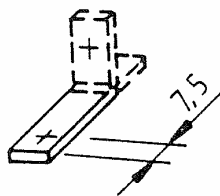
Fig. 2: Single-phase choke

2.4.3 Single phase chokes for power connection

Type	Max. DC current	Dimensions (in mm)					Weight	Ref. No.
3804-	[A]	a	b	c	d	e	[kg]	029.
25	25	120	84	50	60	80	2	298 809
35	43	151	100	64	73	86	3	023 253
55	55	158	112	91,7	75	120	4	024 730

2.4.4 3-phase chokes for power connection

Type	Frame size	Max. rated DC current	Max. power loss	Dimensions [mm]									Weight	Ref. No.
3804-	DD..	[A]	[W]	B1	B3	D1/d2	D3	H3	H4	L1	L2	L3	[kg]	029.
50	7 N	60	70	164	-	7/13	7,0	75,5	95,5	60	178	135	11	047 776
65	8 N	80	80	204	160	9,5/14	9,5	74	100	76	228	170	13	047 777
90	8 N	110	95	204	160	9,5/14	9,5	74	100	76	228	170	13	047 778
110	9 N	136	155	204	160	9,5/14	9,5	98	124	76	338	170	18	047 779
140	10 N	170	180	234	180	9,5/14	9,5	92	116	88	264	190	21	047 780
175	11 N	215	215	234	180	9,5/14	9,5	118	142	88	264	190	29	047 781
220	12 N	270	255	270	200	11,5/17,5	9,5	127	157	100	300	220	42	047 782
280	13 N	345	295	297	220	11,5/17,5	11,5	142	172	112	336	250	62	047 783
345	13 N	420	355	297	220	11,5/17,5	11,5	142	172	112	336	250	62	047 784
440	15 N	540	440	370	270	11,5/17,5	14	134	165	140	420	300	87	047 785
550	16 N	670	515	370	270	11,5/17,5	14	164	195	140	420	300	112	047 786
690	17 N	845	650	370	270	11,5/17,5	14	194	225	140	420	300	138	047 787
830	17 N	1020	685	370	270	11,5/17,5	14	194	225	140	420	300	138	047 788
900	17 N	1100	700	370	270	11,5/17,5	14	194	225	140	420	300	138	047 789



Connections for choke DD7N

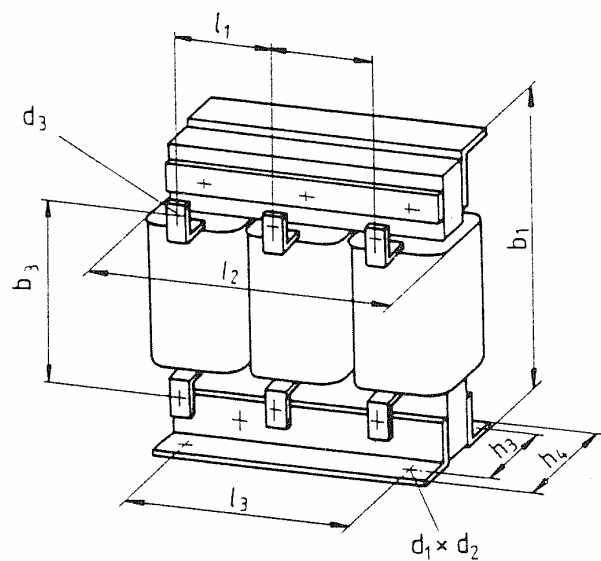


Fig. 3: 3-phase choke

2.5 Semiconductor fuses and fuse bases

Semiconductor fuses selected specifically for each type of thyristor must be used to protect the thyristors in the power stack. The thyristor power stacks of Minisemi D units may or may not already be fitted with semiconductor fuses. Additional semiconductor fuses to protect the thyristors must be fitted on the DC circuit (armature circuit) of GO units equipped with semiconductor line fuses. No semiconductor fuses are required in the DC circuit of units with built-in branch fuses.

The series fuses in the 3-phase circuit of units with built-in semiconductor branch or line fuses need not be semiconductor fuses. Either fuse isolators or fuse bases may be used to construct the semiconductor fuses externally.

Section 3.3 Fig. 18, Fig. 19 and Fig. 20 show Minisemi D units equipped with fuses.

2.5.1 Semiconductor fuses for the 3-phase power circuit

MINISEMI D E and GO	Semiconductor fuse	Ref. No. 029.	Capsule size	Quantity	Fitted
380(415)/ 40	6.621 CP URG A50	099 477	22 x 58	3	No
380(415)/ 60	6.621 CP URG A63	099 478	22 x 58	3	No
380(415)/ 100	6.621 CP URQ 100	099 482	27 x 60	3	No
or	6.621 CP URQ 125	099 483	27 x 60	3	No
380(415)/ 160	6.621 CP URQ 160	099 484	27 x 60	3	No
380(415)/ 200	6.621 CP URQ 200	099 485	27 x 60	3	No
380(415)/ 275	6.621 CP URQ 250	099 499	27 x 60	3	No
380(415)/ 320	170 M 4111/ 350 A	131 788		3	Yes
380(415)/ 420	170 M 3120/450 A	131 789		3	Yes
380(415)/ 500	170 M 3122/ 550 A	131 790		3	Yes
380(415)/ 760	170 E 8078/ 550 A	057 995		6	Yes
380(415)/ 875	170 E 7649/ 630 A	056 446		6	Yes
380(415)/ 1100 and 1250	170 L 9653/1000 A	122 766		6	Yes
500/ 40	6.621 CP URG A40	099 476	22 x 58	3	No
500/ 60	6.621 CP URG A63	099 478	22 x 58	3	No
500/ 100	6.621 CP URQ 100	099 482	27 x 60	3	No
500/ 160	6.621 CP URQ 160	099 484	27 x 60	3	No
500/ 200	6.621 CP URQ 200	099 485	27 x 60	3	No
500/ 275	6.621 CP URQ 250	099 499	27 x 60	3	No
500/ 320	170 M 4111/ 350 A	131 788		3	Yes
500/ 420	170 M 3120/450 A	131 789		3	Yes
500/ 500	170 M 3122/ 550 A	131 790		3	Yes
500/ 760	170 E 8078/550A	057 995		6	Yes
500/ 875	170 E 7649/630A	056 446		6	Yes
500/1100 and 1160	170 L 9655/800A	122 765		6	Yes

2.5.2 Semiconductor fuses for the DC power circuit

(Only required for GO units with line fuses)

MINISEMI D	Semiconductor fuse	Ref. No. 029.	Capsule size	Quantity	Fitted
380(415)/ 40+GO	6.621 CP UR D50	099 481	22 x 58	2	No
380(415)/ 60+GO	6.621 CP URG A80	099 479	22 x 58	2	No
380(415)/100+GO	6.621 CP URQ 125	099 483	27 x 60	2	No
380(415)/160+GO	660 C4 URE 200L	097 243	C4 80 mm	2	No
380(415)/200+GO	660 C4 URE 250	097 244	C4 80 mm	2	No
380(415)/275+GO	660 C4 URE 315	097 245	C4 80 mm	2	No
380(415)/320+GO	170 M 5109 / 450 A	131 792		2	Yes
380(415)/420+GO	170 M 3122 / 550 A	131 790		2	Yes
380(415)/500+GO	170 M 4117 / 700 A	131 791		2	Yes
500/ 40+GO	1.021 CP URB 80	099 486	27 x 60	2	No
500/ 60+GO	1.021 CP URB 80	099 487	27 x 60	2	No
500/100+GO	1.021 CP URB 125	099 488	27 x 60	2	No
500/160+GO	1.000 C4 URC 200	099 489	C4 80 mm	2	No
500/200+GO	1.000 C4 URC 250	099 490	C4 80 mm	2	No
500/275+GO	1.000 C4 URC 315	099 491	C4 80 mm	2	No
500/320+GO	10BDOKC3URAC72ESP/400	069 148		2	Yes
500/420+GO	10BDOKC3URAB72ESP/525	112 708		2	Yes
500/500+GO	10BDOKC3URAB73ESP/630	149 235		2	Yes

2.5.3 Semiconductor fuses for field the power circuit

MINISEMI D E and GO	Semiconductor fuse	Ref. No. 029.	Capsule size	Quantity	Fitted
40 ... 275 A	500 V / 12.5 A	154 858	6.3 x 32	2	Yes
320 A ... 1250 A	660 V / 30 A	151 908	10.3 x 38	2	Yes

The fuses are located on board -A3.

2.5.4 Fuse bases and isolators

Fuse	Base/isolator	Ref. No. 029.	Use for Minisemi
Capsule 22 x 58	2 pole fuse base ¹⁾	070 787	DC circuit
Capsule 22 x 58	3 pole fuse base ¹⁾	023 007	AC circuit
Capsule 22 x 58	3 pole isolator ¹⁾	218 955	AC or DC circuit
Capsule 22 x 58	3 pole isolator ²⁾	216 216	AC or DC circuit
Capsule 27 x 60	3 pole isolator ³⁾	101 984	AC or DC circuit
C4 80 mm	1 pole fuse base	102 494	DC circuit ⁴⁾
	Partition	102 495	
	Micro switch ⁵⁾	350 728	

¹⁾ 1 contact (two-way) for indication „fuse tripped“

²⁾ 2 contacts (two-way) for indication „isolator open“ and „fuse tripped“

³⁾ 1 contact (two-way) for indication „isolator open or fuse tripped“

⁴⁾ 2 fuse bases + 1 partition necessary

⁵⁾ 2x necessary for indication „fuse tripped“

2.6 Power loss

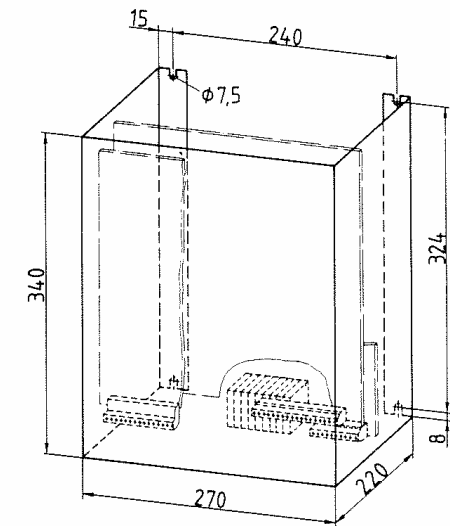
Total power loss of Minisemi D units for operation with type current:

Type current [A]	Total power loss [W]	Type current [A]	Total power loss [W]
40	220	420	1440
60	280	500	1680
100	440	760	2560
160	620	875	3050
200	740	1100	3530
275	980	1160	3840
320	1180	1250	4200

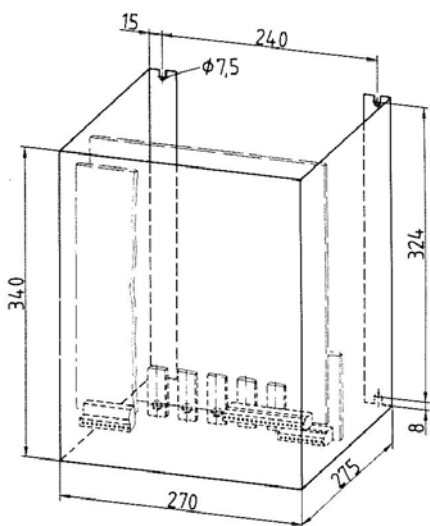
For units with type currents from 40 to 275 A the power loss of the semiconductor fuses which are to be placed outside of the Minisemi D unit is already included in the above listed total power loss.

2.7 Dimension drawings

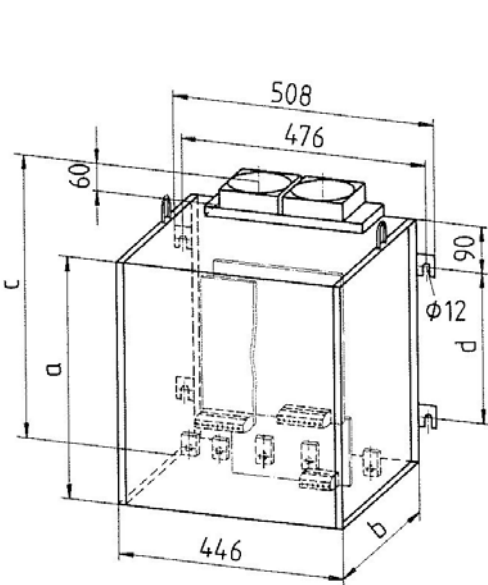
2.7.1 Unit dimensions



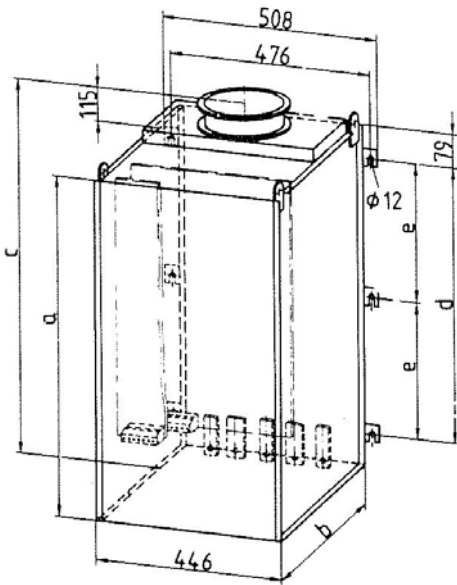
Minisemi D
380 (415) ... 500/40
380 (415) ... 500/40+GO



Minisemi D
380 (415) ... 500/60 ... 275
380 (415) ... 500/60 ... 275+GO



Minisemi D
380 (415) ... 500/320 ... 500
380 (415) ... 500/320 ... 500+GO



Minisemi D
380 (415) ... 500/760 ... 1250
380 (415) ... 500/760 ... 1250+GO

Fig. 4: Minisemi D dimensions

Minisemi D		a	b	c	d	e
380 (415) ... 500/	320 ... 500	479	410	539	300	
"	320 ... 500+GO	479	410	539	300	-
"	760 ... 1250	553	540	668	390	-
"	760 ... 1250+GO	816	540	931	660	330

2.7.2 IMRA96K layout drawing

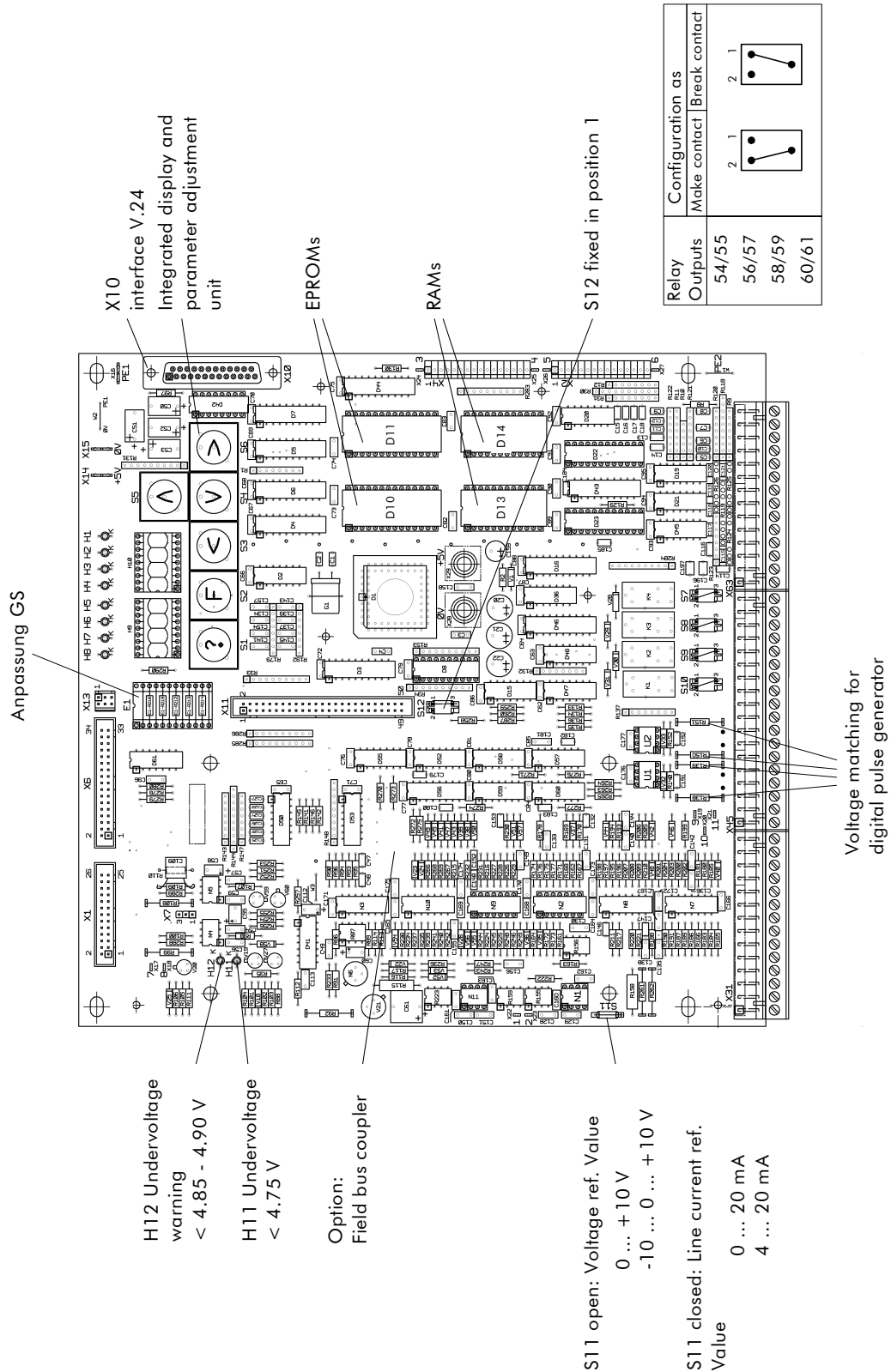


Fig. 5: IMRA96K A2

2.7.3 DC interface layout drawing

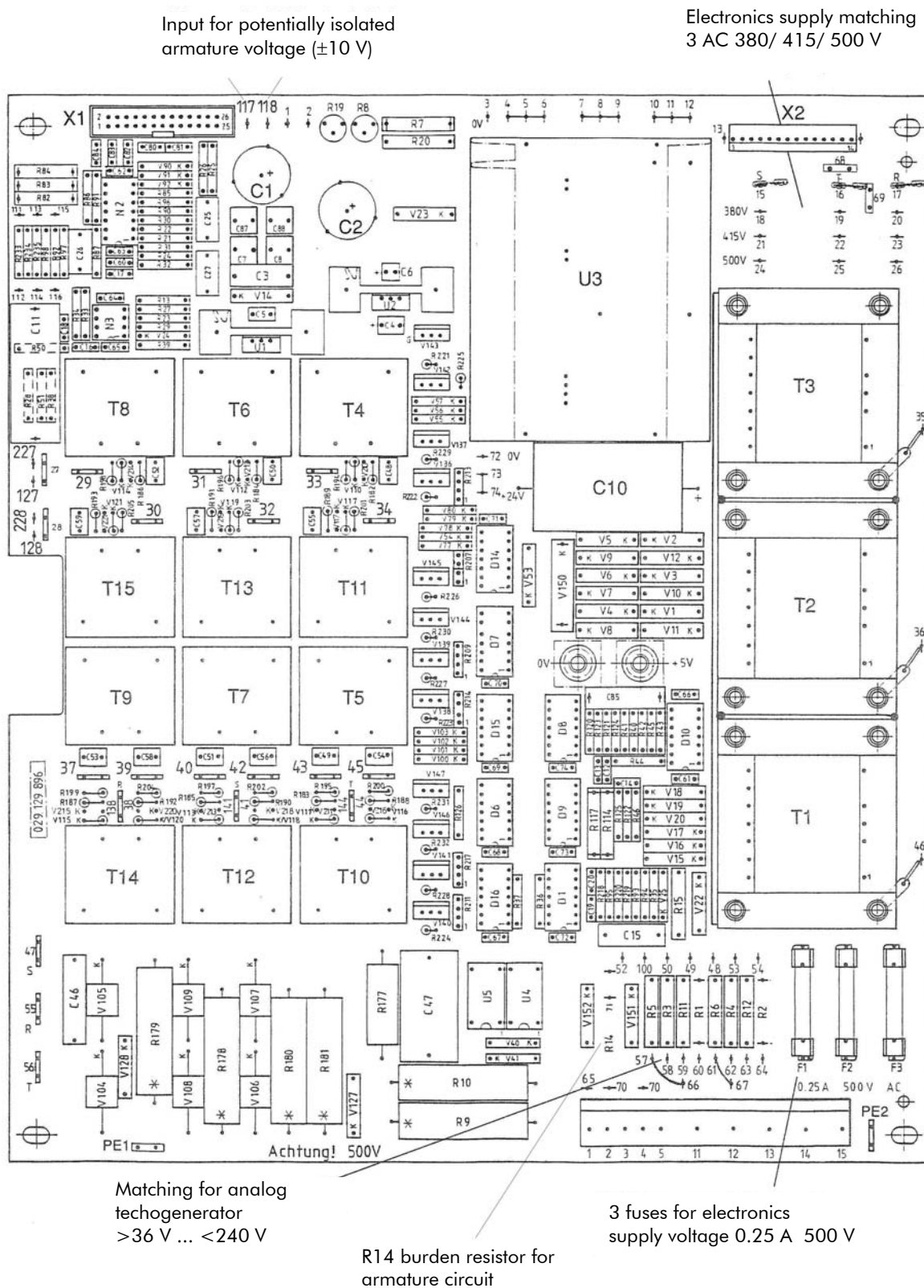


Fig. 6: GS-Interface A1

2.7.4 Layout Drawings field converters

Minisemi D units from 40 ... 275 A are equipped with a regulated 10 A field supply. This field supply consists of the basic board -A3 (Fig. 8) and the transformer board A7 (Fig. 7).

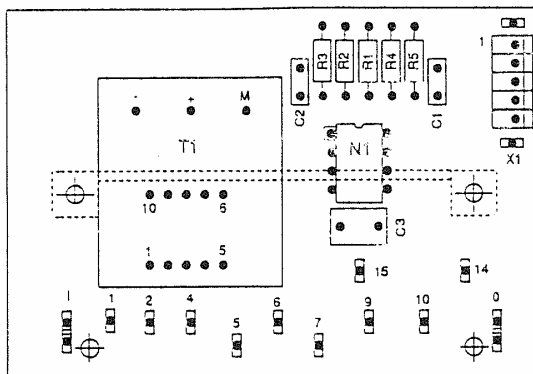


Fig. 7: Transformer board A7, Ref. No. 029.138 493

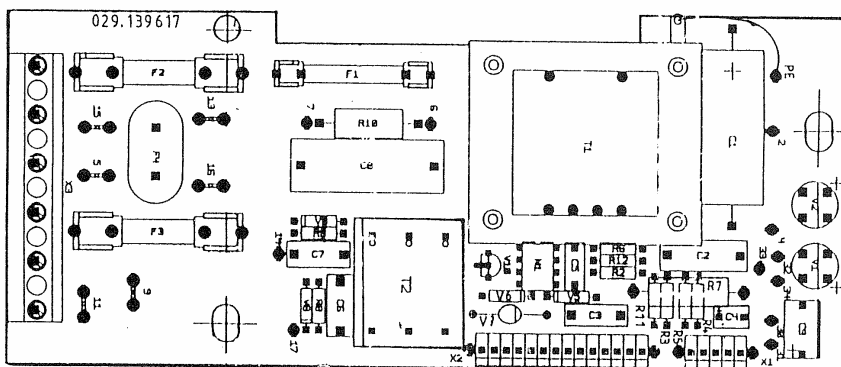


Fig. 8: Basic board A3, Ref. No. 029.139 617

Field converter for Minisemi D units from 320 ... 1250 A is the 25 A field interface A3.

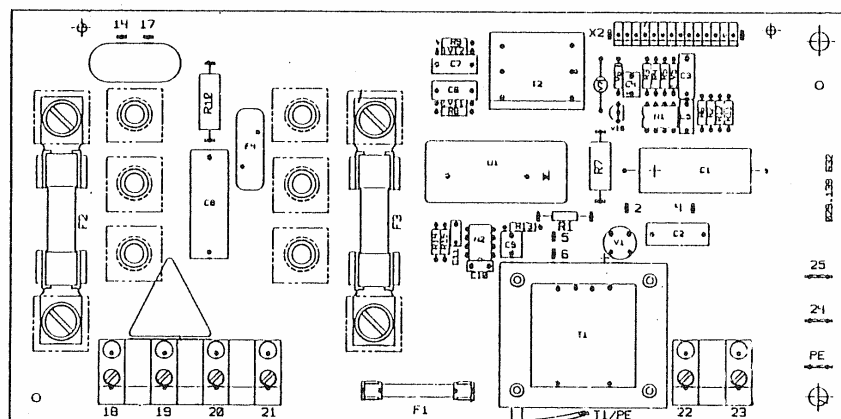


Fig. 9: Field interface 25 A A3, Ref. No. 029.139 632

2.8 Block circuit diagrams

2.8.1 Speed control

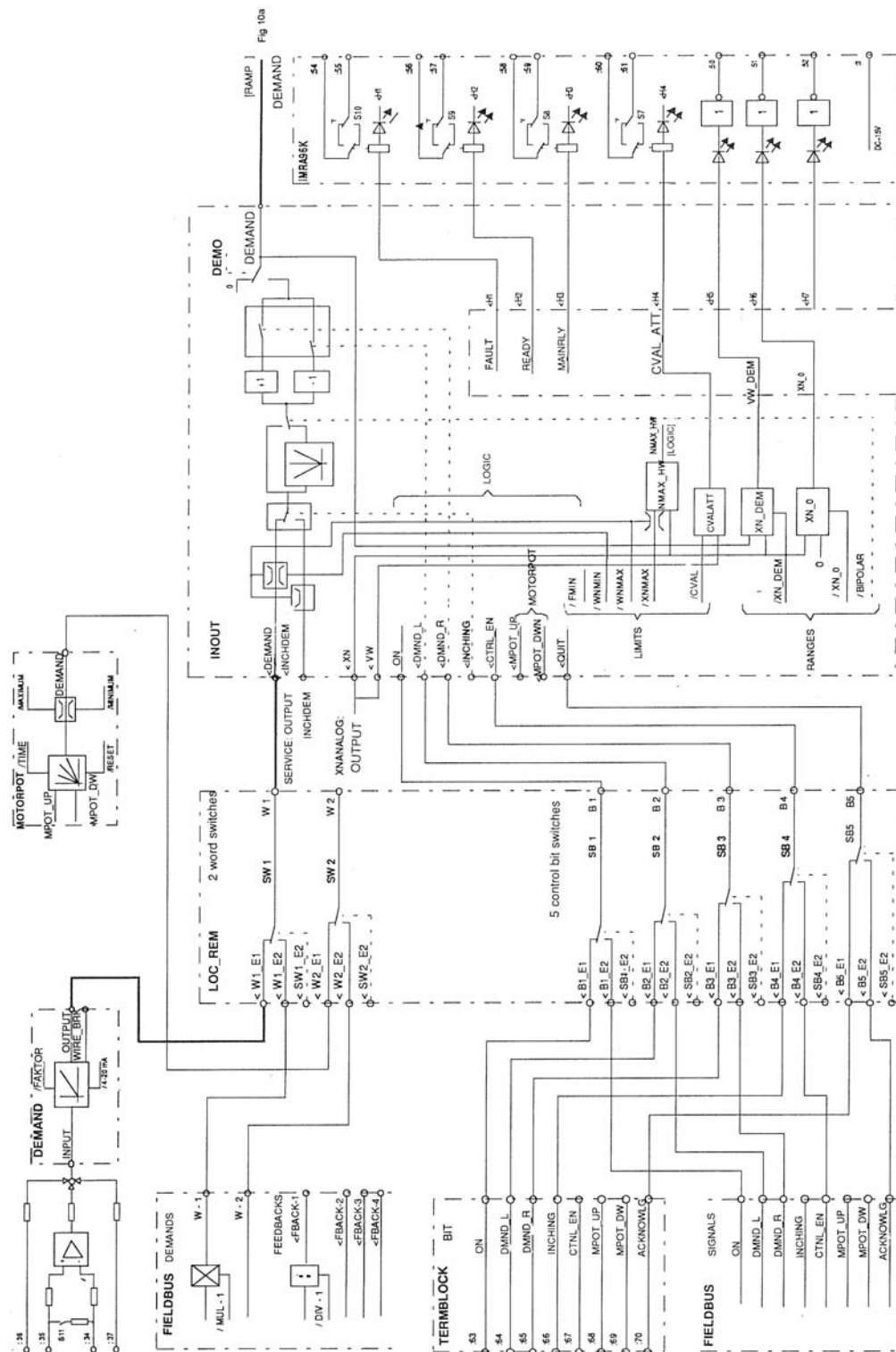


Fig. 10: Speed control, STRUCTUR ---> /CTL_TYP = SPEED_TA (TD)

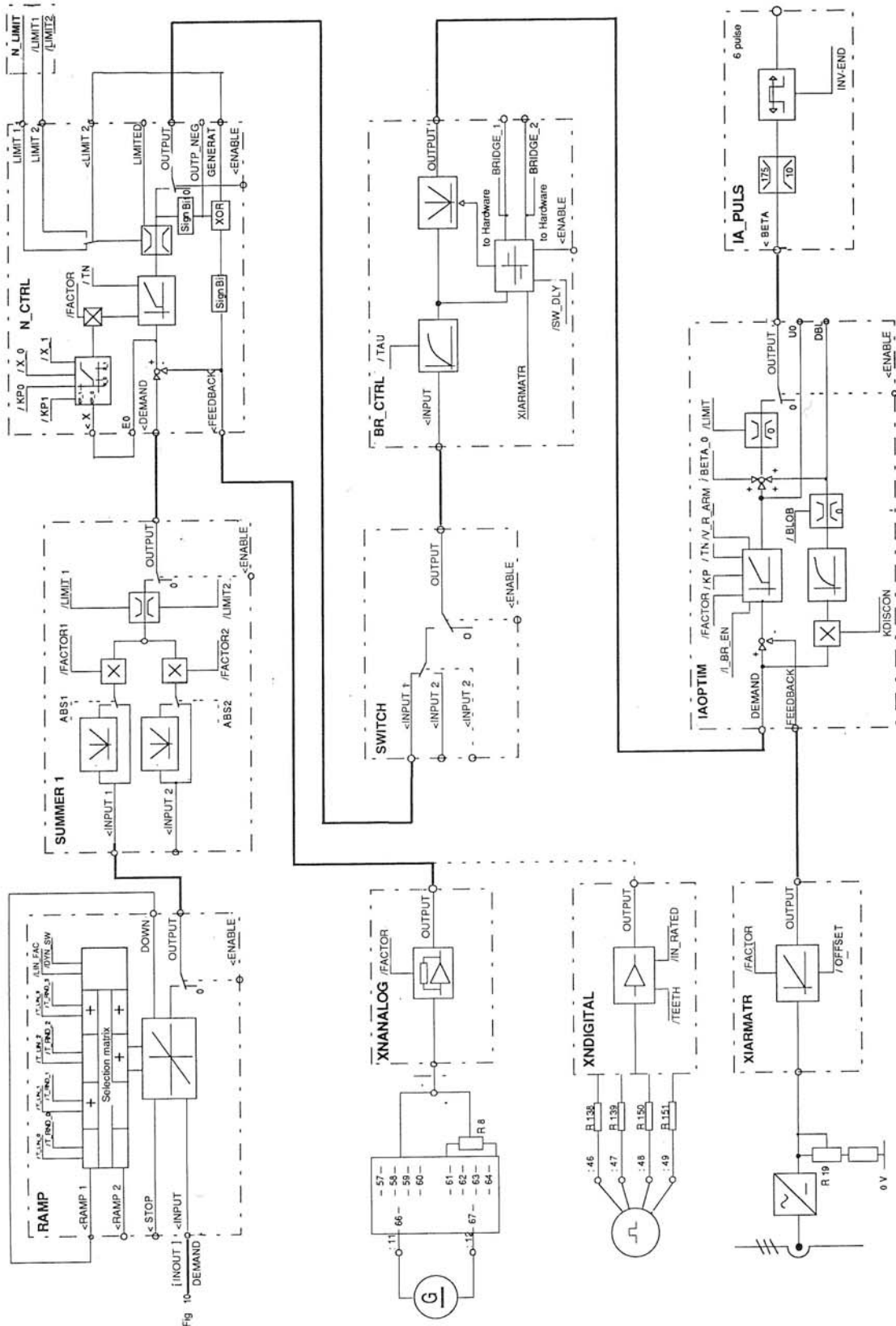


Fig. 11: Speed control, STRUCTUR ----> /CTL_TYP = SPEED_TA (TD)

2.8.2 Torque control

When switching the control structure to torque control TORQ_TA (TD) it is important to ensure that the speed actual value XNANALOG or XNDIGITAL is also connected and in operation.

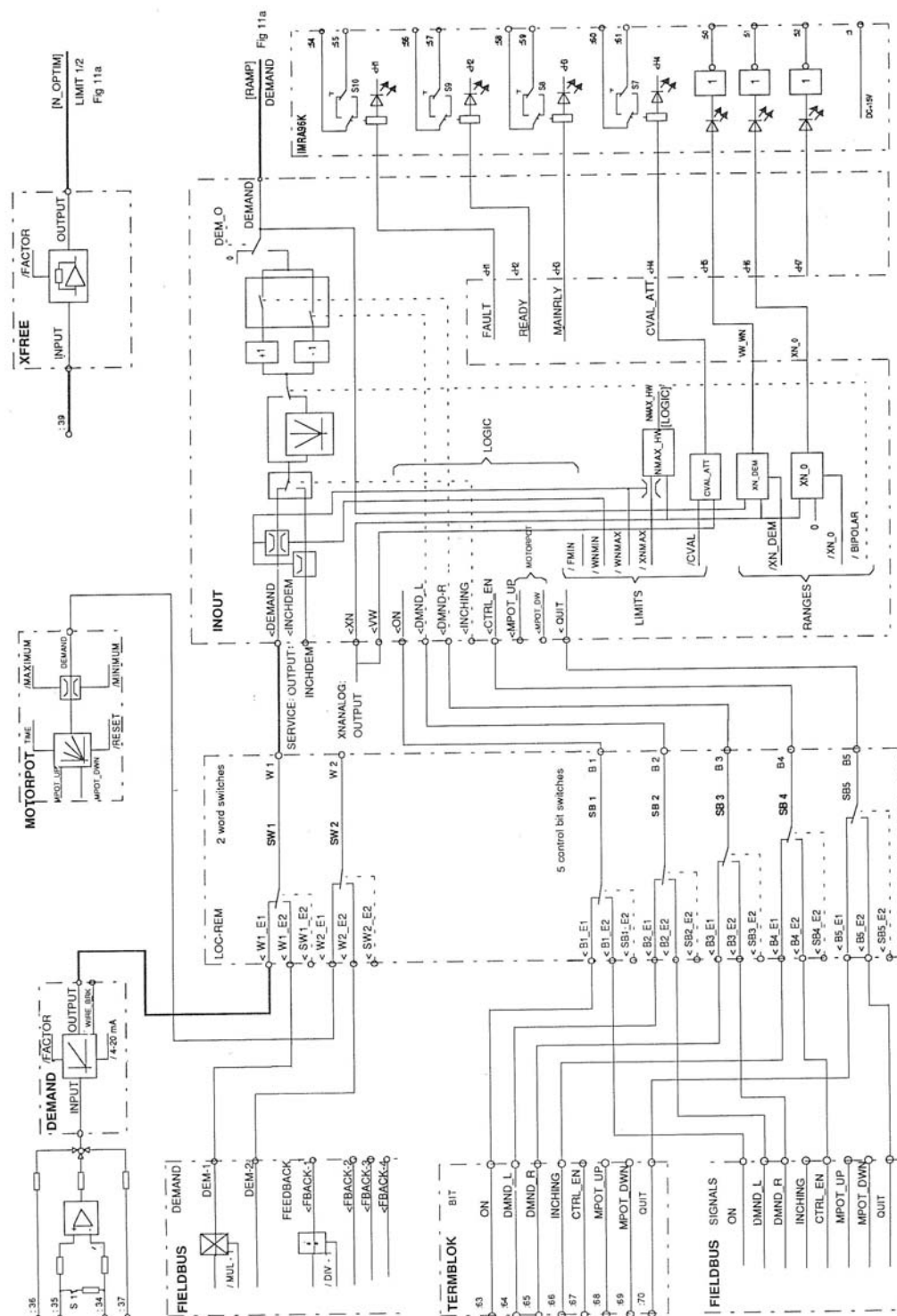
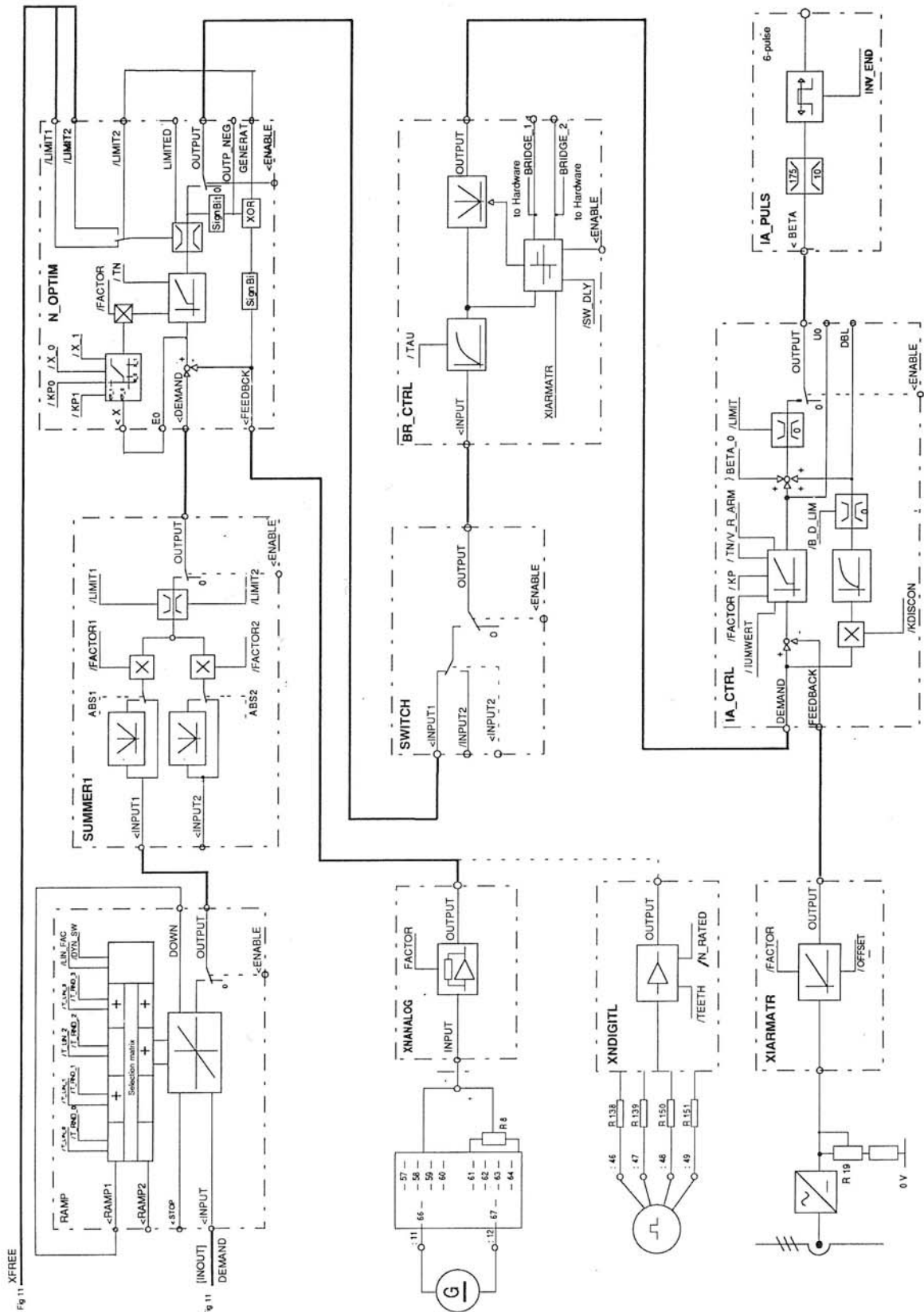


Fig. 12: STRUCTUR ---> /CTL_TYP = TORQ_TA (TD)



2.8.3 Field current

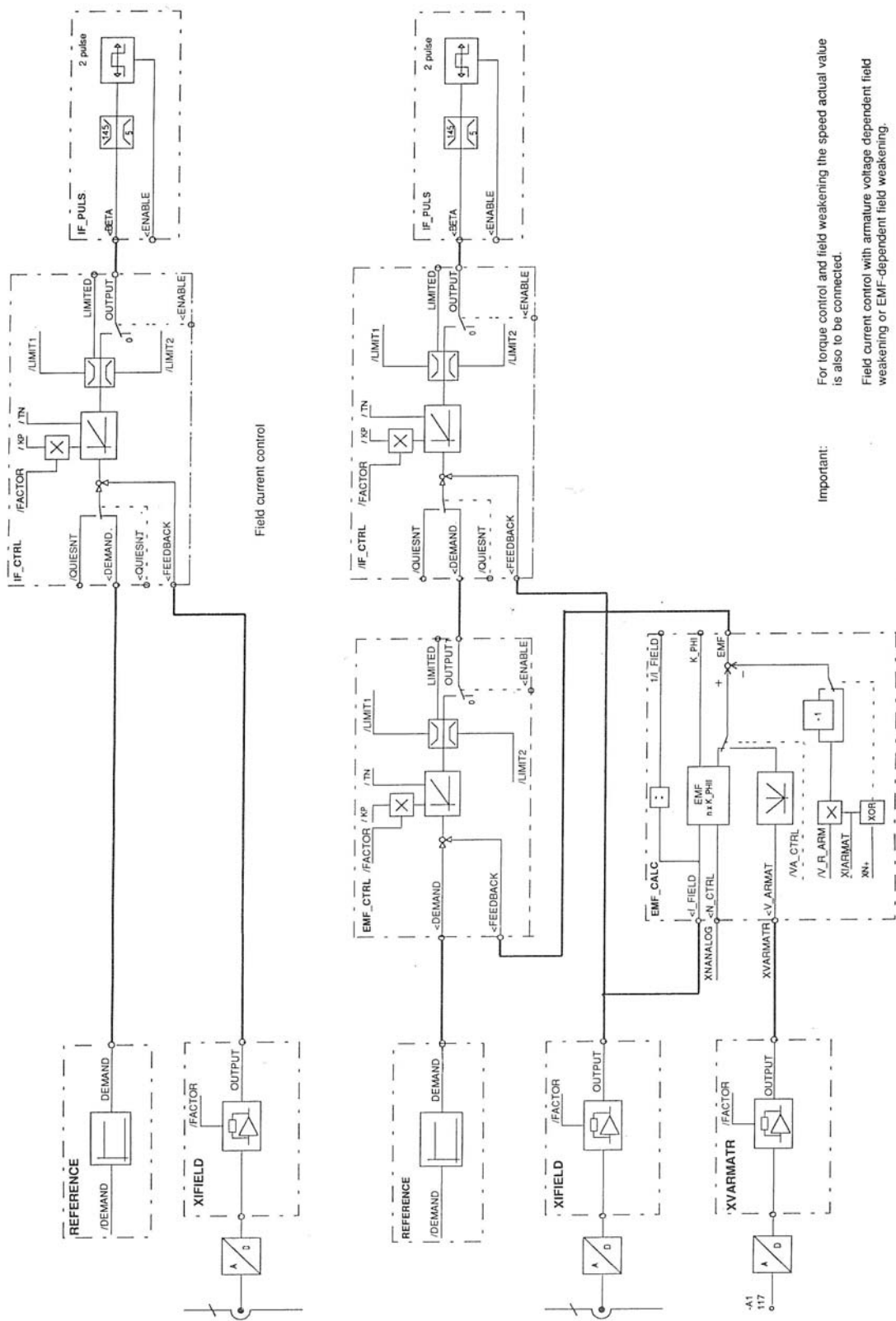


Fig. 14: Field current control

3 Transport, installation, connection and terminal wiring

3.1 Safety instructions, installation and storage

When transporting and installing any build-in or cubicle mounted unit it must be remembered that the centre of gravity may lie far away from the physical centre of the unit. The resultant asymmetrical loads occurring during transportation and installation must therefore be taken into account accordingly.

Suitable lifting equipment and trained personnel are required for handling heavy equipment. The units may only be transported in the upright position as shown. They must not be laid down or transported horizontally.

Incorrect lifting and transportation of the equipment can result in severe or even fatal physical injury and extensive material damage.

Our converters are supplied packed for the climatic conditions expected during transportation and at their destination.

All instructions given on the packaging concerning transportation, storage and handling are to be noted accordingly.

The equipment may not be stored outdoors. Stacking is expressly forbidden! It is essential that only well ventilated and dry rooms may be used for storing converters.

The units are mounted on a pallet for transportation using forklift trucks. When unpacked, the units can also be transported with the aid of the eyebolts or support tracks provided. Uniform distribution of the load is essential. Particularly when lifting using the eyebolts the force on all eyebolts must remain equal. For this, the lifting cables must always be within 30 degrees (60 degrees) of the vertical.

Heavy vibration and shocks must be avoided during transportation and when lifting and lowering the equipment.

3.1.1 Installation

After unpacking, the entire consignment must be checked carefully to ensure that the equipment is complete and undamaged. The equipment must then be installed in dry dust-free rooms. The cooling air must not contain corrosive gas. If local conditions differ, the air supply to the installation area must be filtered. If air containing dust cannot be avoided sufficient protection of the units must be provided at the air inlets to the equipment and cubicles.

The climatic conditions for the converter in the operating areas may not exceed the values of code F to DIN 40040 and a temperature of +45 °C (+35 °C with forced air cooling). Otherwise a reduction in power must be made as stated in the operating manual. Built-in units comply with protection class IP20.

Cubicle mounted units are designed for securing to the floor, build-in units are intended to be secured to vertical walls and columns. Use the bolt sizes specified in the operating manual to connect the unit to the foundations or rear walls. Under no circumstances may undersized bolts be used.

For ventilation purposes the spacing between built-in and cubicle mounted units and the ceiling or any covers or obstructions above the equipment may not be less than the minimum spacings stated in the operating manual.

Cubicle mounted units may also be wall-mounted. For easier installation and operation the units should be spaced at least 500 mm from the wall. In built-in and cubicle mounted units the air is drawn in from below and warm air is output at the top. Particularly in cubicle mounted units the air supply can be fed both from the front and through partitions, air ducts or similar. The installers must ensure an adequate supply of air. The instructions given in the operating manual must be observed.

Minisemi D units are designed for wall-mounting.

On installation, adequate ventilation is to be provided by a minimum clearance of 150 mm both above and below the unit. The volume of cooling air required depends on the built-in unit fan (see section 2.3).

The cooling air infeed is from below.

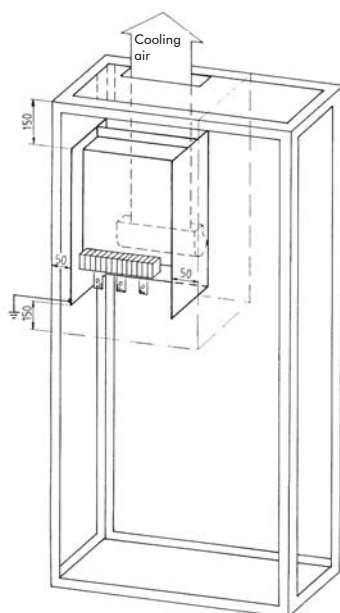


Fig. 15: Minisemi D, cubicle mounted, dimensions in mm

3.1.2 Storage

The equipment may not be stored outdoors. Stacking units one above the other is expressly prohibited. It is particularly important to ensure that only well-ventilated dry rooms are used for storing converter equipment.

3.1.3 Stopping and starting the clock with option „clock“

Stopping the clock before storage

The clock in the RAM D13 is to be switched off before the unit is put into storage. This is to ensure that clock operation does not exhaust the battery in the RAM during the storage period.

To enable the clock to be switched off, the operating voltage according to the Minisemi D rated voltage must be applied to terminals :13, :14 and :15. The power circuit need not be connected.

1. Open the extended menu (see section 4.7)
2. Set the value of the parameter /MODE to STOP and enter (cursor →)

```

SYSTEM → TEST
          STARTUP
          CLOCK → TIME
                  DATE
                  SET_UP → /MODE = STOP
  
```

3. Switch off the mains voltage.

Starting the clock after a period in storage

After ending the storage period or when commissioning a newly supplied unit, the clock can be restarted and the date and time must then be reset.

1. Open the extended menu (see section 4.7)
2. Set the date and time according to section 4.5.
3. Set the value of the parameter /MODE to RUNNING and enter (cursor →)

```

SYSTEM → TEST
          STARTUP
          CLOCK → TIME
                  DATE
                  SETUP → /MODE = RUNNING
  
```

4. Check that the clock is running.

SYSTEM → TEST
STARTUP
CLOCK → TIME → HOURS
MINUTES
SECONDS =

If the SECONDS are not incrementing (Note: During the first pass perhaps hexadecimal in the value range 00..FF), then you must set the value of the parameter /MODUS to START to reliably start the clock oscillator.

SYSTEM → TEST
STARTUP
CLCOK → TIME
DATE
SETUP → /MODE = START

After a few seconds the display will switch automatically from STARTEN to RUNNING.

Important!

The mains voltage may only be switched off again when the display shows LAEUFT. **Otherwise the battery will be discharged quickly!**

3.2 Connection notes

Please note the following when connecting the units.

All work on the units and the installation must comply with any national electrical standards and local regulations applicable. This means that the converter must be correctly **earthed** to ensure that no easily accessible part of the unit can be at mains potential or any other dangerous voltage level.

Check the rating plate on the converter and compare the rated voltage and current to the data for the supply and the motor.

The user is responsible for ensuring that the converter, the transformer and other equipment are installed and connected correctly in accordance with the accepted rules of technology in the country involved as well as any other local or regional regulations. Particular attention is thus to be paid to the sizes of cables, fuses, earthing, shutdown, isolation and overcurrent protection.

When connecting the equipment to the mains supply it is important to ensure clockwise rotation of the control electronics and power and that the phases coincide. The field supply must be connected to terminals 18 for L1 and 21 for L3.

If converters are not earthed, the casings can carry dangerous voltages which may result in death, severe physical injury and extensive material damage.

The supply and control cables are fed in from below.

In order to prevent inductive and capacitive coupling on signal leads and the unit itself and to achieve good electromagnetic compatibility (EMC) the following should be noted with respect to cable runs and screening:

- Heavy current cables and signal cables (low voltages) may not be placed together in the same duct (VDE 10042a).
- Heavy current cables (if laid in ducts at all) and signal cables must be laid in separate ducts spaced at least 10 cm apart.
- Each unit is equipped with a 0 V bus.
All incoming 0 V cables and screens are to be connected to this 0 V bus.
The screen is to be insulated at the peripheral end.
- Control signal cables may be unscreened and laid in the same duct as the screened demand and actual value cables.
- Screened cables are to be continuous from the unit to the peripheral device.
Only one separation point with an unscreened section of cable of less than 2 cm in length is permitted.
- The central earth point of the Minisemi D unit, marked with the earth symbol, is to be connected to the plant earth (PE) using a green/yellow conductor of at least 16 mm².
- Terminal 53 and the 0 V bolt between boards -A1 and -A2 must be connected to the 0 V bus (this is connected ex works).
- To prevent earth loops, terminals 32, 38 and 40 (0 V analog) may not be used.

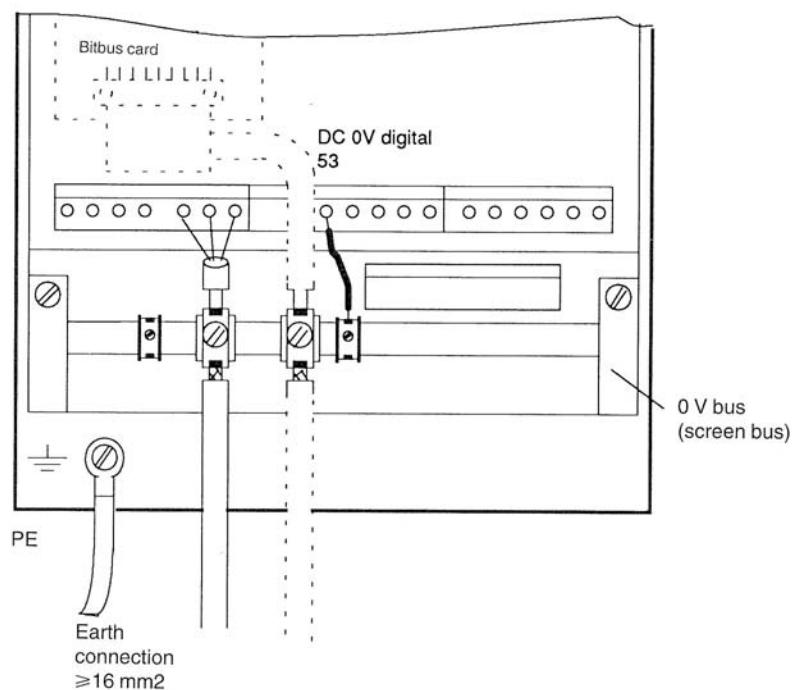
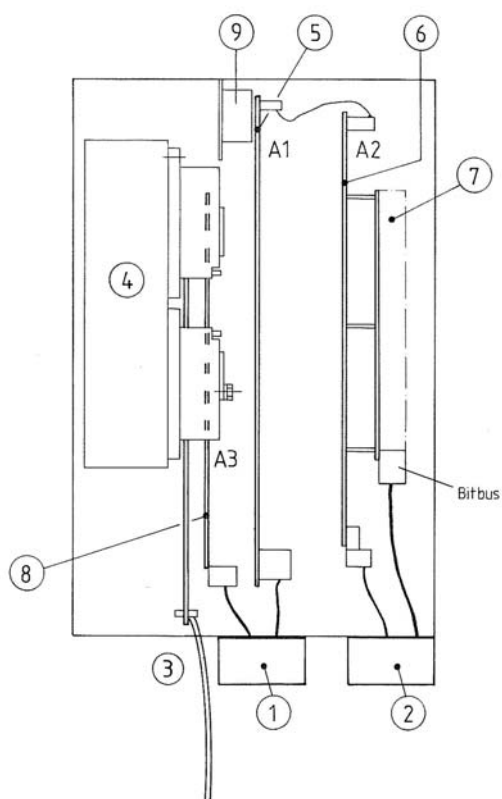


Fig. 16: Connection example, front view



- 1 Cable duct or cable bundle, electronics supply DC, AC < 60 V
- 2 Cable duct or cable bundle, screened and unscreened control cables DC < 60 V
- 3 Power cable
- 4 Power stack
- 5 Electronics board, DC interface A1
- 6 Electronics board IMRA96K A2
- 7 Field bus coupler (Option)
- 8 Electronics board field interface A3
- 9 Converter board for field matching
- 10 Bitbus

Fig. 17: Connection example, side view

3.3 Connection drawings

3.3.1 Control electronics, power only for Minisemi D 40 ... 275 A

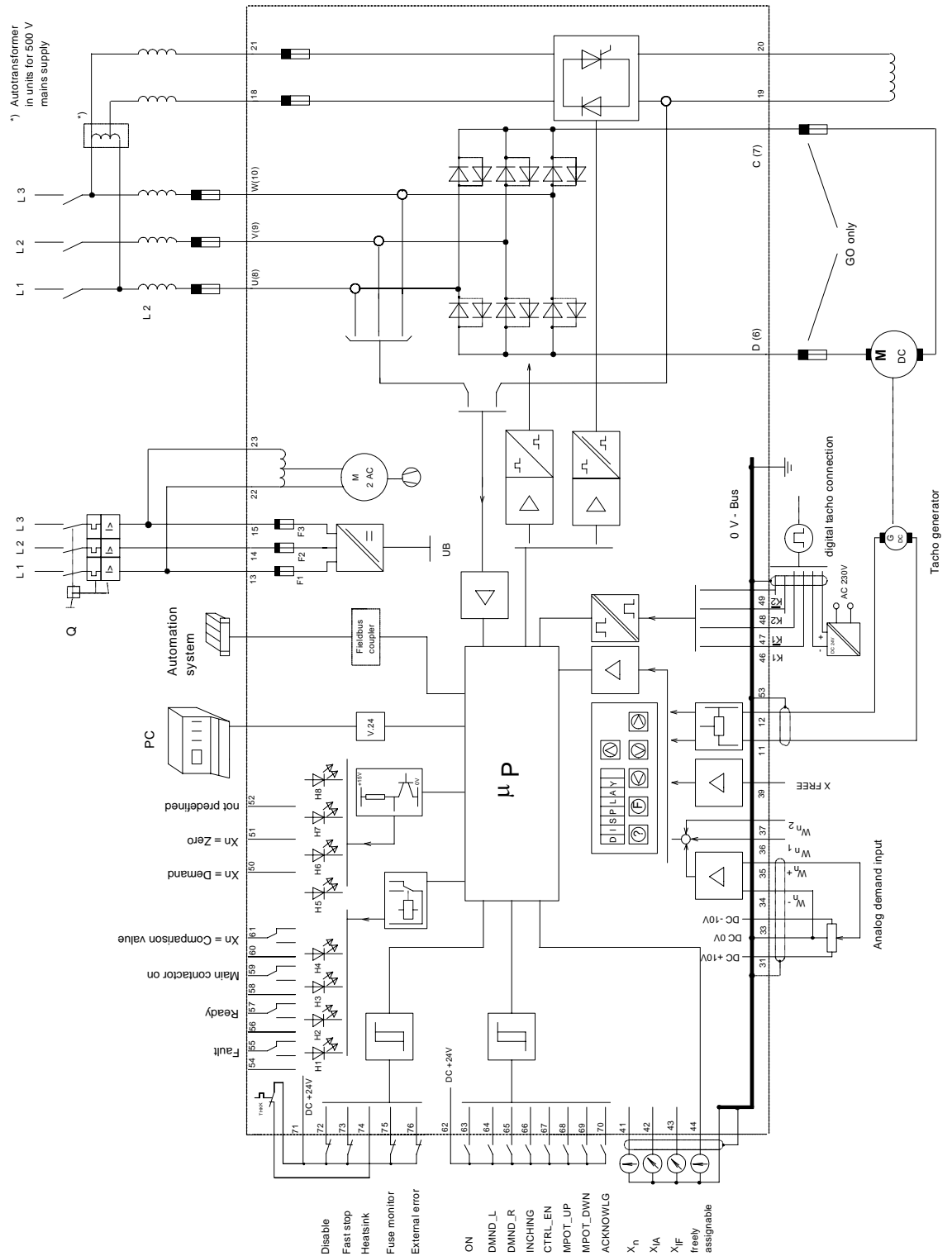


Fig. 18: Minisemi D /40 ... 275 A E and GO power and control electronics
Minisemi D /320 ...1250 A E and GO control electronics

3.3.2 Minisemi D power stacks

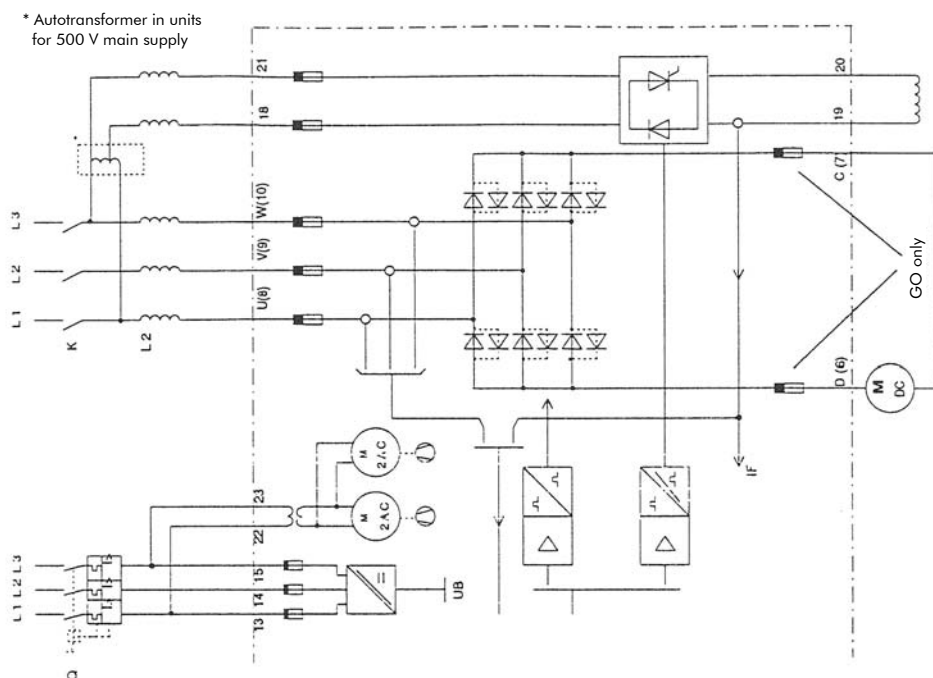


Fig. 19: Power stack Minisemi D /320 ... 500 A E and GO

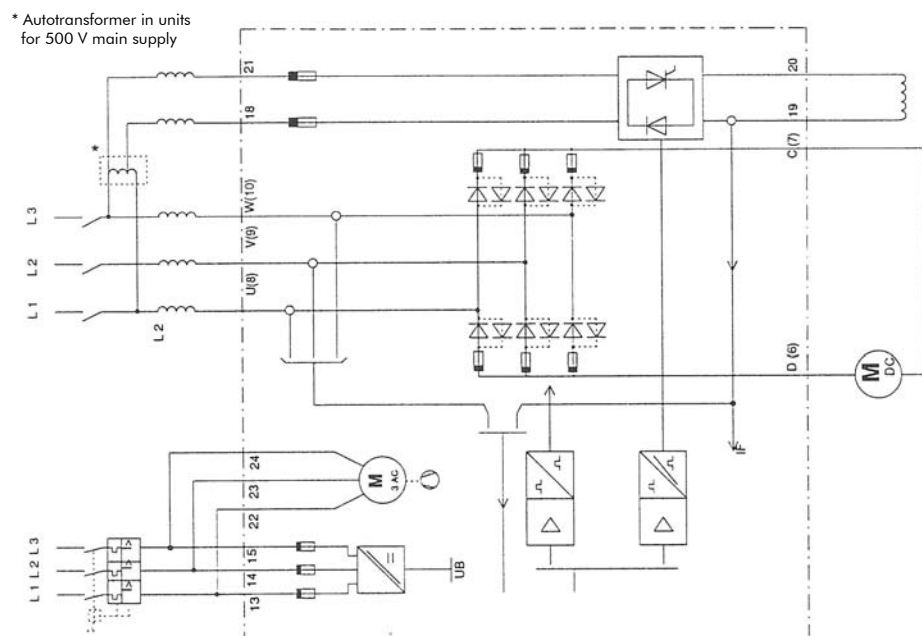


Fig. 20: Power stack Minisemi D /760 ... 1250 A E and GO

3.4 Terminal wiring

Analog demand inputs

Terminal	Function	Comments
0V	Reference potential 0 V bus	All 0 V connections are to be connected to the 0 V / screen bus (see fig. 16)
31	DC+10 V demand potentiometer	Through series resistor 1,8 k Ω at +15 V
33	DC-10 V demand potentiometer	Through series resistor 1,8 k Ω at +15 V
34	-W _n - Demand input	Negative input of differential amplifier
35	+W _n + Demand input	Positive input of differential amplifier
36	W _{n1} Additional demand 1	Input to summation point, weighted 10 k Ω
37	W _{n2} Additional demand 2	Input to summation point, weighted 10 k Ω
39	XFREE Free analog input	± 10 V, 0,2 mA, switched as torque demand input for torque control.

Analog actual value inputs

(On DC Interface board)

11	X _n tacho input	Differential input of tacho generator, variable through divider and potentiometer R8
12	X _n tacho input	
LSP 117	X _{VA} - Armature voltage actual value	Input for armature voltage 10 V after potential isolating transformer for armature voltage dependent field weakening
LSP 118	X _{VA} + Armature voltage actual value	

Analog actual value outputs

(Derived from the hardware)

41	Speed actual value *)	+10 V (max. 1 mA) $\hat{=}$ n _N or n ₂
42	Armature current actual value **)	+8,5 V (max. 1 mA) $\hat{=}$ Unit type current
43	Field current actual value display	+10 V (max.1 mA) $\hat{=}$ Unit type field current

*) Only available when using an analog tachogenerator

**) Only unipolar, with GO-types the absolute value is put out

(Derived from the microprocessor)

44	PWM output, can be assigned to the output of a module	± 10 V, 1 mA, freely variable, resolution 10 V = 7 bit plus sign
----	---	--

Digital speed actual value input

(Pulse encoder input)

46	Pulse 1 +	DC 5 ... 24 V 10 mA, set ex works to U _e = DC 24 V
47	Pulse 1 -	Inverted, DC 5 ... 24 V 10 mA
48	Pulse 2 +	DC 5 ... 24 V 10 mA
49	Pulse 2 -	Inverted, DC 5 ... 24 V 10 mA

Control signal inputs

U_{low} DC 5 V, U_{high} DC 12 V, 4.2 mA, max. DC 28 V

Terminal	Signal name in the menu	Comments
62	Source voltage *	DC 24 V for switching the control inputs
63	ON	Control command, switch drive on
64	DMND_L	Demand enable for CCW rotation
65	DMND_R	Demand enable for CW rotation
66	INCHING	Control command: Inching
67	CTRL_EN	Enable the control
68	MPOT_UP	Control command: Motor potentiometer up
69	MPOT_DWN	Control command: Motor potentiometer down
70	ACKNOWLEDG	Acknowledge error message

Interrupt inputs

71	Source voltage *	DC 24 V for switching the control inputs
72	PULS-DIS	Disable all controllers and main contactor off by de-energising relay K3, no braking
73	FASTSTOP	Immediate braking at the current limit and shutdown of main contactor at zero speed
74	HSNK-TMP	Heatsink overtemperature
75	FUSE	Semiconductor fuse monitor
76	IP76_FLT	Freely assignable interrupt input, acts as an external error

* External source voltage max. DC 28 V

Relay outputs with LED indicator, potential-free

54/55	FAULT	H1 = Yellow	Relay K1* energises if an error occurs
56/57	READY	H2 = Green	Ready, relay K2* energises if no error occurs
58/59	MAINRLY	H3 = Green	Main contactor on, relay K3* energises if all conditions are fulfilled
60/61	CVAL_ATT	H4 = Green	Speed actual value = Comparison value, relay K4* energises when the speed attains a set comparison value

* Max. contact rating 60 V, 0.5 A, 20 W

Logic outputs with LED indicators

3	Source voltage	DC +15 V regulated	
50	XN_DEM	H5 = Green	Speed actual value = demand
51	XN_0	H6 = Green	Speed actual value = zero
52		H7 = Green	Freely assignable

DC-0V digital

53		Connection to 0 V bus with cables of at least 1.5 mm ² cross section
----	--	---

3.5 Terminal description

3.5.1 Inputs

Note the following circuit diagrams when using the inputs:

3.5.1.1 Analog demand inputs

Speed demand: $+W_n$ $-W_n$
S11 open: DC ± 10 V
S11 closed: 0 ... 20 mA
Additional demand: W_{n1} W_{n2}

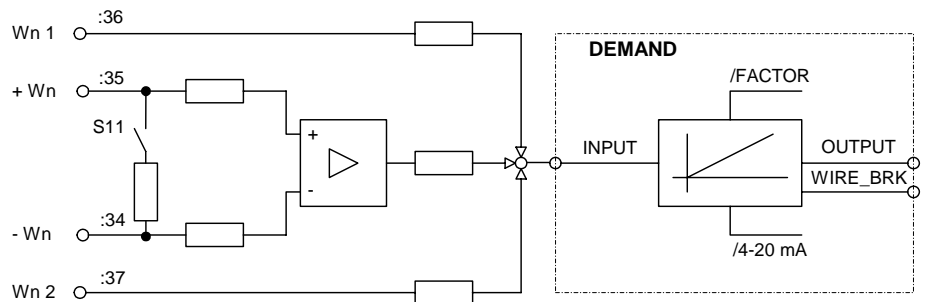


Fig. 21: Analog control value inputs

3.5.1.2 Control signal and interrupt inputs

If the signals are controlled with relays, the internal DC 24 V supply should be used (terminals :62 and :71). With an external source voltage: max. DC 28 V. The relay contacts must be capable of reliably switching a current of 4 mA.

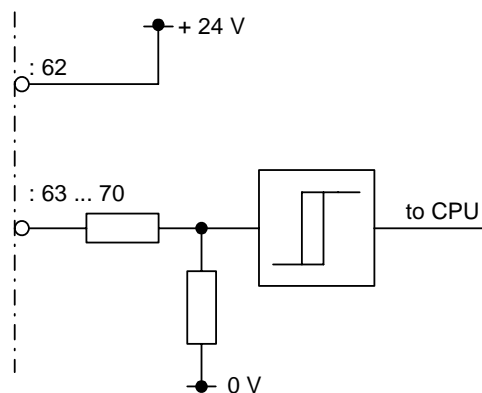


Fig. 22: Control inputs

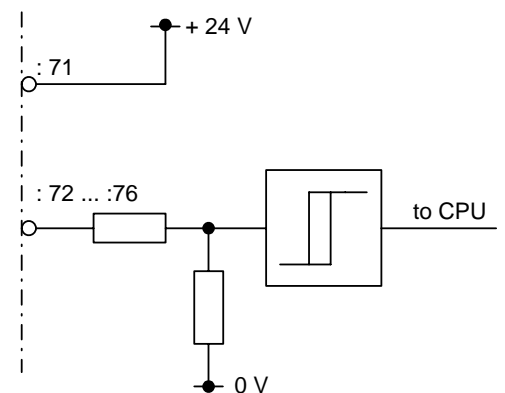


Fig. 23: Interrupt inputs

3.5.2 Outputs

3.5.2.1 Relay outputs with LED indicator

Contact switching capacity: 20 W, DC 60 V, 0.5 A
NO or NC contacts are available by reversing the hook switches, see printed circuit board A2 (Fig. 5).

Function (Signal name in the menu)	Relay	LED	Switch	Terminals
Fixed assignment				
Error (FAULT)	K1	H1 yellow	S10	:54, :55
Freely assignable, default assignment:				
Ready (READY)	K2	H2 green	S9	:56, :57
Main contactor on (MAINRLY)	K3	H3 green	S8	:58, :59
Speed = comparison value (CVAL_ATT)	K4	H4 green	S7	:60, :61

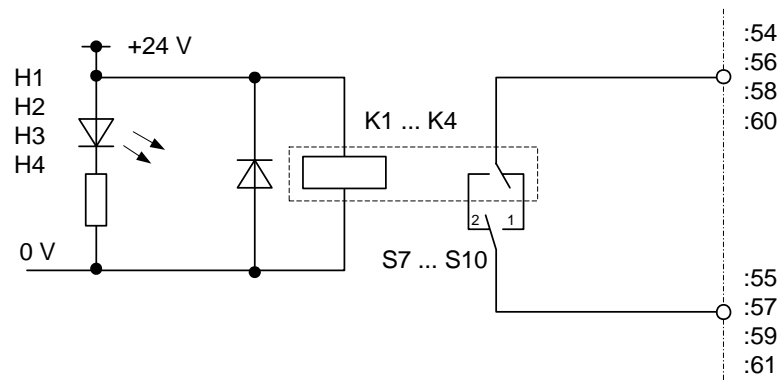


Fig. 24: Relay outputs with LED indicator

3.5.2.2 Logic outputs with LED indicator

Function (Signal name in the menu)	LED	Terminals
Freely assignable, default assignment:		
Speed actual value = demand (XN_DEM)	H5 Green	:50
Speed actual value = zero (XN_0)	H6 Green	:51
Freely assignable, without default assignment	H7 Green	:52

These outputs can be used for example by external extension with optocouplers.

Example 1

Non-inverting circuit (Optocoupler is conductive, when signal is logical one)

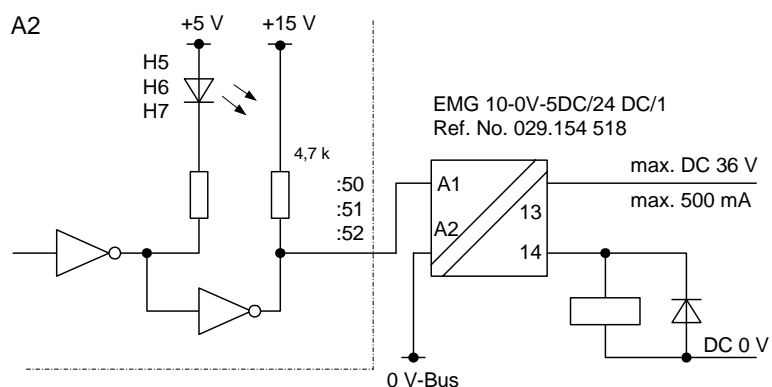


Fig. 25: External extension for logic outputs, example 1

Example 2

Inverting circuit (Optocoupler is non-conductive, when signal is logical one)

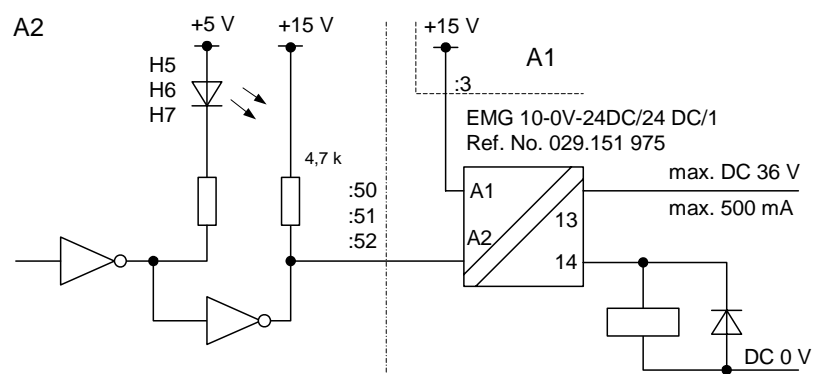


Fig. 26: External extension for logic outputs, example 2

3.5.2.3 Analog display outputs

The outputs at terminals :41, :42 and :43 are derived directly from the analog measurement values detected and are connected to terminals. Test equipment with an internal resistance of $R_i = 1 \text{ k}\Omega$ can be connected.

Output terminal :44 is an analog output from the microprocessor. It can be used for indication of an output signal from a software module.

If for example the actual value of the speed is to be indicated in the case of using a digital encoder this output is to be used. The reassignment of this output is to be made via the handling menu (see section 4.8 and 5.5.1).

Function	Signal level	Terminals
Speed actual value X_n	$\pm 10 \text{ V}$ ¹⁾	:41 – 0 V bus
Armature current actual value X_{IA} (absolute value)	$+ 10 \text{ V}$ ²⁾	:42 - "
Exciter current actual value X_{IF}	$+ 10 \text{ V}$ ³⁾	:43 - "
Available as required	$\pm 10 \text{ V}$:44 - "

¹⁾ Only present if an analog generator is connected to terminals :11 and :12

²⁾ $+ 8.5 \text{ V}$ corresponds to the type current of the unit

³⁾ $+ 10 \text{ V}$ corresponds to the type exciter current of the unit

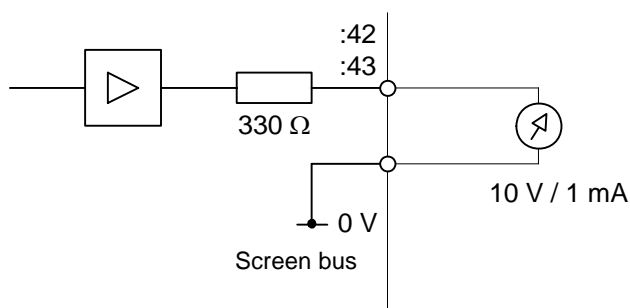


Fig. 27: Unipolar display

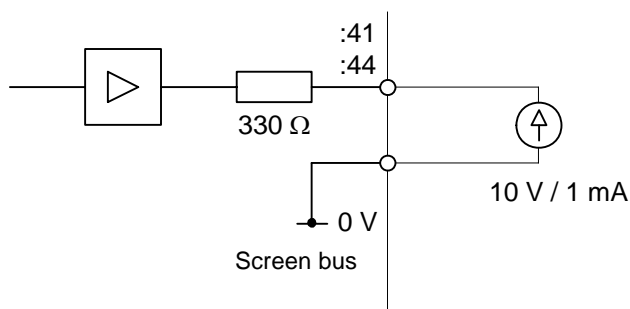
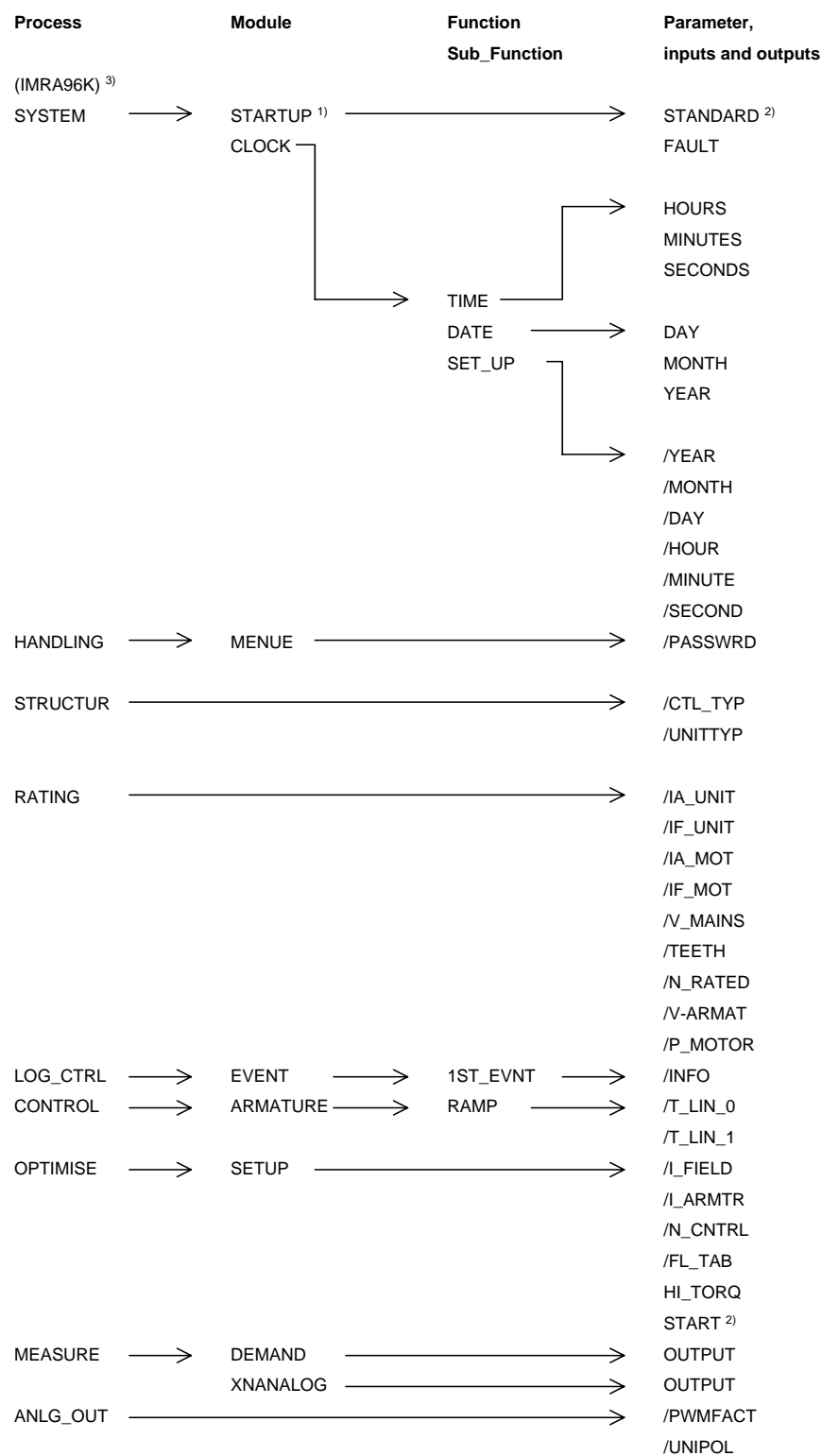


Fig. 28: Bipolar display

4 Handling

4.1 Software structure



1)

= Call hidden parameter with F, >

2)

= Execute accessible function with F, F

3)

= IMRA96K appears on first switching on or after a restart, otherwise SYSTEM.

Fig. 29: Basic menue

The scope of parameters, inputs and outputs which are accessible in the basic menu can be extended by the entry of passwords. Section 4.7 describes how to switch to the next level the "Extended menu". Further levels are for service only.

Legend of the names in the column "Parameter, inputs and outputs"

Preceded by	Meaning
No symbol	Inputs or outputs which cannot be assigned Functions
/	Variable parameters
<	Assignable inputs

The parameters can be altered during operation. If the changes are excessive, however, compensation processes must be expected which may also result in overcurrent and therefore fuse failure.

4.2 Control panel

With the control panel provided on the electronics card -A2 you can:

- Display values and signals
- Input and modify data
- Create, disconnect and adjust connections between modules and functions (vary assignable pointers)
- Execute functions and
- Check information.

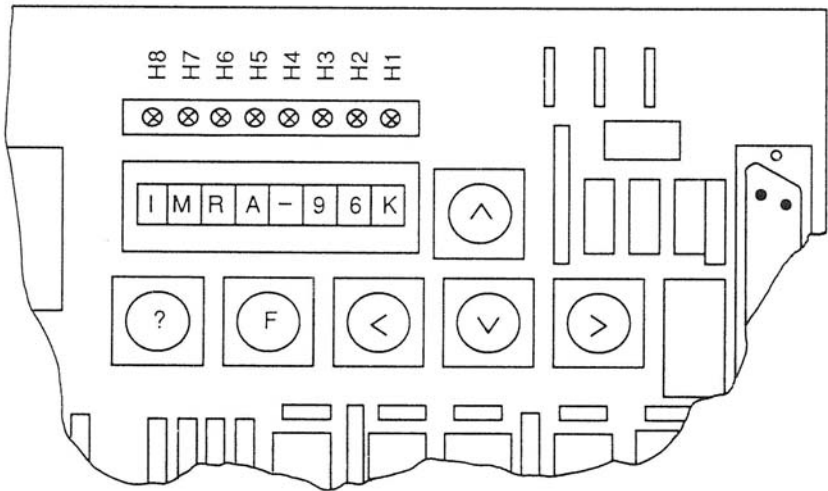


Fig. 30: Control panel, part of the IMRA96K board

The control panel consists of:

- An 8-character display
- The four direction keys
- A function key and
- An information key






The display can be considered as a window which can be moved over the handling software using the direction keys.














8 LEDs are available to indicate operating conditions:

- H1 = Error
- H2 = Ready
- H3 = Main contactor on
- H4 = Xn = CVAL
- H5 = Xn = DEM
- H6 = Xn = 0
- H7 = Available as required
- H8 = Of no importance to the user

If the displays are not of interest to the user, some of them can be re-assigned (see section 4.8, modifying connections).

4.3 Operation of the keypad

Key	Effect
	Move left to next column ("Left" key)
	Move right to next column ("Right" key)
	Move up one line, increase a value by one digit or adjust a bit parameter ("Up" key)
	Move down one line, reduce a value by one digit or adjust a parameter ("Down" key)
	Display the type of data word, eg. for a word input

Press keys consecutively	Effect
 	Display hidden functions
 	Cancel parameter changes or reassignments
 	Select outputs, reconnect inputs or set to zero
 	Execute a function
	Display the type of data word, eg. for a word input
Press keys simultaneously	Effect
   	Execute a STARTUP

4.4 Parameter adjustment

Unit parameters can only be adjusted either via the control panel or via PC. When using a PC you need the PC handling software and the adaptor cable to connect the PC with the unit.

4.4.1 Move the display position

The position of the display on the menu can be moved according to the structure shown in section 4.1 with the aid of the 4 direction keys. The "left" or "right" key executes a movement along the connection lines to the next column in the direction selected. With the "up" or "down" key the display is moved up or down along a column which is part of a "heading".

4.4.2 Check, adjust and save parameters

We differentiate between three different types of parameters:

- A word parameter is: Generally a multiple digit decimal number, which may also have a polarity
- A bit parameter is: A parameter which has the status "YES" or "NO"
- A list parameter is: A parameter which the user can select from a given fixed number of parameters.

The individual parameters can be adjusted and saved as follows: First move the name of the parameter onto the display using the direction keys. The relevant value is then displayed when you press the "right" key.

- **Word parameter**

With a word parameter the figures appear on the display. The cursor is initially positioned at the fourth digit from the right of the display. If it does not have a number, it will have the flashing symbol "**".

The number of the parameter can be selected using the "left" and "right" keys. The number can be increased or decreased using the "up" and "down" keys.

If the value for the digit goes beyond the permitted range it is carried forward to the next higher or lower digit respectively.

To save the parameter in the system the cursor must be moved beyond the lowest value digit to the right using the "right" key. Saving is indicated by the message "OK!" appearing briefly on the display. If the cursor is moved completely to the left, the value of the parameter is retained.

- **Bit parameter**

With a bit parameter the cursor is located on the first character of the bit word "YES" or "NO". Pressing the "up" or "down" key changes between "YES" and "NO". The parameter is saved by moving the cursor beyond the right-hand character. Saving is confirmed by the message "OK!" appearing briefly on the display.

- **List parameter**

The list parameter allows you to select from several unit-specific values.

As with the bit parameter, the cursor appears on the first character from the left. Pressing the "up" or "down" key displays each of the parameter values from the beginning to the end of the list. The value selected is then saved by using the "right" key. The program responds with "OK!" and the value saved is displayed.

- **Cancelling any entries**

An unwanted entry can be cancelled by pressing the keys "F" and "left" consecutively (pressing them one after the other).

This is only possible before you exit from the input field. As soon as you exit from the input field the old value stored is lost. If you now try to cancel the last entry the error message "VALUE?" appears.

4.5 Setting the date and time with option "clock"

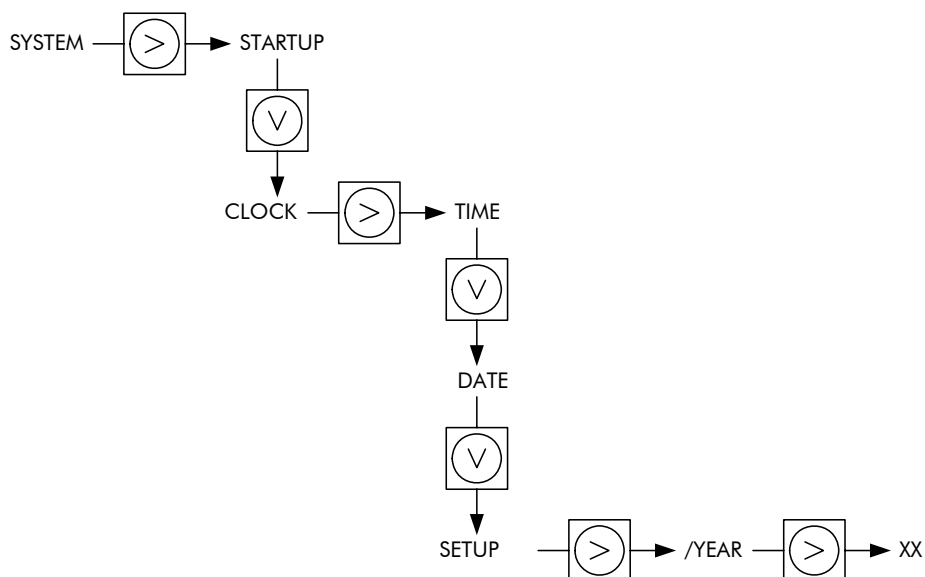
The option "clock" allows errors and events written in the event log to be timed. Starting the clock, see section 3.1.3.

Setting the date and time is only possible on the extended menu level. See section 4.7 for switching to the extended menu level.

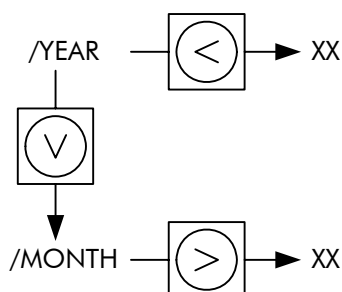
Preparations:

max. 5 x  ==> SYSTEM

Execution:



Set the word parameter "/YEAR" to the number of the year (eg. 91 for 1991) and then press the "right" key. Then enter the value of the parameter "/MONTH".



Proceed accordingly to enter the day, hour, minute and second. Follow the path through the menu using the software structure of the basic menu or the chart on the rear cover.

4.6 Load defaults and execute restart

The latest parameters are taken from the RAM when the program is run. The unit has a basic structure and standard parameters. The relevant values are stored in EPROM. If the DEFAULTS function is executed, all the parameter values are copied from the EPROM into the RAM.

IMPORTANT!

All modifications made in the past are lost when the DEFAULTS function is executed.

When the default values are loaded, error messages may appear which are to be acknowledged after the restart is completed.

As DEFAULTS is a hidden function, the keys "F" and ">" must be pressed consecutively to display this. Execute the DEFAULTS function as follows:

SYSTEM → STARTUP "F" ">" DEFAULTS "F" "F"

This function is executed by pressing the "F" key twice. The message "LOADED" appears for approx. 1 second and then DEFAULTS reappears.

- The default values are loaded

A restart **must** then be executed by pressing the four cursor keys simultaneously. The display flashes "RESTART", the LEDs H1 to H8 go out and after approx. 3 seconds "IMRA-96K" appears on the display. If the "write protect" jumper is set to "P", the display initially shows "PROTECT?". Loading the default values and executing the restart was not successful. The old values have been retained. Pressing the "left" key displays the starting point of the basic menu "SYSTEM".

4.7 Switching to the extended menu

A password must be entered for switching to the next menu level (the extended menu). The password consists independently, whether the unit operates with option "clock" or not, of the numbers or letters for the day and date appearing on the display.

These data appear under:

SYSTEM → STARTUP
CLOCK → TIME
DATE → DAY → XX
MONTH → YY

They are to be entered in the order XYYX under /PASSWRD as shown in the following example. In the case of units with option "clock" the password results from the current date. In the case of units without "clock" it is possible to set an individual fixed password.

(Starting the clock, see section 3.1.3; Setting the date and time with option "clock", see section 4.5).

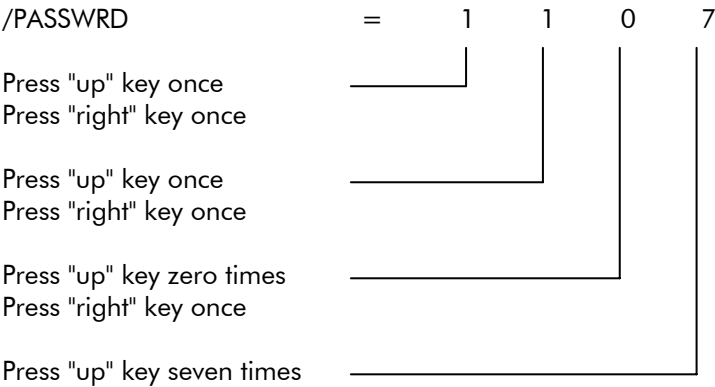
The entering of the password has to be mode under:

SYSTEM
HANDLING → MENUE → /PASSWRD = 0000

If a value other than 0000 is displayed, the parameter /PASSWRD is to be set to 0000 using the "down" key (on all 4 digits) and saved by using the "right" key.

Example:
/PASSWRD has been set to "0000" as described above and the displayed date is 11.07. (DAY = 11, MONTH = 07).

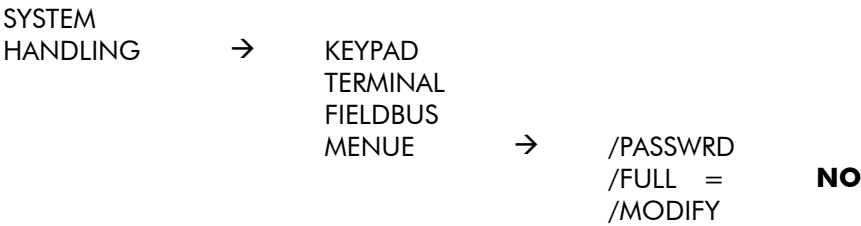
Password input:



The value is saved and checked by the unit when the "right" key is pressed. If the entry is correct, "OK!" appears on the display, followed by the word "SYSTEM". If an incorrect value is entered, the program responds with "PASSWORD".

4.7.1 Closing the menu levels

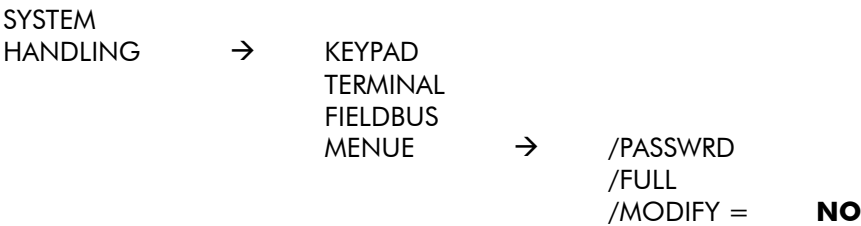
The bit parameter /FULL is to be switched from YES to NO in the HANDLING process.



When the "right" key is pressed, the program responds with "OK!" and generally switches back to the "basic menu".

4.7.2 Disable changes

Set the bit parameter /MODIFY from YES to NO in the HANDLING process.



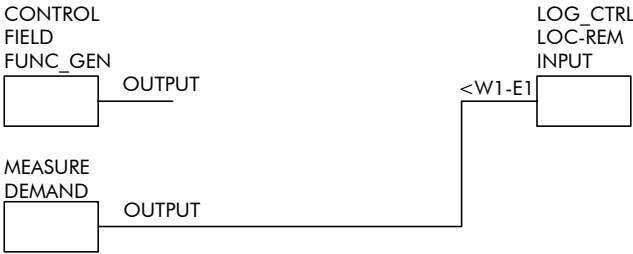
4.8 Reassignment of inputs and outputs

Reassignment (the creation of a new connection) is explained below using the example of the function generator.

Connections between function modules can be modified on the "extended menu". All inputs which are marked with a "<" symbol are suitable for this. Only the same types of inputs and outputs can be connected together. One output can be connected to several inputs. This means that the output is always to be selected first and then connected to the input. If only an input is put on the display and the keys "F" "UP" are pressed consecutively without first selecting an output, the relevant input is switched to zero. This therefore breaks its existing connection. Modification of connections is comparable to rewiring in analog technology.

The function generator should form the speed reference value.

In the initial condition the input <W1-E1 of LOC-REM in the INOUT module is connected to the output of the DEMAND in the MEASURE module.



The input <W1-E1 of LOC-REM is now to be connected to the output of the function generator.

Step 1

The output of the module to be connected (in this case "OUTPUT" of FUNC_GEN) must be located on the menue, i.e. brought onto the display.

CONTROL ---> FIELD ---> FUNC_GEN ---> OUTPUT

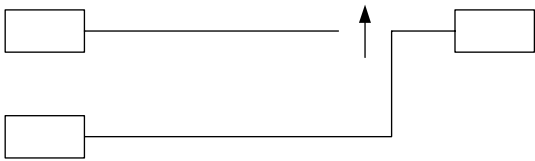
This output is selected using the keys "F" and "UP" and is confirmed with "OK!".



Step 2

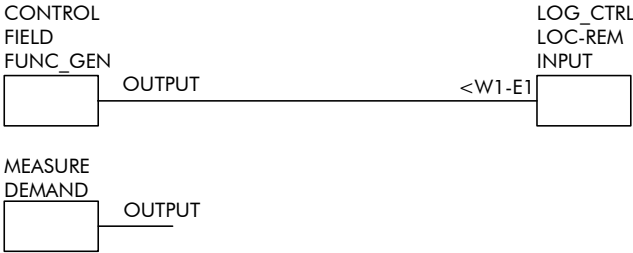
Now the input <W1-E1 required for the connection must be located on the menue and brought onto the display.

LOG_CTRL ---> LOC-REM --> INPUT ---> <W1-E1



Step 3

The old connection is broken and the new one made by pressing the keys "F", "UP" and confirmed with "OK!".



This completes the switching of the demand to the function generator.

4.9 General system messages

In the following section are shown the messages which can appear during the self-test after the supply voltage is switched on, during normal operation and during or after data transfer by using a PC. The messages can be conditions or disturbances given by the handling of Minisemi.

The following messages can appear in case of a fault generated by the self-test.

CPU_FAIL	A fault is appeared with the microprocessor
RAM_FAIL	The data transfer with the RAM is faulty
ROM_FAIL	The ROMs are faulty.
SYSBOOT!	The system-data in the RAMs are faulty, the system calls for a system boot. The default values must be loaded. See section 4.6.

Messages, which can appear after the self-test.

BATTERY	Only when RAMs with a battery are used. Warning! The voltage of the battery is too low. The RAM must be changed. (See section 7.1)
RAM_FAIL	The Rams are faulty, presumably.
KEYPAD	In the keypad on the IMRA-board is a fault, or a key is pressed continuously.
DEFAULTS	The unit demands to load the defaults values and to finish the process with a restart.

Messages during the operation or when handling the unit by the keypad or a PC.

ON	The signal ON is on YES. The system calls for switching off.
REPLACED	It is selected a new output.
FORMAT?	With the reassignment different sizes becomes together; for example a word-output with a bit-input.
DISABLE	The lock for changing parameter is active!
NOT EXEC	The typed value is no executable-function
RUNNING	The drive is running, the speed is not zero!
MAXIMUM	The maximum-value of the parameter has been exceeded.
MINIMUM	The minimal-value of the parameter has been underpassed
NO!	An illegal command was typing in
RESTART	The system enforces a reboot The system parameters are not changed, only the initialization takes place.
NULL	The pointer is on zero
OK!	The dialed function was executed successfully!
PARAM?	The parameter was not found
PASSWORD	The entered password is wrong, the access is denied
LOADED	The default values are loaded.
INVALID	The entered value is an invalid parameter
PWR-FAIL	The 5 V-voltage supply is too low
WARNING	General warning

WAIT...	The unit waits to complete the command
OLD VAL?	It is no value stored
X X X...	The data transmission to the PC is blocked (The PC sends the X-OFF – signal)
POINTERS?	It is no pointer defined!

Messages which appears during or after the data transmission, respectively which can appear in case of a fault.

(Handling the unit with the PC)

ABORTED	The transmission was broken off.
READY....	The unit is ready for the data transmission.
COM ERR!	The data transmission is faulty
LOADS..	The data transmission from the PC into the Minisemi takes place.
CHECK -	The data transmission is checked.
SEND..	The data transmission from the Minisemi into the PC takes place.

5 Commissioning

5.1 Safety instructions

During operation of the equipment described here dangerous electrical voltages in excess of 1000 V can occur which can cause death, severe physical injury and extensive material damage. Extreme caution is thus essential when working on the equipment and the following must be noted:

- Only qualified maintenance and commissioning personnel are permitted to check or repair units or their parts.en
- During normal operation all covers must remain fitted and the doors of the cubicle must be kept closed.
- Before touching any electrical contacts ensure that the voltage between two thyristor anode connections is less than 50 V. Failure to do so may result in severe or fatal injury.
- Do not use any test equipment unless you know it is in perfect operating condition. Failure to do so may result in severe or fatal injury.
- Stand on an insulated mat (complying with EGB) and ensure it is not earthed when you carry out commissioning work with the unit switched on.
- The main switch of the system or the main circuit breaker must be padlocked in the OFF position if you are working on the machine or its supply cables.
- VBG 4 regulations must be observed when carrying out setting up or adjustment work with the unit or cubicle doors open during operation.
- In the event of a fault the Minisemi unit should be isolated from the mains supply by a safety circuit which de-energises the main contactor. However, this cannot guarantee that the machine will be brought to an immediate standstill and that no residual voltages are present at the output terminals or in the unit.
After opening the unit or the cubicle door therefore always measure the residual voltage on all parts which may be "live".
- Following the correct commissioning procedure according to this manual will help prevent damage. If you require further information please contact the manufacturer.

- Incorrect parameter settings and type data can cause damage to the unit and the entire drive system. Always set parameters with great care. Please note Section 4 accordingly.
- Only ever remove cards and plug connections when the unit is isolated from the mains supply. This is the only way to avoid damaging entire assemblies and the risk of personal injury.
- Avoid touching electronic components if at all possible. If unavoidable, first discharge any static electricity which may be present in your body. To do this, touch an electrically conducting, earthed part of the unit (e.g. the zero bus or the chassis connection which is marked for identification purposes).
- When an oscilloscope is used, it must be powered through an isolating transformer to ensure potential separation and to prevent earth loops. Connect the casing of the oscilloscope directly to the reference potential of the Minisemi D (the 0 V bus).
- When using a PC or printer connected to the V24 interface you must provide potential compensation or discharge the static electricity through the earthed plug casing before you touch any of the contacts.
- Test equipment such as oscilloscope probes, sensors, terminals etc. may only be applied to electronic components after potential compensation and when the unit is isolated from the mains supply.

5.2 Commissioning procedure

Commissioning should be proceeded after the commissioning sequence diagram (Fig. 31). The diagram leads the commissioner through a basic commissioning, which must be accomplished with each unit independently of the respective application. Following basic commissioning the settings for field weakening operation – if required – and user orientated structures and settings are to be made.

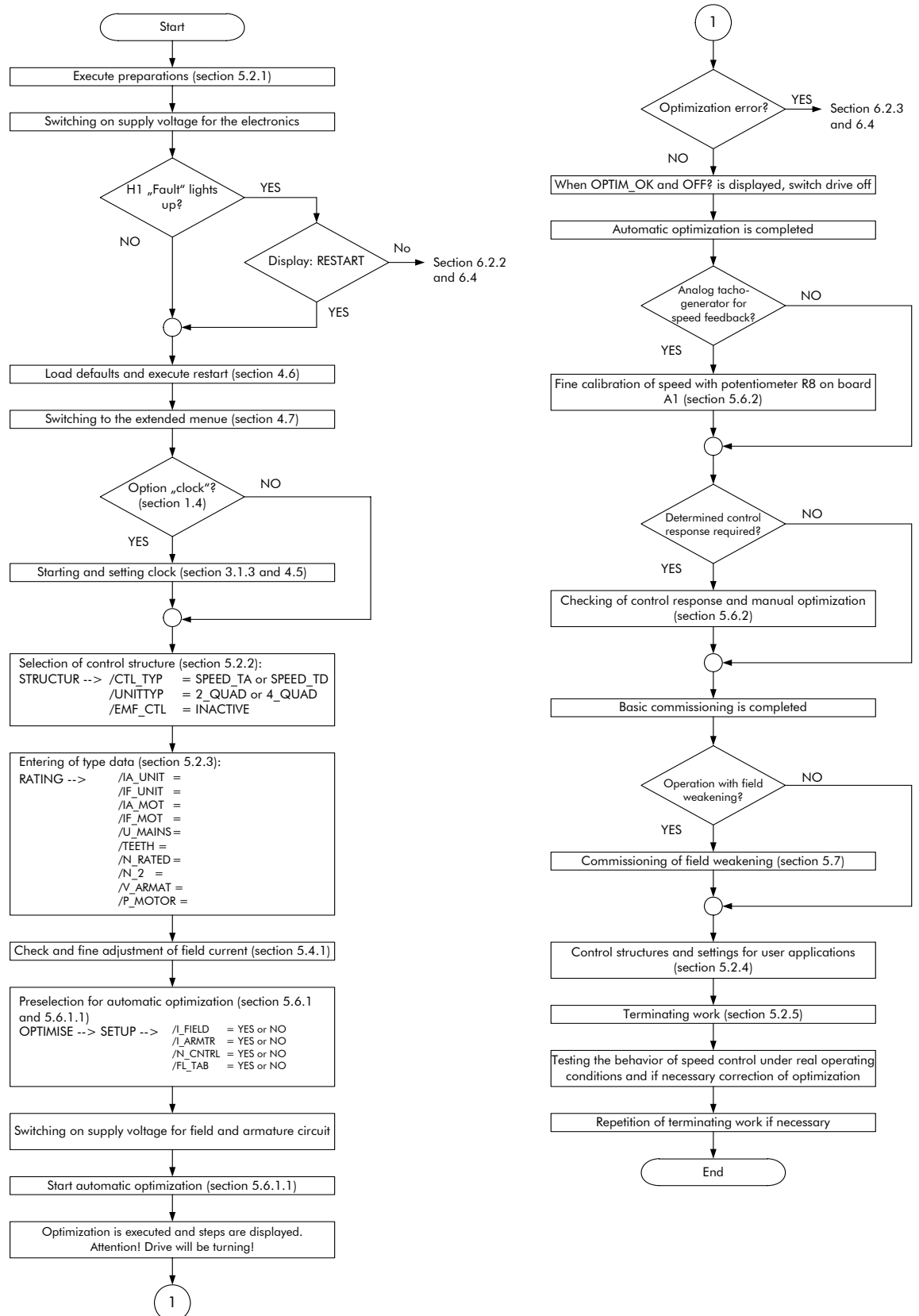


Fig. 31: Commissioning sequence diagram

5.2.1 Preparation

The following checks or steps are to be executed in preparation for commissioning. These work takes place with all circuits switched off from supply voltage.

- Connect the Minisemi D according to the connection diagram (see section 3.3 and 3.4).
- In the case of an electronics supply voltage of 415 V, matching is necessary (see section 5.3).
- The interrupt inputs (terminals :72 to :76) must be connected either directly or indirectly by the external wiring to DC 24 V (terminal :71). Otherwise the ON signal cannot become active.
- For safety reasons the control inputs (terminals :63 to :70) must be open or connected to 0 V before switching on the electronics supply.
- Setting of the measuring range for the field converter (see section 5.4).
- Connection of speed feedback generator:
 - With a digital encoder check the permissible borders for the product of maximum speed and number of teeth; resistors are to be soldered in accordance with pulse encoder voltage.
 - With analog tacho generator set jumpers in accordance to the tacho voltage at rated speed in the armature control range (see section 5.5.2). Matching for the field weakening range – if required – takes place later.
- Connect the measuring instruments (see section 3.5.2.3)

5.2.2 Control structures

Several preset control structures can be selected via the handling menu under STRUCTUR.

/CTL_TYP

Possible settings:

- | | |
|----------|--|
| SPEED-TA | Speed control with analog tacho generator |
| SPEED-TD | Speed control with digital encoder |
| TORQ-TA | Combined speed and armature current control with analog tacho generator (torque control) |
| TORQ-TD | Combined speed and armature current control with digital encoder (torque control) |

The pertinent block circuit diagrams you can find in section 2.8.

Depending on, which kind of speed feedback generator is present, for basic commissioning control structure SPEED-TD or SPEED-TA has to be selected.

/UNITTYP

Possible settings:

- | | |
|--------|--|
| 1_QUAD | The present Minisemi type possesses one simple thyristor bridge for only one direction of current (1 quadrant operation) |
| 4_QUAD | The present Minisemi type possesses an antiparallel thyristor bridge for both directions of current (4 quadrant operation) |

See section 2.1 and rating plate at the unit.

/EMF_CTL

Possible settings:

INACTIVE Operation without armature voltage dependent field weakening
 ACTIVE Operation with armature voltage dependent field weakening

See block diagram in section 2.8.3.

For the basic commissioning /EMF_CTL = INACTIVE has to be selected. The commissioning of the armature voltage dependent field weakening – if it is intended for the drive - takes place later.

5.2.3 Type data

The type data parameters are located under RATING on the handling menu.
 Setting notes for the type data parameters:

/IA_UNIT

Here the type current of the unit has to be entered. The type current can be taken from the type designation on the rating plate.

Example: Minisemi D 380 / 160 → /IA_UNIT = 160 A

If the Minisemi is to be driven with an intermittent overload current, which is higher than the type current, a suitable matching of the burdens for the current transformers must be executed. In this case under /IA_UNIT the maximum overload current is to be entered. However temporary overload above type current needs a load cycle calculation of the concrete application (on request).

/IF_UNIT

Here the type field current for the selected measuring range of the built in field converter has to be entered. (See section 5.4)

/IA_MOT

Enter here the rated armature current of the motor or the maximum current, which is to be driven, if this is higher than the rated armature current of the motor. The possible range for /IA_MOT is

$$25 \% /IA_UNIT < /IA_MOT < /IA_UNIT.$$

The value entered under /IA_MOT is the value of the actual armature current, if in the handling menu an actual value of 100 % is displayed.

/IF_MOT

Here the rated field current of the motor for speed range under armature control has to be entered. The possible range for /IF_MOT is

$$25 \% /IF_UNIT < /IF_MOT < /IF_UNIT.$$

The value entered under /IF_MOT is the value of the actual field current, if in the handling menu an actual value of 100 % is displayed.

/V_MAINS

This parameter can be set either to 380 V or to 500 V. Set this parameter to 380 V if mains voltage is 400 V or 415 V.

/TEETH

If a digital encoder is used for speed feedback the number of teeth (pulses per revolution) has to be entered here. When using an analog tacho-generator the setting of this parameter does not have any effect on the operation of the unit.

/N_RATED

Here the rated speed of the motor for speed range under armature control has to be entered.

/N_2

Without field weakening operation here the same value must be entered as under /N_RATED. This setting is also to be used for the basic commissioning! With field weakening operation here the maximum speed of the motor in the field weakening range has to be entered. This setting is not to be done until basic commissioning is completed. It will take place during commissioning of field weakening.

/V_ARMAT

The setting of /V_ARMAT is only for purpose of documentation and does not have any effect on the operation of the unit.

/P_MOTOR

The setting of /P_MOTOR is only for purpose of documentation and does not have any effect on the operation of the unit.

5.2.4 Control structures and settings for user applications

Control structures for user applications can be made by reassignment of the inputs and outputs of the software modules (see section 4.8). The control structure „Combined speed and armature current control (torque control)“ can be generated by setting the parameter /CTL_TYP accordingly (see section 5.2.2).

Technology modules such as SUMMER1 or SWITCH are inserted already in the standard structure in practical position and only further inputs of these modules need to be connected (see section 2.8). Further freely available technology modules such as T_CTRL (technology controller), FILT_1ST and SUMMER2 are represented in section 9.

An example for settings for user applications is the parametrization of the ramp module.

A description of all software modules and the pertinent parameters is available with the PC handling software in conjunction with the unit specific files (see section 1.4).

Online in the „Terminal“ mode or offline in the „Edit Parameter“ mode information about the item in the handling menu, where the cursor is positioned, can be called by function key F4.

5.2.5 Terminating work

For the closing of the commissioning the following steps should be executed:

- The monitoring of the phase allocation between power stack and electronics supply, which is intended as a help for the commissioning phase, should be switched off. Otherwise later during operation the commutation dips in the supply voltage can cause a random tripping if the armature current is high enough.

LOG_CTRL → MONITOR → /PHASE_M = NO

- In order to protect the settings on the unit from unauthorized modifications, it is possible to block with the parameter /MODIFY all other parameters against modifications.

HANDLING → MENUE → /MODIFY = NO

- **Backup file of the commissioning data has to be created** by copying the data from the Minisemi on a data storage in the PC (in the „Terminal“ mode start function „Save“ with function key F5 of the PC keyboard).

5.3 Supply voltage matching

The electronics supply of the units are set ex works to 380 V or 500 V respectively, depending on their type data.

Minisemi D 380 (415)/ ... to 380 V, Minisemi D 500/ ... to 500 V.

If Minisemi D 380 (415)/ ... units are connected to 415 V, matching is necessary by reconnecting the jumpers stated below on the DC interface board. See Fig. 32 and Fig. 6.

If mains voltage is 3AC 400 V jumpers has to be positioned as same as for 3AC 380 V.

3AC 380 V	Jumpers	15 - 18	3AC 415 V	Jumpers	15 - 21
		16 - 19			16 - 22
		17 - 20			17 - 23

3AC 500 V Jumpers 15 - 24
16 - 25
17 - 26

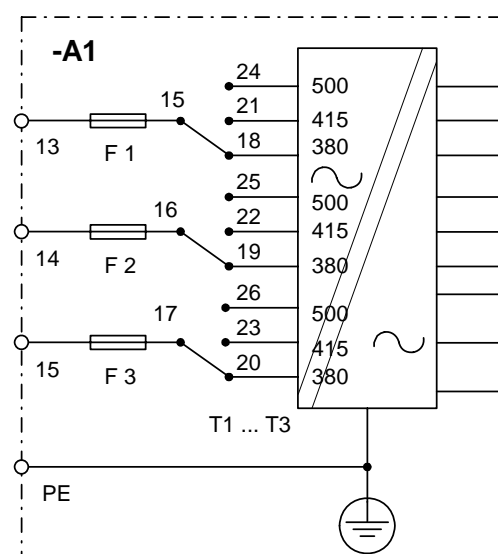


Fig. 32: Electronics supply, mains connection

5.4 Field current matching

Minisemi D 40 ... 275 A

Minisemi D units of 40 ... 275 A are equipped with a regulated field converter for a maximum field current of 10 A. The field converter consists of the basic board A3 (Ref. No. 029.139 617) and the transformer board A7 (Ref. No. 029.138 493).

In order to ensure a sufficient resolution of the current measurement, different measuring ranges can be set on the transformer board A7 by means of jumpers and resistors (see table). The smallest possible measuring range should be always selected.

Type field current [A]	Connections by jumpers	Further modifications
2.5	5 – 7, 2 – 10	²⁾
5.1	5 – 7, 2 – 10	none
8.5 ¹⁾	1 – 2, 4 – 5, 6 – 7, 9 – 10	none
10	1 – 2, 4 – 5, 6 – 7, 9 – 10	³⁾

¹⁾ State of delivery

²⁾ On the transformer board A7 the resistor R2 has to be removed (position of R2, see section 2.7.4, Fig. 7).

³⁾ On the transformer board A7 a resistor of 56 kOhm (0,1 Watt) has to be soldered between the soldering terminals 14 and 15 (see section 2.7.4, Fig. 7).

Minisemi D 320 ... 1250 A

Minisemi D units of 320 ... 1250 A are equipped with a regulated field converter for a maximum field current of 25 A - the field interface A3 (Ref. No. 029.139 632).

In order to ensure a sufficient resolution of the current measurement, different measuring ranges can be set on the field interface A7 by changing the number of transformer windings and resistor R1 (see table). The smallest possible measuring range should be always selected.

Type field current [A]	Number of windings x cable area	Load resistor R1
5	6 x 0.5 mm ²	300 Ohm / 0.5 Watt
10	3 x 4 mm ²	300 Ohm / 0.5 Watt
15	2 x 4 mm ²	300 Ohm / 0.5 Watt
25 ¹⁾	2 x 4 mm ²	180 Ohm / 0.5 Watt

¹⁾ State of delivery

5.4.1 Entering of type data and fine adjustment

The type field current belonging to the selected measuring range must be entered in the menu under RATING --> /IF_UNIT. By entering the motor field current stated on the motor rating plate under RATING --> /IF_MOT the matching to the motor takes place.

For checking the set field current and for fine adjustment field current has to be measured. For this purpose an ampere meter has to be connected directly into the field circuit. Possibly a shunt is available or a current measuring pliers is used.

The field current will flow, when field supply is switched on and afterwards the ON signal is given.

By changing the factor MEASURE --> XIFIELD --> /FACTOR a fine adjustment can be made via the handling menu.

It is to be noted that this factor resets itself automatically by a further input of /IF_UNIT or /IF_MOT to the ratio (/IF_UNIT) / (/IF_MOT) and the setting of the fine adjustment thereby would be lost.

5.5 Speed feedback generator matching

Important!

The connection of speed feedback generator to the motor must be torsionally rigid.

5.5.1 Digital encoder connection

When using a digital encoder you need an external voltage supply (see Fig. 16 in section 3.3).

Incremental pulse encoders with two squarewave pulses offset through 90° electrical and the relevant inverted signals with a permitted pulse current of approx. 10 mA are to be provided for forming the speed control value. The shape of the curve must be ensured to avoid incorrect measurements. In general the information given by the manufacturer of the pulse encoder must be observed, particularly if the pulse encoder and the processing electronics are installed some distance apart. Pulse encoders can be designed for symmetrical and asymmetrical operation.

Inputs: Terminal :46: Pulse 1, Kl.:47: Pulse 1 inverted,
 Terminal :48: Pulse 2, Kl.:49: Pulse 2 inverted.

Important!

The product of the maximum speed (n_{RATED} or n_2) x number of teeth (pulses per revolution of the pulse generator or encoder) may not exceed the upper limit of 4,200,000 and the lower limit of 572,185.

$$572\,185 \leq n_{\text{max}} * z \leq 4\,200\,000$$

z = Pulses/revolution of the generator (number of teeth)
 n_{max} = Max. possible speed

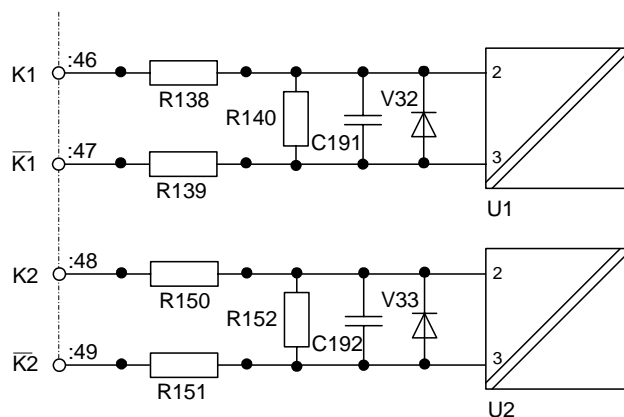


Fig. 33: Digital encoder connection, symmetrical

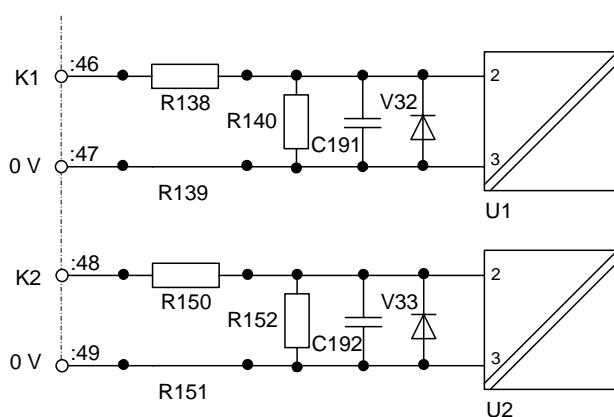


Fig. 34: Digital encoder connection, asymmetrical

As supplied, the resistors R138, R139, R150 and R151 are each rated at 820 ohms in symmetrical operation for a pulse input voltage of DC 24 V at approx. 10 mA.

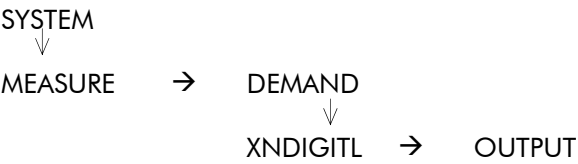
When converting to a different input voltage or asymmetrical operation the resistors must be changed (see table).

Note!

Soldering may only be carried out when the units are isolated from the supply voltage, with a potentially-separate and temperature regulated low voltage soldering iron.

Pulse encoder voltage	R138, R150	R139, R151	
DC 24 V	820	820	Symmetrical
DC 24 V	1800	0	Asymmetrical
DC 12 V	390	390	Symmetrical
DC 12 V	820	0	Asymmetrical
DC 5 V	130	130	Symmetrical
DC 5 V	240	0	Asymmetrical

When using a digital encoder the actual value of the speed can be seen in the menu under



When connecting this output OUTPUT to the input <PWM of the module ANLG_OUT you get the actual value of the speed as an analog signal at terminal :44 (see section 3.5.2.3).

5.5.2 Analog tachometer generator connection

Inputs: Terminals :11 and :12 on the DC interface board -A1

The signal level is calibrated roughly with the jumpers on the GS-Interface board A1 (see Fig. 6) when the unit is isolated from the supply voltage. Calibration is to be made in accordance to the tacho voltage at maximum speed.
If operation with field weakening is required calibration is to be made for the maximum speed in the field weakening range. By consideration of field weakening from the beginning of basic commissioning a second calibration during commissioning of field weakening will not be necessary.

U-tacho	Jumpers From ... to
36 V ... 56 V	66 ... 57 und 67 ... 61
57 V ... 93 V	66 ... 58 und 67 ... 62
94 V ... 160 V	66 ... 59 und 67 ... 63
161 V ... 240 V*	66 ... 60 und 67 ... 64

* Fit R1 and R2 with 10 kOhm each.

The fine calibration of the speed does not take place until the optimization of the speed controller has been executed. For the purpose of fine calibration a speed demand value of 100 % is given and the speed is measured with a separate r.p.m. counter. With the potentiometer R8 on the GS-Interface board A1 (see Fig. 6) the speed is then adjusted on the rated speed (according to the value entered under RATING -> /N_RATED). Thereby you get a voltage drop of approx. 10 V x (N_RATED / N_2) across the series connection of R7 and R8. If the adjustment range of the potentiometer R8 should not be sufficient, another resistor can be soldered parallel to R7.

If the analog signal is very noisy so that no smooth characteristic can be achieved, a capacitor (of approx. 4.7 µF) should be connected between solder pins 51 and 53.

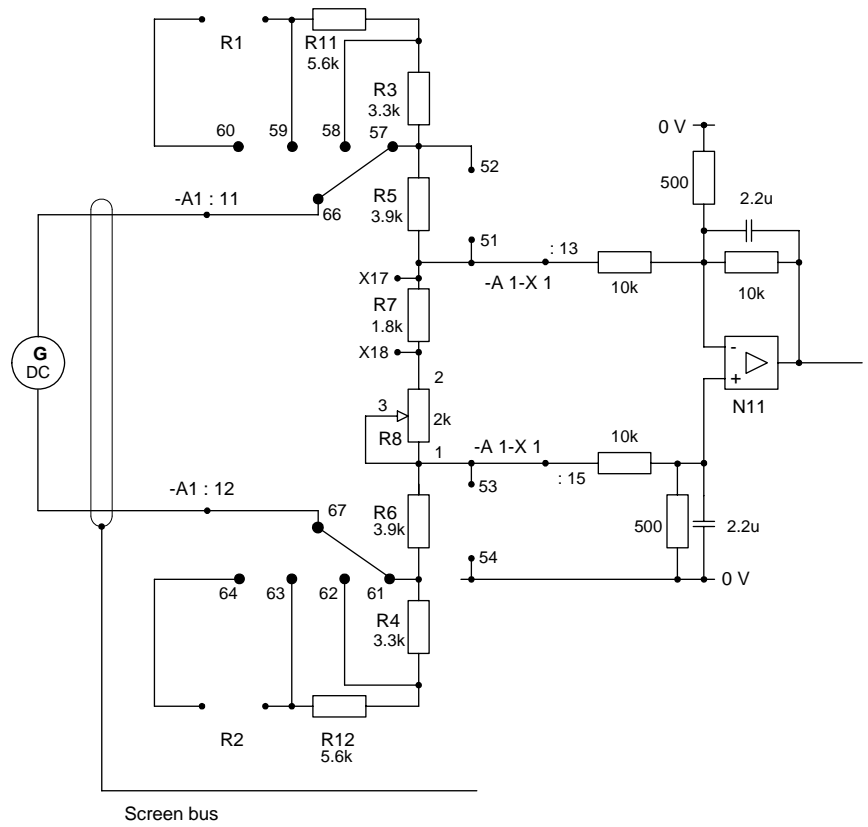


Fig. 35: Analog tachometer input

5.6 Optimization of control circuits

The Minisemi D - units possess a self-optimization function for the automatic optimization of the most important control circuits.

If the control characteristics achieved with automatic optimization are not satisfactory or the automatic optimization routine is interrupted prematurely, because of the system parameters lying outside of the admissible range, manual optimization is necessary.

5.6.1 Automatic optimization

The following control circuits can be set by automatic optimization:

- field current control circuit
- armature current control circuit
- speed control circuit

and furthermore the flux table for field weakening operation with EMF calculation from flux table can be recorded.

Automatic optimization can be executed completely following the order stated but individual control circuits can also be excluded by means of bit parameters. Fig. 36 shows the optimization procedure in the form of a sequence diagram. For automatic optimization of the armature current controller the machine should be at a standstill or moving only slightly.

The polarity of the speed actual value is checked before automatic optimization of the speed controller or, if this path has been inactive, before recording the flux table.

For setting the speed controller and recording the flux table the machine must be able to run freely in the range up to rated speed (with field weakening: up to the basic speed)!

The recording of the flux table can be omitted (set /FL_TAB = NO), if for the drive no field weakening operation is intended or the armature voltage is measured directly (see section 5.7.2).

During the automatic optimization according to the control circuit which is to be optimized a special structure is built up by the program. Also only the appropriate monitoring circuits are effective.

The automatic optimization is performed according to the self-tuning method. First the system parameters and then the control parameters are determined.

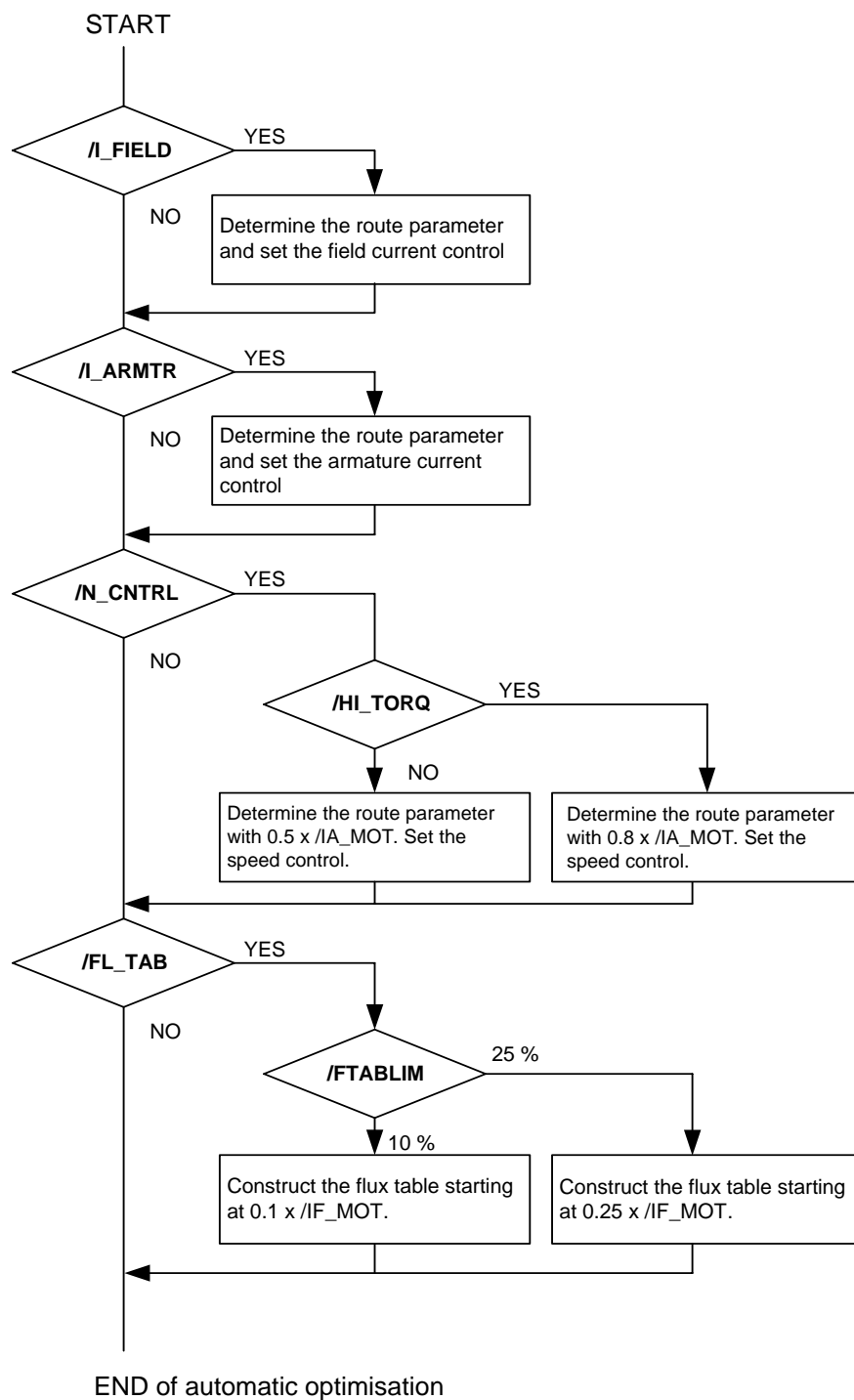
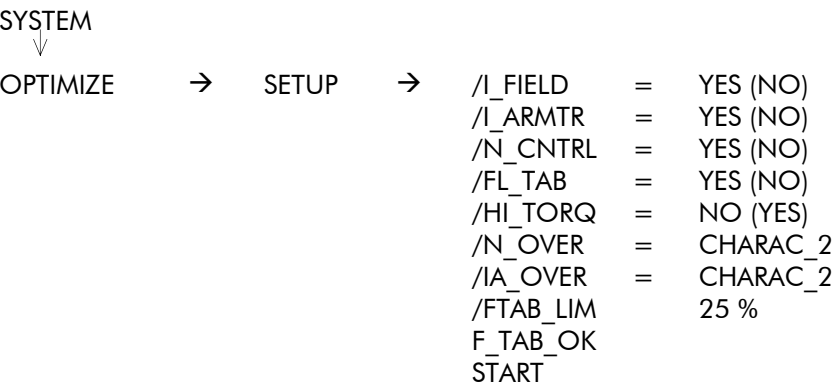


Fig. 36: Automatic optimization sequence diagram

5.6.1.1 Executing automatic optimization

The automatic optimization is to be started only if all preceding steps of the commissioning sequence diagram (see section 5.2) are completed.
If the settings for the field weakening operation are already made, the automatic optimization of the speed controller and the recording of the flux table may not be executed!

The bit parameters for switching off optimization sequences and the START function are brought onto the display as follows:



Before starting automatic optimization for the first time, there is only need to choose the control circuits to be optimized by the parameters /I_FIELD, /I_ARMTR, /N_CNTRL and /FL_TAB.
The further parameters /HI_TORQ, /N_OVER, /IA_OVER and /FTABLIM at first are not to be changed from their standard values. It can be necessary to change these parameters under special operating conditions (see below).

After START is brought onto the display automatic optimization is started by pressing the key "F" twice. Now the display shows RUNNING and then ON? This message is a prompt to switch the drive on with the ON signal (connect terminal :63 on the IMRA board to DC 24 V).
After this step, automatic optimization is executed in the order shown on the sequence diagram and the individual steps are displayed on the control panel. When automatic optimization is successful completed the display alternates between OPTIM_OK and OFF?.
As soon as the drive is switched off by taking away the ON signal (open terminal :63) the display shows START. Automatic optimization is now finished.

Attention!
In any case the behaviour of the speed controller has to be tested under real operating conditions by comparing the shape of the actual value with the shape of the demand value of speed.

Use of the further optimization parameters:**/HI_TORQ**

The setting of the list parameter /HI_TORQ determines whether the machine should run up when specifying the system parameters of the speed control circuit with 50 % (/HI_TORQ = NO) or 80 % (/HI_TORQ = YES) of the motor current set under RATING → /IA_MOT.

In the case that motor and machine are already coupled, it may be that 50 % of torque is not sufficient to accelerate the drive to nominal speed in the maximum permissible time for automatic optimization. In this case automatic optimization of the speed control circuit can be repeated with the setting /HI_TORQ = YES.

/N_OVER

See section 5.6.2.3.

/IA_UEBR

See section 5.6.2.2.

/FTAB_LIM

The setting of the list parameter /FTAB_LIM determines whether the recording of the flux table starts with 10 % or with 25 % of the motor field current (/IF_MOT).

5.6.2 Checking control response and manual optimization

With applications, where a determined control response is required, the settings found by the automatic optimization should be checked and corrected if necessary. The handling is described below.

When executing manual optimisation of the speed controller the motor must be able to run freely as same like for automatic optimisation.

5.6.2.1 Field current controller IF_CTRL

Preparations:

- Connect oscilloscope with memory function to terminal :43 (see section 3.5.2.3)
- Switch for giving the ON signal (terminal :63) is required, terminals :64 to :70 remain open
- Power supply for the field circuit must be switched on
(In the case that field circuit and armature circuit have separate power supplies, it is necessary to switch on also the power supply for the armature circuit. This is because of the phase monitoring in the armature circuit. For disabling the thyristors in the armature circuit terminal :67 (signal CTRL_EN) must be open.)

After switching on the ON signal at terminal :63 the field current controller will be enabled after a delay time of 200 ms. This means a setpoint step-change from 0 to 100 %, because the setpoint is given internally constantly with 100 %. With the controller parameters CONTROL → FIELD → IF_CTRL → /KP and /TN the step-response can be optimized.

5.6.2.2 Armature current controller IA_CTRL

Preparations:

- Connect oscilloscope with memory function to terminal :42 (see chapter 3.5.2.3)
- Switches for giving the signals ON (terminal :63) and CNTL_EN (terminal :67) are required, terminals :64 to :66 and :68 to :70 remain open
- Monitoring „field current is less than minimum value“ has to be set inactive: LOG_CTRL → MONITOR → /IFMIN_M = NO
- The output of the function generator has to be connected with the input of the bridge control (see section 4.8)
(CONTROL → ARMATURE → BR_CTRL → <INPUT)
- Power supply for the field circuit must be switched off
- Power supply for the armature circuit must be switched on

The desired value for the armature current will be set via the internal function generator.

Parameterize the function generator so that you get a square wave signal at its output (FUNC_GEN → /WAVFORM = SQ_WAVE). Choose the frequency so that you can record the step-response of the armature current with the storage oscilloscope. By the setting of /AMPL and /OFFS can be produced both unipolar as well as bipolar setpoint step-changes. With bipolar setpoint step-changes it is to note that at terminal :42 the absolute value of the armature current is output.

If the ON signal is active, you need only the signal CNTL_EN for enabling or disabling the armature current controller.

For the protection of the motor a break should be made after some current impulses and the rotor be turned into a different position.

If the response of the armature current control circuit is not satisfactory, then the automatic optimization can be repeated with another characteristic for the step response. Five different characteristics can be selected. The more highly the index, the more steeply is the characteristic of the step-response (standard: CHARAC_2). The selection of the characteristic is made with the parameter OPTIMIZE → SETUP → /IA_OVER.

If the step-response with none of the preselectable characteristics is satisfying, then there is also a manual optimization possible by an individual setting of the parameters /KP and /TN of the armature current controller (CONTROL → ARMATURE → IA_CTRL).

If the optimization of the armature current controller is completed, the monitoring „field current is less than minimum value“ has to be set active again. Additionally the standard control structure must be rebuilt in accordance with section 2.8.1, i.e. the output of the software module SWITCH (CONTROL → ARMATURE → SWITCH → OUTPUT) must be connected again with the input of the bridge control BR_CTRL.

5.6.2.3 Speed controller N_CTRL

Before optimization of the speed controller field and armature current controller must have been optimized.

Preparations:

- Connect oscilloscope with memory function to terminal :41 and :44 respectively (see section 3.5.2.3)
- Switches for giving the signals ON (terminal :63), CNTL_EN (terminal :67) and DMND_R (terminal :65) are required, terminals :64, :66 and :68 to :70 remain open
- The output of the function generator has to be connected with the demand input of the module INOUT (see section 4.8)
(LOG_CTRL → INOUT → INPUT → <DEMAND)
- Power supply for field and armature circuit must be switched on

The desired value for the speed will be set via the internal function generator. Parameterize the function generator so that you get a constant value at its output (FUNC_GEN → /WAVFORM = DC), which can be set by the parameter /OFFS.

If the signals ON and CNTL_EN (Enabling of speed and armature current controller) are active, then the activation of the signal DMND_R (Enabling of speed demand value for CW rotation) works like a setpoint step-change from zero to the output value of the function generator. If all three control signals are active, then a modification of the output value of the function generator causes directly a setpoint step-change.

If the response of the speed control circuit is not satisfactory, then the automatic optimization can be repeated with another characteristic for the step response. Five different characteristics can be selected. The more highly the index, the more steeply is the characteristic of the step-response (standard: CHARAC_2). The selection of the characteristic is made with the parameter OPTIMIZE → SETUP → /N_OVER.

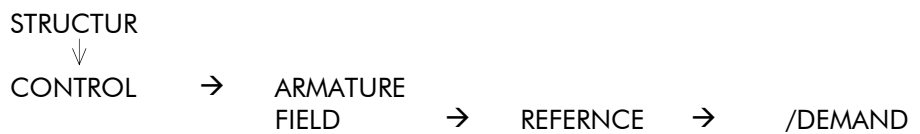
If the step-response with none of the preselectable characteristics is satisfying, then there is also a manual optimization possible. The required step-response can be achieved by the appropriate setting of the gain KP (KP is set via the parameters /KP_0 and /KP_1. For constant gain, that means without KP adaption, both parameters must have equal settings. It results $KP = /KP_0 = /KP_1$.) and the time constant /TN. If the mechanical characteristics are problematic, such as for example torsional vibration, the KP value can be adjusted depending on the input variable <X (adaptive gain).

If the optimization of the speed controller is completed, the standard control structure must be rebuilt in accordance with chapter 2.8.1, i.e. the output W1 of the software module LOC-REM (LOG_CTRL → LOC-REM → OUTPUT → W1) must be connected again with the input <DEMAND of the software module INOUT.

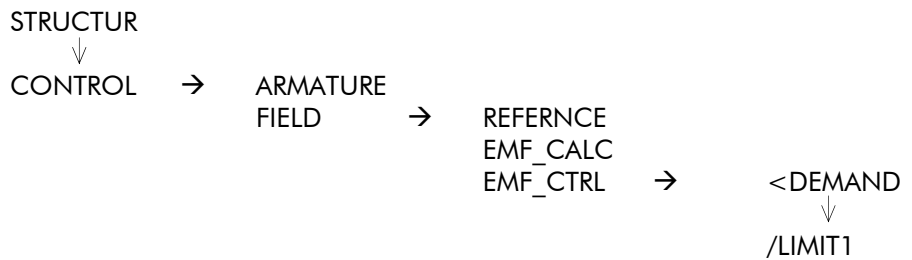
5.7 Armature voltage dependent field weakening

Field weakening is implemented using the armature voltage controller (EMF_CTRL). If the parameter /EMF_CTL in the block STRUCTUR is set to ACTIVE (setting will be made later in the commissioning!), the control structure shown at the bottom of Fig. 14 is created automatically.

The parameter /DEMAND in



is the demand signal for the voltage controller, and the parameter /LIMIT1 in



is the maximum field current. This is the field current in the range with constant field.

The following sections require that the parameters /DEMAND and /LIMIT1 have not been changed to this point of the commissioning. They must have their standard value of 100 %.

There are two methods to calculate the actual value of the electromotive force (EMF):

1. Calculating the EMF of the motor from the flux table recording during optimization.
2. Measurement of the armature voltage and compensation of the $I_x R$ portion in the armature circuit.

5.7.1 Armature voltage dependent field weakening with EMF calculation from flux table

Armature voltage dependent field weakening with EMF calculation from flux table only should be used in applications with a compensated motor and with a field weakening range less than 1:2.

The EMF must be calculated or measured in order to control it. The EMF is calculated from the motor speed and the flux. The flux is determined from the excitation current and a value from a flux table. The flux table is defined during optimization and can be found under:

```

OPTIMIZE    →    SETUP
                ↓
              FLUXTABL →    /TAB_10%
                        ...
  
```

Its values can be adjusted manually. This may be necessary if the EMF does not remain constant depending on the speed.

After any correction, even of just one value, the function TAB_NORM under

```

OPTIMIZE    →    SETUP
                ↓
              FLUXTABL →    /TAB_10%
                        ↓
                      TAB_NORM
  
```

must be called by pressing the "F" key twice. This function normalises the adjacent table values that cannot be accessed directly by the user.

5.7.1.1 Commissioning

1. Conditions

- The basic commissioning is completed according to the commissioning sequence diagram.
- During automatic optimization also the flux table has been recorded.
- When using an analog tachometer generator the voltage divider of the input has been configured by jumpers for the maximum speed in the field weakening range.
- The maximum speed in the field weakening range has been entered under RATING → /N_2.
- The parameter CONTROL → FIELD → REFERENCE → /DEMAND has not been changed during commissioning and is still set on its default value of 100 %.

2. Settings in the menu

- STRUCTUR → /EMF_CTL = ACTIVE
- CONTROL → FIELD → EMF_CALC → /VA_CTRL = NO
- The settings of the speed controller found by automatic optimization have to be matched to the speed range of field weakening:
CONTROL → ARMATURE → N_CTRL → /KP_0, /KP_1
$$/KP_0 \text{ (new)} = /KP_0 \text{ (old)} \times (N_2 / N_RATED) \times 0,8$$
$$/KP_1 \text{ (new)} = /KP_0 \text{ (new)}$$

Note:

After the setting /EMF_CTL = ACTIVE a speed demand of 100 % in the menu corresponds now to the maximum speed in the field weakening range N_2.

That means also that motor speed must be N_RATED if speed demand is $(N_RATED / N_2) \times 100 \%$.

3. Check function of field weakening

Increase the speed demand value starting with $(N_RATED / N_2) \times 100 \%$ in small steps of approx. 5 %.

If field weakening operates correctly, the field current will be reduced and the armature voltage will not rise above the rated armature voltage.

4. Optimization of the EMF controller

By means of the parameters /KP and /TN of the EMF controller (CONTROL → FIELD → EMF_CTRL) the control response has to be optimized. The EMF response has to be observed when accelerating the motor from the speed range under armature control into the field weakening range. (The output EMF of the module EMF_CALC has to be reassigned to the output terminal :44 where an oscilloscope has to be connected. See section 3.5.2.3).

The overshoot of the EMF must be as little as possible and the EMF must remain stable in the total field weakening range.

5. Fine calibration of the maximum speed N_2

Set a speed demand value of 100 % digital with the internal function generator (see section 5.6.2.3).

The motor speed must be now approx. N_2.

Calibrate the speed with potentiometer R8 and a separate r.p.m. counter to N_2.

5.7.2 Armature voltage dependent field weakening with measurement of the armature voltage

The armature voltage must be potentially isolated before connection to the Minisemi D. The DC isolating transformer module, Ref. No. 029.132 387, is available as an option (see Fig. 37, Fig. 38, Fig. 39). The capacitor C1 is used to dampen the harmonics present in the armature voltage. Capacitor C6 is smaller and serves to dampen any harmonics from the oscillator signal.

A DC isolating transformer is to be installed and wired according to Fig. 37. It should be connected as close as possible to the Minisemi D. Only heat-resistant insulated leads should be used to connect the armature voltage to the board and these leads should not be laid in the same cable guides as other cables. If the connection to the armature is fused, the level of the armature voltage must be considered.

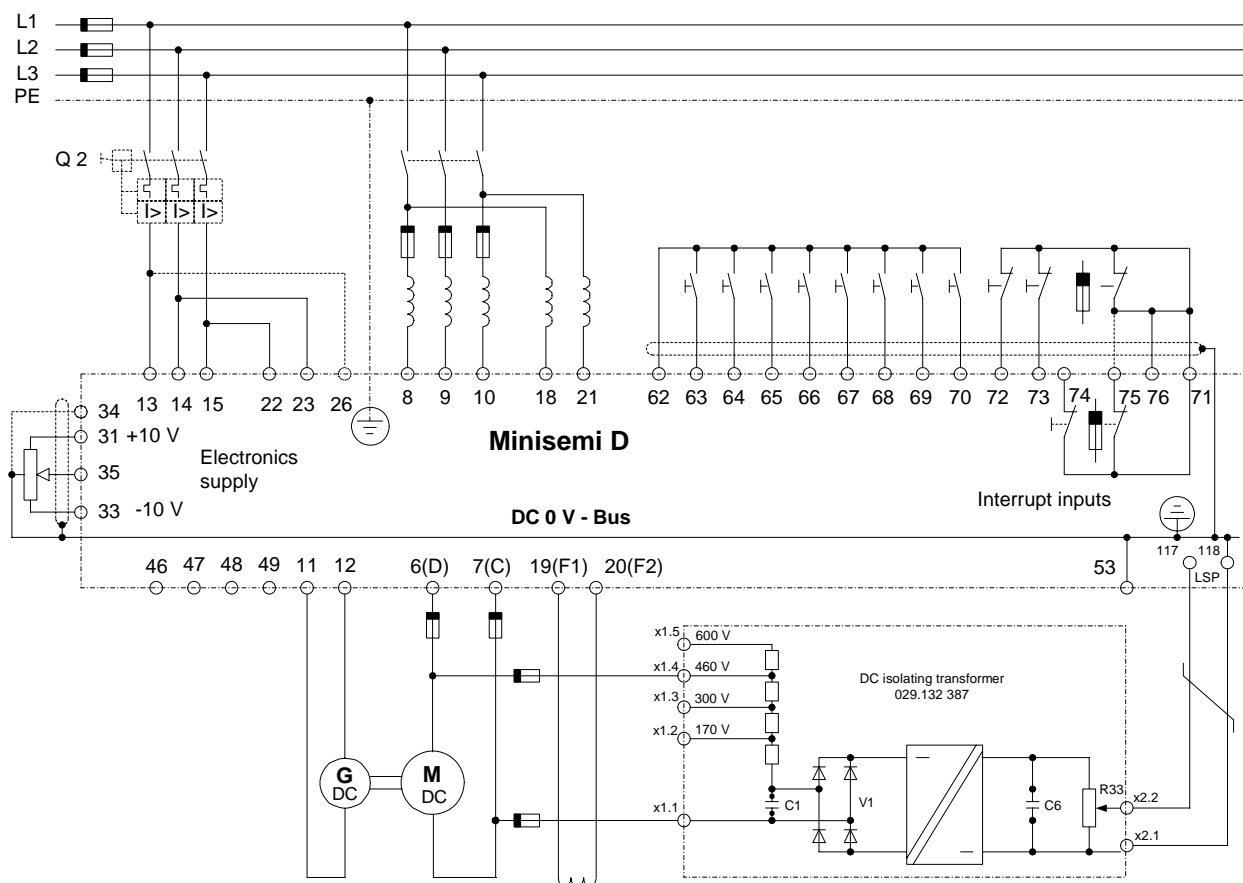


Fig. 37: Connecting the DC isolating transformer

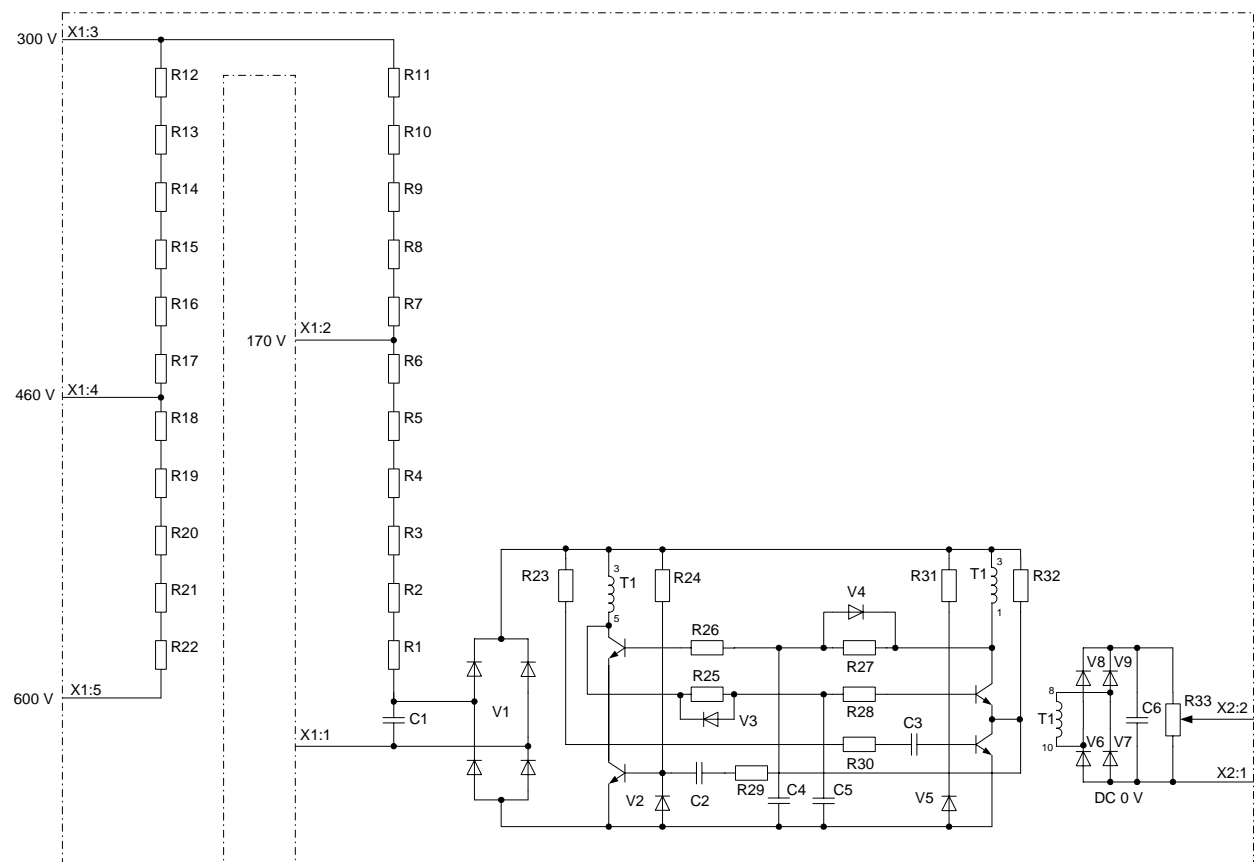


Fig. 38: Circuit diagram of DC isolating transformer

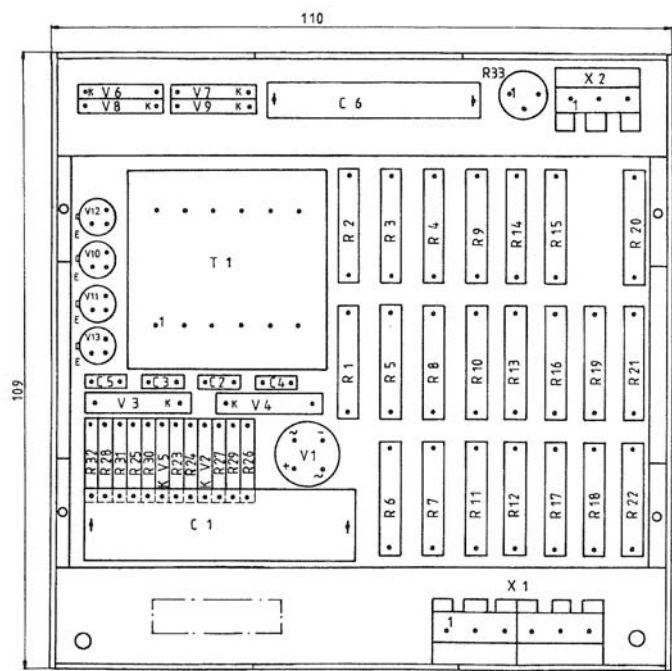


Fig. 39: Component layout of DC isolating transformer

An over voltage can occur on the armature circuit if the measured armature voltage is lost in the field weakening range. So it is recommended that a microswitch be used to register the fuse status. This switch is to be connected into the interrupt input terminal :75. Additionally the actual value of the armature voltage is monitored in the Minisemi D.

The terminals on the potential isolating transformer are to be chosen according to the rated value of the armature voltage. Fig. 40 shows the transfer characteristics of the DC isolating transformer according to the four terminals. The gain of the characteristics can be reduced using the potentiometer R 33. The output of the isolating transformer must be connected directly to terminals 117 + and 118 - (0 V) on the DC interface board -A1, using twisted leads. The DC isolating transformer does not require a supply voltage.

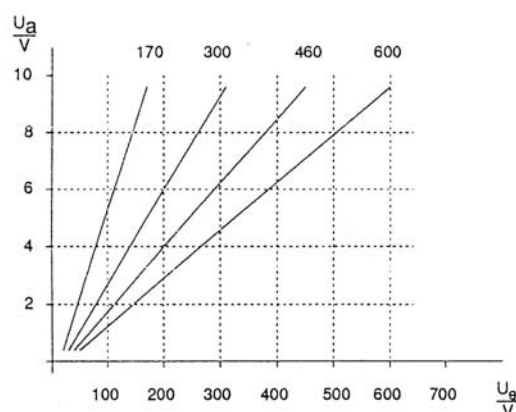


Fig. 40: Transfer characteristic of DC isolating transformer

5.7.2.1 Commissioning

1. Conditions

- The basic commissioning is completed according to the commissioning sequence diagram.
- When using an analog tachometer generator the voltage divider of the input has been configured by jumpers for the maximum speed in the field weakening range.
- The maximum speed in the field weakening range has been entered under RATING → /N₂.
- The parameter CONTROL → FIELD → REFERENCE → /DEMAND has not been changed during commissioning and is still set on its default value of 100 %.
- The DC isolating transformer has been connected according to 5.7.2.

2. Calibration of the DC isolating transformer

- Setting MEASURE → XVARMATR → /FACTOR = 125 %.
- Let the motor turn with N_{RATED} (in the course of which the motor running at no load must generate rated armature voltage reduced by the ohmic voltage drop at rated armature current!)
- Adjust potentiometer R33 on the DC isolating transformer in such a way that in the menu under MEASURE → XVARMATR → OUTPUT an actual value of armature voltage of 100 % is displayed. The output voltage at the DC isolating transformer will be adjusted thereby to approx. 8 V.

3. Settings in the menu

- STRUCTUR → /EMF_CTL = ACTIVE
- CONTROL → FIELD → EMF_CALC → /VA_CTRL = YES
- The settings of the speed controller found by automatic optimization have to be matched to the speed range of field weakening:
 CONTROL → ARMATURE → N_CTRL → /KP_0, /KP_1

$$/KP_0 \text{ (new)} = /KP_0 \text{ (old)} \times (N_2 / N_RATED) \times 0,8$$

$$/KP_1 \text{ (new)} = /KP_0 \text{ (new)}$$

Note:

After the setting /EMF_CTL = ACTIVE a speed demand of 100 % in the menu corresponds now to the maximum speed in the field weakening range N_2.

That means also that motor speed must be N_RATED if speed demand is $(N_RATED / N_2) \times 100 \%$.

4. Check function of field weakening

Increase the speed demand value starting with $(N_RATED / N_2) \times 100 \%$ in small steps of approx. 5 %.

If field weakening operates correctly, the field current will be reduced and the armature voltage will not rise above the rated armature voltage.

5. IxR-compensation

The IxR - compensation considers the voltage drop, which is caused by the armature current and the ohmic resistance of the motor. In the module EMF_CALC this voltage drop is calculated and subtracted with correct sign (dependent on the direction of armature current and the direction of rotation) from the measured armature voltage, so that one gets approximately the actual value for the EMF of the motor.

For a IxR compensation set the parameter CONTROL → FIELD → EMF_CALC → /V_R_ARM, which corresponds to the voltage drop at rated armature current related to the rated armature voltage.

If there is no specification by the motor manufacturer a value of approx. 10 % should be entered, if the armature voltage is measured directly at the converter output.

6. Optimization of the EMF controller

By means of the parameters /KP and /TN of the EMF controller (CONTROL → FIELD → EMF_CTRL) the control response has to be optimized. The EMF response has to be observed when accelerating the motor from the speed range under armature control into the field weakening range. (The output EMF of the module EMF_CALC has to be reassigned to the output terminal :44 where an oscilloscope has to be connected. See section 3.5.2.3.)

The overshoot of the EMF must be as little as possible and the EMF must remain stable in the total field weakening range.

7. Fine calibration of the maximum speed N_2

Set a speed demand value of 100 % digital with the internal function generator (see section 5.6.2.3).

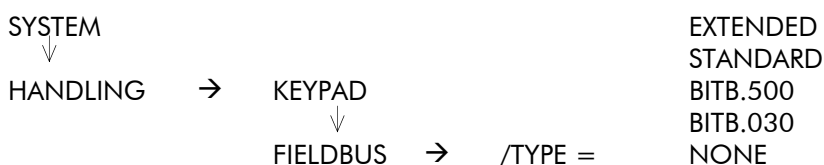
The motor speed must be now approx. N_2. Calibrate the speed with potentiometer R8 and a separate r.p.m. counter to N_2.

5.8 Field bus coupling

As an option, all units can be equipped with field bus couplers for bus systems. These coupling modules are used for operation with the serial bus on automation systems. The table below shows the bus systems currently available with the field bus couplers and the automation equipment.

Bus system	Coupler type	Automation unit
Bitbus M1S	FBK M1S K1/S 029.101 174	Modicon A500
Bitbus SN1	FBK SN1 K1/S 029. 123 872	LOGIDYN D1
Bitbus M1D	FBK M1D K1/S 029. 121 262	LOGIDYN D1
Modbus Plus	FBK MBP K1/S 029.143 050	Modicon 984
Profibus SINEC L2/FMS	FBK PBD K1/S 029.143 051	SIMATIC S5 and PLCs of other manufacturers
Profibus DP	FBK PBD MIN 25B15 029.211 081 Replacement type: FBK PBD MIN 65B12 029.220 280	SIMATIC S7, LOGIDYN D2 and PLCs of other manufacturers
CAN Bus	FBK CAN MIN 51N 029.223 763	LOGIDYN D2 and PLCs of other manufacturers
Interbus S	FBK IBS MIN 65N 029.214 967	PLCs of different manufacturers

For operation with field bus coupler the bus type must be entered via the menu. Open the extended menu and set the list parameter /TYPE.



The following settings of the list parameter /TYPE are possible:

- NONE:**
BITB.030:
BITB.500:

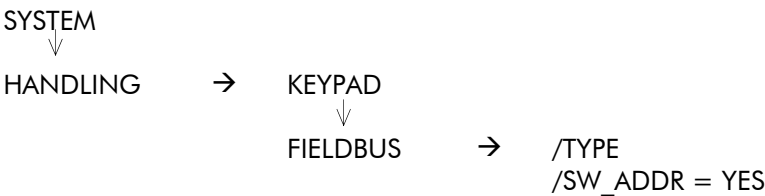
No field bus operation
No more use of this setting
One of the following bus systems is to be used:
Profibus DP
Profibus SINEC L2/FMS
CAN Bus
Modbus Plus
Interbus S
Bitbus M1S
Bitbus M1D
- STANDARD:**

The bus system
Bitbus SN1
is to be used
- EXTENDED:**

Reserved for future couplers with extended functions

Except of the Profibus the node address is to be set on the coupling card via DIP switches. When using the Profibus coupler the node address has to be entered in the menue.

Open the address channel by changing the parameter /SW_ADDR from NO to YES.



Enter the node address in HEX format under /DEV.ID.



6 Control and monitoring system

6.1 Logic Control

The Logic Control (LOG_CTRL) process includes:

- Formation of the control values for the main control circuits
- The binary control and
- The monitor functions.

6.1.1 General

Minisemi D units can be controlled either using signals from the terminal strip (as standard) or through a field bus. For this, the relevant bus system must be entered on the menu under HANDLING. The changeover required can be executed via the software module LOC-REM after suitable "assignment".

The standard control signals are as follows:

ON	Terminal :63	- "ON" command
CTRL_EN	Terminal :67	- Controller enable
DMND_L	Terminal :64	- Demand enable for CCW operation
DMND_R	Terminal :65	- Demand enable for CW operation

Depending on the operating condition of the unit the different controllers, the 6-pulse and 2-pulse firing circuit and the ramp are enabled when the ON signal is given and the controller is enabled. The logic control which controls the procedure is located in the LOGIC module. The equivalent logic circuit is shown in Fig. 41.

The units are switched on in the following order:

ON = YES → **CTRL_EN = YES** → **Demand enable** either **DMND_L = YES**
or **DMND_R = YES**

The units are switched off in the reverse order.

The simplest variant of the external control, which is sufficient in most applications, is, to connect the control signal inputs CTRL_EN and DMND_L or DMND_R constantly to +24 V, whereby all internal control signals and releases are then produced automatically by the internal logic control. The switching on control is started with the changing of the ON signal from NO to YES. The other way round the switching off control is started with the changing of the ON signal from YES to NO.

An individual controlling of the inputs CTRL_EN and DMND_L or DMND_R is meaningful normally only during commissioning or with special drive applications.

6.1.2 Switching on

The ON signal (terminal :63 is connected to +24 V) can only be active if the control signal inputs PULS-DIS (disable) and FASTSTOP (fast stop) are not active, that means terminals :72 and :73 are connected to +24 V. In addition no fault may be detected (the yellow LED H1 must be off) and a possibly existing field bus coupling must run correctly. (Field bus monitoring is active if a field bus type is set under HANDLING:FIELD:BUS:/TYPE and the monitor bit LOG_CTRL:MONITOR:/BUS_M is set to YES.)

With the ON signal the command 'main contactor on' is given (LOG_CTRL:LOGIC:OUTPUT:MAINRLY = YES, output relay K3 picks up, LED H3 is on). And after an adjustable delay time (LOG_CTRL:LOGIC:ON_DLYS:/CTL_DLY, standard setting: 200 ms) the armature voltage controller and the field current controller are enabled by setting the internal control bits ECTRL_EN and FCTRL_EN to YES.

Field quiescent current function for the purpose of motor heating with drive switched off

If the parameter LOG_CTRL:LOGIC:ACTIVBIT:/IF_QUIE is set to YES, then the field current controller is enabled also without ON signal, presupposed no fault is detected.

If the ON signal is set to NO, then the internal control bit IF_QUIES is set to YES. Because of this field current demand is switched over to an adjustable field quiescent current (CONTROL:FIELD:IF_CTRL:/QUIESNT, standard setting: 20.0 %).

6.1.3 Switching off

If the ON signal is set back to NO while the machine is running, then first a speed demand of zero is given internally. This is done by setting the internal control bit DEM_0 to YES. If "Speed actual value equal zero" simulation is switched off, that means the parameter LOG_CTRL:LOGIC:ACTIVBIT:/XNO_SIM is set to NO, then with a 4-quadrant unit (+GO) the drive brakes regenerative with the adjusted ramp time.

As soon as the control recognizes an actual speed value close to zero (LOG_CTRL:INOUT:OUTPUT:XN_0 = YES), all controllers are disabled and the signal MAINRLY (main contactor on) is set back to NO after an adjustable delay time (LOG_CTRL:LOGIC:OFF_DLYS:/MAINRLY, standard setting: 200 ms). Output relay K3 releases and LED H3 goes off.

6.1.4 Controller enable armature circuit

If the control input CTRL_EN is constantly set to YES (terminal :67 is constantly connected to +24 V), the controllers of the armature circuit will be enabled with an adjustable delay time after the controllers of the field circuit (LOG_CTRL:LOGIC:ON_DLYS:/NIA_DLY, standard setting: 1000 ms).

Otherwise only then, when the signal CTRL_EN is set on YES. This sets the internal control bit IARM_EN to YES and the armature current controller and the bridge changeover logic are enabled.

Enabling the speed controller and the ramp depends on whether the machine is running or at a standstill. If the actual speed value is less than 3 % of rated speed, speed controller and ramp are enabled immediately. This is done by the setting of the internal control bit CURREXST (current exists) to YES and resulting from this the changing of the control bits NCTRL_EN and RAMP_EN from NO to YES.

Switching on to rotating machine

If the actual speed value is greater than 3 % of the rated speed, then the case "Switching on to rotating machine" is present. In order to ensure in this case a quick and smooth intervention of the controllers, a special procedure is started. First an armature current demand value of 5 % is given. Dependent on the direction of rotation the polarity of the armature current demand value is determined in such a way that a quadrant with motor operation results. If an armature current greater than the parameter /I_BR_EN is flowing, which is according to standard adjusted with 4 %, the internal control signal CURREXST is set to YES.

For the synchronisation of the current controller to be as fast as possible, the integral component of the PI control is set to an initial value which is calculated from the speed, the field current and a factor /U0_EMF. The factor U0_EMF is determined during the self-optimization of the armature current controller and is put down under the parameter IA_CTRL:/U0_EMF.

When switching on to rotating machine it is mostly meaningful that after the enabling of the speed controller and the ramp the output of the ramp starts with the actual speed value. A possibly deviating demand value at the input of the ramp will arrive the output in the adjusted ramp time. This behavior of the ramp is preset by the standard setting of the parameter LOG_CTRL:LOGIC:ACTIVBIT:/CAPTURE to YES.

If the external control signal CTRL_EN is set back to NO while the machine is running, then the armature current controller, the speed controller and the ramp are disabled and the machine coasts.

6.1.5 Demand enable

The external control signals DMND_L (demand enable for CCW operation) and DMND_R (demand enable for CW operation) affect the software module LOG_CTRL:INOUT (see also Fig. 10 in section 2.8.1). With these two signals the polarity of the speed demand value can be exchanged. If both signals are NO, the demand value at the output of the INOUT module is zero. If for example the signal DMND_L is set to YES, although the signal DMND_R has been already set to YES before, then the signal DMND_R remains active.

Furthermore the module contains adjustable borders for the speed demand value and an absolute-value generator. If for example a speed range from -100 % to +100 % rated speed should be driven through with a speed demand value from -10 V to +10 V, then the absolute-value generator must be switched off by setting the parameter LOG_CTRL:INOUT:FORM:/BIPOLAR to YES.

6.1.6 Disable

The opening of terminal :72, that means an interruption of the 24 V control voltage, generates the command "disable" by setting the signal PULS-DIS to YES. This immediately disables all controllers and the output relay K3 (main contactor on) releases after an adjustable time

(LOG_CTRL:LOGIC:OFF_DLYS:/MAINRLY, standard setting: 200 ms).

A resumption of operation is only possible with a positive flank of the ON signal (change from NO to YES).

6.1.7 Fast stop

The opening of terminal :73, that means an interruption of the 24 V control voltage, generates the command "fast stop" by setting the signal FASTSTOP to YES. If "Speed actual value equal zero" simulation is switched off, that means the parameter LOG_CTRL:LOGIC:ACTIVBIT:/XN0_SIM is set to NO, then with a 4-quadrant unit (+GO) the drive brakes regenerative with the adjusted ramp time. As soon as the control recognizes an actual speed value close to zero (LOG_CTRL:INOUT:OUTPUT:XN_0 = YES), all controllers are disabled and the output relay K3 (main contactor on) releases after an adjustable time (LOG_CTRL:LOGIC:OFF_DLYS:/MAINRLY, standard setting: 200 ms).

6.1.8 Control structure

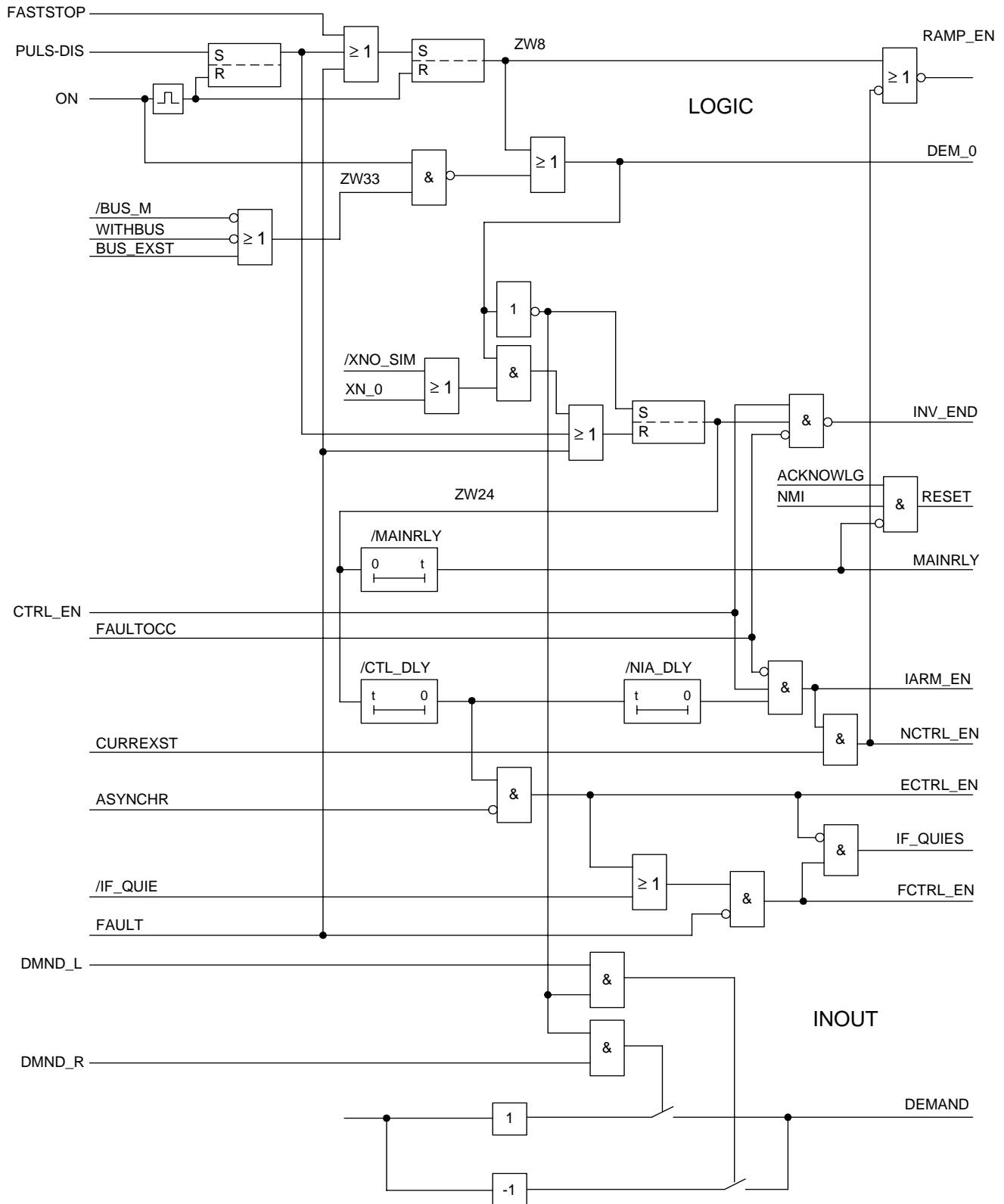
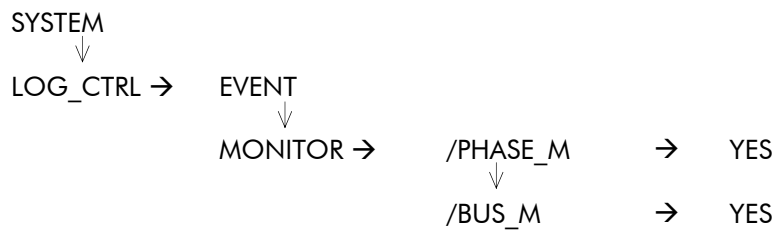


Fig. 41: Control structure

6.2 Monitor

Minisemi D units have a monitor system which shuts the system down if an error is detected and displays the cause of the error. The various possible error signals are grouped together. Individual monitor circuits can be rendered inactive using bit parameters, see Fig. 42. If the bit parameters accessed on the extended menu in



are set to NO, the relevant monitor circuit is inoperative.

6.2.1 Shutdown sequence in the event of an error

The monitor system is constructed so that not every tripping of an internal monitor circuit results in the unit being shut down. With most internal error messages first a so-called event bit FAULTOCC is set, which disables the armature current controller, the speed controller and the ramp and sets the 6pulse firing module of the armature circuit to the inverter end position. Only if the internal error message is detected for more than an adjustable delay time (LOG_CTRL:LOGIC:ON_DLYS:/FAULT, standard setting: 50 ms) or the frequency of the appearance within an adjustable time interval (LOG_CTRL:LOGIC:COUNTER:/WINDOW, standard setting: 750 ms) is greater than an adjustable number (/COUNT, standard setting: 3), it comes to a shutdown and an error message via output relays. Otherwise the event bit FAULTOCC is set back and the controllers are enabled again. If the machine is running during this procedure the case "Switching on to rotating machine" is present (see section 6.1.4).

Shutdown sequence in the event of an error

- the signal READY is set back to NO, output relays K2 releases, LED H2 goes out
- the error log is set and the signal FAULT is set to YES, output relay K1 picks up, LED H1 (yellow) lights up
- the thyristor firing pulses are moved to the inverter end position, all controllers are disabled
- the signal MAINRLY (main contactor on) is set to NO after an adjustable delay time (LOG_CTRL:LOGIC:OFF_DLYS:/MAINRLY, standard setting: 200 ms), output relays K3 releases, LED H3 goes out

6.2.2 Start-up sequence after an error shutdown

After an error shutdown the event log should be read before acknowledgement for purpose of error analysis - best through saving the data from the unit to hard disk or diskette. If this is not possible in the moment, at least the first value log should be read and noted (see section 6.2.3).

If the acknowledgement pushbutton is pressed when internal error messages are still present, the first value log is deleted and the current error messages are written in the first value log and also appear on the display or the PC screen for a short time. The yellow LED H1 for indicating an error remains on.

Only if no more current error messages are detected, the signal FAULT can be set back with the acknowledgement signal QUIT. A resumption of operation is only possible with a positive flank of the ON signal (change from NO to YES).

6.2.3 Event and first value log

All events – switching operations and errors – are registered sequentially into a so-called event log.

The event log has 30 memory locations, in which the last 30 events are stored. The memory locations are numbered from 0 to -29. Location 0 always contains the most recent entry, location -29 the oldest entry. When a new entry arrives, the existing entries are shifted downward one location and the oldest entry is deleted.

All events written into the event log get a suffix, either YES or NO, so that the appearance or disappearance of an event is marked.

It is possible that more than one event is recorded in a single memory location, if these were all detected during a single sampling cycle (3.3 ms).

The first error which causes the unit to be shut down is copied into the so-called first value log. This could also contain several error messages detected during the same sampling cycle. Then further events are stored to the event log until the first value reaches the storage location -15. Thus in addition to the "triggering" event also the previous history and possible subsequent errors are recorded in the event log.

In addition to the error which occurred first, the first value log also records any other event (a change in the logic status of the control inputs) taking place at the same time.

With the external control signal QUIT the first event log is deleted.

First error and first event are briefly displayed on the control panel and on the PC screen when they occur.

Reading the event log via the handling menu (control panel or PC)

The event log can be read on the menu under LOG_CTRL:EVENT.

Read first value log

For this, set 1ST_EVNT:/INFO = FAULT and then - as when transferring a parameter change - press the cursor key '⇒' whereby the stored message is displayed.

To check whether also an event was recorded with the first error, repeat this process with the setting 1ST_EVNT:/INFO = INTERRUPT.

Read event log

The memory locations of the event log (0 to -29) can be read individually. Set the number of the required memory location under MEMORY:/LOCATN and then call the message by pressing the cursor key '⇒'. All memory locations can be read simply by repeatedly pressing the cursor key '⇒'.

Save and list (print) contents of event log via PC and handling software

Save the latest data from the unit to hard disk or diskette by using function key F5 in the 'Terminal' (= online) mode. For example FAULT.DAT can be used as the file name. Under no circumstances may the original file produced during commissioning be overwritten.

Then exit from the terminal mode by pressing F10 and call the 'List Parameter' mode pressing F2.

You are offered the file you have just created, so that you can select it simply by pressing the ENTER key. Respond to the next prompts by press-in an E for the event log and then a P for Printing via the printer connected or an S to show on the screen.

The list shows the entries in the event log at the time the data was saved. The error message which occurred first and which caused the unit to shut down is printed in bold type (on printout) or displayed in a different colour (on screen).

6.3 Structure of monitor system

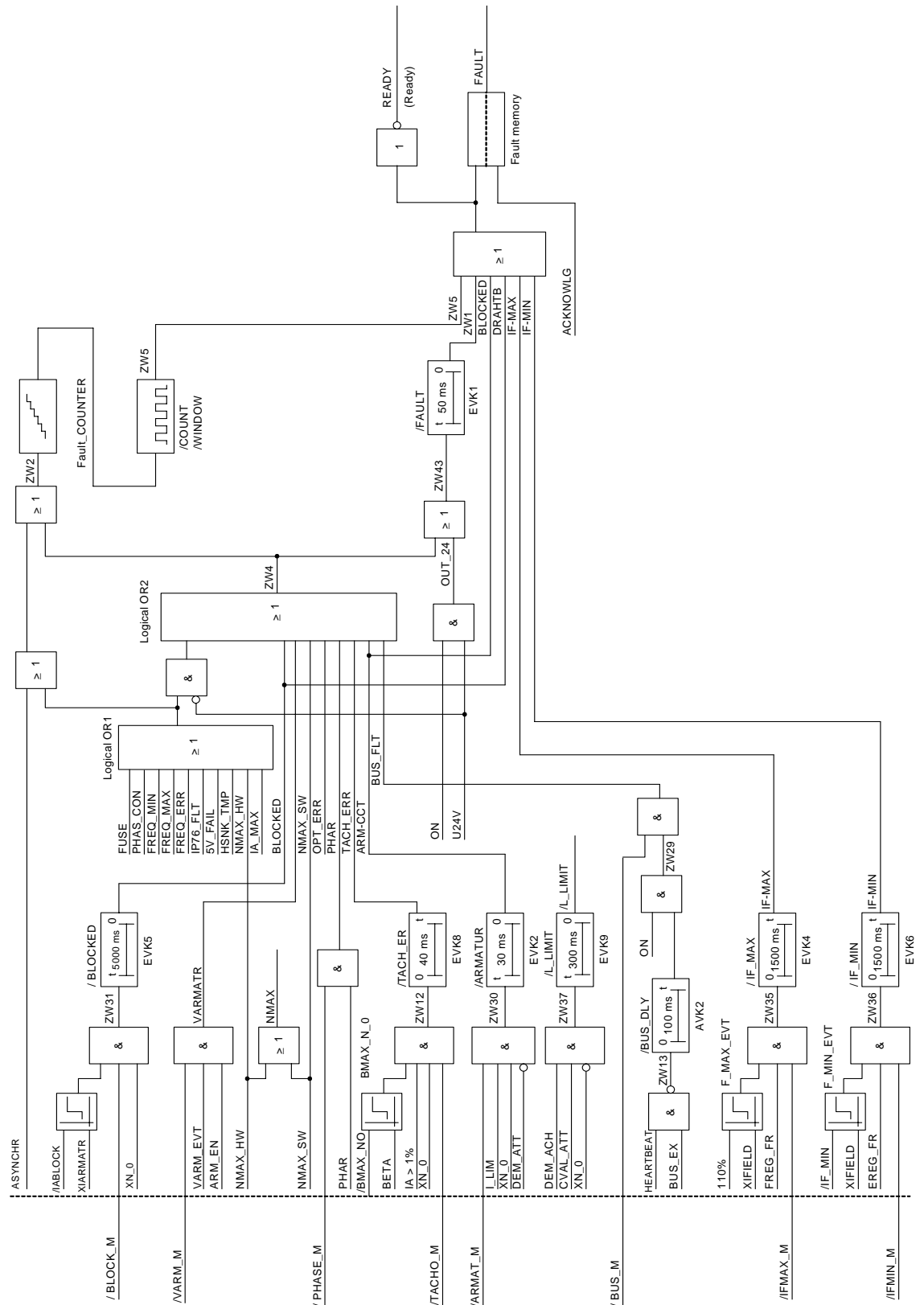


Fig. 42: Schematic layout of monitoring system

6.4 Error messages

The listed error causes are possible causes and must not be right in any case.
General system messages, see section 4.9.

Message	Meaning	Failure Tripping	Cause / Help
ARM-CCT	failure in the armature circuit	The armature-current regulator is at the upper limit and the speed is zero. Tripping takes place with a time delay, adjustable with parameter /ANKRS (1).	The armature-circuit is open, fuses are blown out, or the mains power supply is missing. Check up the contacts and links in the armature circuit.
ASYNCHR	the system is running asynchron	The sampling system is running asynchron to the mains.	Failure in the voltage supply of the regulator; for example phase-jump in the mains voltage
BLOCKED	Drive blocked	The speed is zero and the armature current is higher than the parameter /IABLOCK (2).	The drive is blocked mechanically or excitation is missing.
FUSE	fuses of the armature circuit are blown	The indicator of a fuse is tripped	One or several fuses are blown out. There was an overcurrent in the circuit. It is a failure in the armature circuit or the armature current regulator is adjusted incorrect. A overcurrent can also occur in case of a commutation failure when the mains voltage drops and the bridge is regenerative braking.
HSNK-TMP	overtemperature at the heatsinks	The thermo-contact at the heatsinks is tripped.	The ambient temperature is too high or the fan is out of order.
IA-MAX	over-current in the armature	The armature current is higher than 150 %.	Fault in the armature circuit or the armature current regulator is adjusted incorrect. Check up the whole armature circuit.
IF-MAX	over-current in the field	The field-current is higher than 110 %. Tripping takes place with a time delay, adjustable with the parameter /IF_MAX (1).	Reference value of the regulator is too high or field-interface is faulty. Check up the whole field circuit.
IF-MIN	under-current in the field	The field-current is lower than the parameter /IF_MIN (2). Tripping takes place with a time delay, adjustable with the parameter /IF_MIN (1).	The fuse in the field-circuit or the field-interface is faulty. Check up the whole field circuit.
IP76_INT	terminal 76 is open external fault	The connection between DC+24 V and the terminal 76 is open.	The external fault device or the chain of collection all the external faults is open.
NMAX-HW	overspeed detected by the hardware	The actual speed is higher than 110 %. The monitoring is only active if using an analog tachogenerator.	Speed-regulator is adjusted incorrect or reference value of the regulator is too high. Check up the complete speed control circuit.

Message	Meaning	Failure Tripping	Cause / Help
NMAX-SW	overspeed detected by the software	The actual speed is higher than the parameter /XNMAX (2).	Speed-regulator is adjusted incorrect or reference value of the regulator is too high. Check up the complete speed control circuit.
OPT-ERR	Fault during the automatic optimization	The optimization could not be completed successfully.	The requirements for the optimization are not fulfilled.
PHASFAIL	failure in the 3-phase voltages supply	The sequence of the phase voltages is faulty.	Incorrect connection of the phases (left-rotary field) or missing a phase. Check up the connections.
PHAS-CON	phase-allocation is incorrect	The phase-allocation of the control unit and the supply of the armature circuit is wrong. :13 :14 :15 / U V W	Wrong connection or one phase is missing. After commission the monitoring should be taken out of service; because the dips in the system voltage can causes a random tripping if the armature current is high enough. The parameter /PHASE_M (3) is set on NO.
SYN-ERR	synchron failure	By switching on the unit, the synchronization it failed.	Failure in the voltage supply of the regulator, or the signal, that is formed from the voltage supply, doesn't arrive at the processor. With continuous error messages change the IMRA- or the DC-Interface board.
TACH-ERR	tacho-generator or tacho-generator cable fault	The speed is zero, the armature current is larger than zero and the angle β is larger than the parameter /BMAX_NO (2). Tripping takes place with a time delay, adjustable with the parameter /TACH_ER (1).	Tacho-generator or the lines of the tacho-generator is faulty. Checkup of the entire feedback of the speed regulator.
V-ARMATR	actual value of armature voltage is missing	The armature voltage is less than 3 % and the speed is higher than 15 %.	The measuring-device of the armature voltage is faulty. Check up the measuring device.
5V-FAIL	5V supply failure	The monitoring is only active, if field-weakening is selected. The comparator on the Imra-board has tripped.	The 5 V power supply is faulty or it is a fault in the electronics. Check up the connections of the 5 V-supply on the IMRA-board.
24V-FAIL	24V supply failure	The comparator on the DC-interface has tripped.	The 24 V-power supply is faulty. The monitoring signal is linked with the ON-signal, so that the tripping is suppressed with the shutdown of the 3 AC-voltage supply. The tripping can occur incorrectly when the unit is switched off with the active ON-signal and is switched on again.

Notes:

→

- (1) In the menu under LOG_CTRL → LOGIC → ON_DLYS
- (2) In the menu under LOG_CTRL → INOUT → LIMITS
- (3) In the menu under LOG_CTRL → MONITOR
If errors occur occasionally or frequently and in particular:
 - 24V-FAIL
 - 5V-FAIL

and cannot be confirmed by a check, this is an indication that the cause is an electromagnetic disturbance injection.

Solution:

1. Pay careful attention to the measures described in section 3.2.
2. Check the system earthing.
3. Check the mains supply.

7 Maintenance

7.1 Maintenance and replacement of battery RAM chips (only with option "clock")

In case of operation with clock (option) both memory chips D13 and D14 on the processor card are battery-backed with a built-in battery. One of them, the so-called TIMEKEEPER-RAM, contains the clock. The batteries contained in the RAM chips do not only supply the clock but also maintain the data of the settings made during commissioning if the electronics supply is switched off. Any deep discharge of the batteries will be detected during the self-test carried out by the operating system directly after the electronics supply is switched on. In this case the message „Battery“ appears in the display. Operation can be continued without interruption but RAM chips should be replaced as soon as possible. After the appearing of the message „Battery“ electronics supply should be only switched off if new RAM chips are existing and if the settings are saved from the unit to a diskette or hard disk via PC and handling software. If the batteries should become discharged during a break of operation (with the electronics supply switched off), because of ignoring the specified maintenance intervals or because of defective RAM modules, so that the data is lost, this is also detected during the self-test. Operation can then only be continued after loading valid data from a PC to the converter or after a new parameter adjustment via the control panel.

Maintenance intervals

The TIMEKEEPER RAM D13 and the ZEROPOWER RAM D14 are both to be replaced at the maintenance intervals stated in the table below. The operating life of the batteries depends on the duty cycle of the electronics supply. The operating life of the TIMEKEEPER RAM greatly depends on whether the clock in this module is stopped or running.

Operating mode	Maintenance interval for RAM chips
Clock running, any duty cycle	3 years
Clock running, on state of duty cycle > 60 %	5 years
Clock stopped, any duty cycle	10 years

Replacement of RAM chips

Before replacing the RAM chips the parameter settings should be saved from the unit to a diskette or hard disk via PC and handling software, if this has not already been done. This must be carried out on-line in the terminal mode with the electronics supply switched on. Then, also in the terminal mode, the operating state of the clock (stopped or running) must be checked under SYSTEM → CLOCK → SET_UP → /MODE („Extended menu“ required, see section 4.7).

With the electronics supply switched off replace the RAM chips. After replacing the RAM chips:

- Switch the electronics supply on
- Load into the converter the data previously saved on the PC
- When operating with the clock running, start and set the clock
(Starting the clock, see section 3.1.3; setting date and time, see section 4.5)

Switching off the clock for longer rest breaks and storage

For the avoidance of an unnecessary battery discharge during longer rest breaks (> 6 months) the clock should be stopped before. Stopping and starting the clock, see section 3.1.3.

Operation with the clock stopped

If the internal clock is not required the operating life of the battery in the TIMEKEEPER RAM is extended considerably, also the maintenance intervals (see above). With the clock stopped, almost all functions of the unit are available.

The following characteristics change:

- Status and failure messages are written without date and time into the event memory.
- The password for reaching the „extended menu“ results no longer from the current date, but from a fixed date arbitrarily adjustable after stopping the clock.

Stopping and starting the clock, see section 3.1.3.

8 Recommended spare parts

Minisemi D 380/... E and GO, 500/... E and GO

Components	40	60	100	160	200	275	320	420	500	760 ... 1250
A1 GS-Interface										
029.129 897	E---	---	---	---	---	---				
029.129 896	GO---	---	---	---	---	---				
029.129 899							E---	---	---	
029.129 898							GO---	---	---	
029.129 846										E/GO
A6 Voltage supply 60 V										
029.114 916										E/GO
A2 IMRA96K ¹⁾										
029.209 916	E/GO	---	---	---	---	---	---	---	---	---
A3 Field interface 10 A										
029.139 617	E/GO	---	---	---	---	---				
A5 Transformer board										
029.138 493	E/GO	---	---	---	---	---				
V7 B2H compact module										
VHF 28-12 05A										
029.133 281	E/GO	---	---	---	---	---				
A3 Field interface 25 A										
029.139 632							E/GO	---	---	---
V8 SKKT 57/16										
029.218 251							E/GO	---	---	
V14 SKKT 57/16										
029.218 251										E/GO
V9 SKKD 26/16										
029.218 252							E/GO	---	---	
V15 SKKD 26/16										
029.218 252										E/GO

1) With option „clock“ additional battery RAM chips D13 and D14 necessary, see section „Spare components for all types“.
 If the EPROMs D10 and D11 with the unit software are not to be taken from the existing board, they must be ordered additionally, see section 1.1
 The same applies to the module A2-E1 "Anpassung GS" 029.108 026, which likewise sits on a socket.

8 Recommended spare parts

Minisemi D 380 /... E and GO

Components	40	60	100	160	200	275	320	420	500	760	875	1100	1250
V1 ...V3 (E)													
V1 ... V6 (GO)													
Thyristor compact modules													
SKKT 20/16													
029.218 250	E/GO												
SKKT 57/16													
029.218 251		E/GO	GO										
TT92N1600													
029.147 538			E	E/GO									
TT106N1200													
029.135 263					E/GO								
TT131N1600													
029.149 233						E/GO	-->						
TT250N1600													
029.097 275								E/GO	---				
Disc thyristors	complet module ¹⁾												
TO508N1600TOC													
029.063 625		029.062 848								E/GO	---		
TO718N1600TOC													
029.122 733		029.122 581										E/GO	---
M1 fan 1AC 230 V													
029.143 787			GO	E/GO	---	---							
T4 autotransformer for fan													
029.105 681			GO	E/GO	---	---	---	---	---				
M1, M2													
fan 1AC 230 V													
029.143 788							E/GO	---	---				
M1 fan 3AC 380 V													
029.120 988										E/GO	---	---	
M1, M2													
fan 3AC 380 V													
029.120 988													E/GO

¹⁾ For fast changing of thyristors: Thyristor clamped between two heatsinks

Minisemi D 500 /... E and GO

Componenten	40	60	100	160	200	275	320	420	500	760	875	1100	1160
V1 ...V3 (E)													
V1 ... V6 (GO)													
Thyristor compact modules													
SKKT 20/16													
029.218 250	E/GO												
SKKT 57/16													
029.218 251		E/GO	GO										
TT92N1600													
029.147 538			E	E/GO									
TT131N1600													
029.149 233					E/GO	---	-->						
TT250N1600													
029.097 275								E/GO	---	-->			
Disc thyristors	complet module ¹⁾												
TO508N1600TOC													
029.063 625		029.062 848								E/GO	---	-->	
TO718N1600TOC													
029.122 733		029.122 581										E/GO	---
M1 fan 1AC 230 V													
029.143 787			GO	E/GO	---	---	-->						
T4 autotransformer for fan													
029.105 679			GO	E/GO	---	---	---	---	---	-->			
M1, M2 fan 1AC 230 V													
029.143 788							E/GO	---	---	-->			
M1 fan 3AC 500 V													
029.120 989										E/GO	---	---	-->
M1, M2 fan 3AC 500 V													
029.120 989													E/GO

¹⁾ For fast changing of thyristors: Thyristor clamped between two heatsinks

Spare components for all types

	Ref. No.
A1 F1 ... F3 G-fuses, 0.25 A / 500V	029.149 254
A3 F1 G-fuses, 0.1 A/ 500V	029.149 251
Plug 14-pin. for A2	029.087 829
Plug 18-pin. for A2	029.093 765
Battery RAM chips for option "clock":	
A2-D13 Timekeeper RAM	029.350 412
A2-D14 Zero Power RAM	029.350 413

Note:

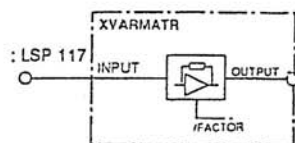
Units supplied may be fitted with suitable thyristors of types other than those stated here.

9 Function diagrams of software modules

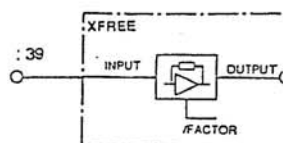
This list consists of three sheets and contains all software modules. Signal flow diagrams can be produced with these modules for project design work on new systems. This simplifies re-assignment and the commissioning of the units.

IMRA96 modules Page 1/3

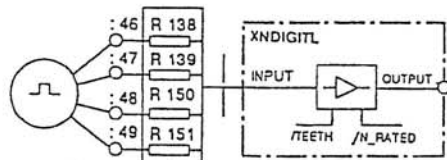
XVARMATR 30x20 mm 42mm



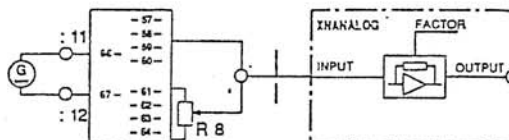
XFREE 30x20 mm 42mm



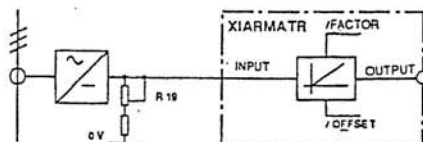
XNDIGITL 30x20 mm 65mm



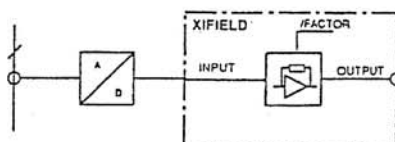
XNANALOG 30x20 mm 77mm



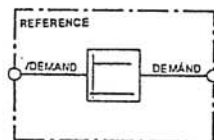
30x20 mm 63mm



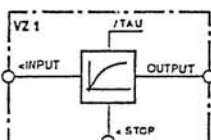
XIFIELD 30x20 mm 57mm



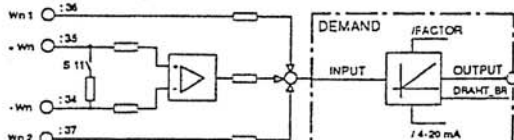
REFERENCE
30x20mm 22mm



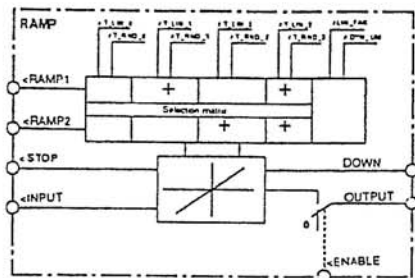
VZ1 30x20mm 32mm



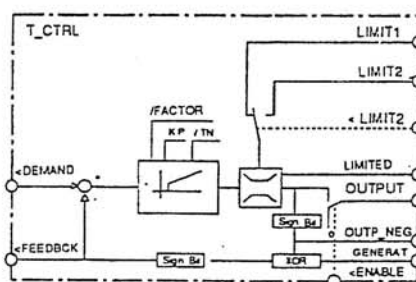
DEMAND 30x20mm 74mm



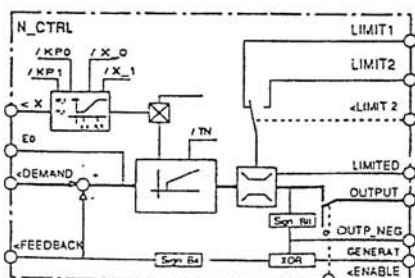
RAMP 60x40mm 62mm



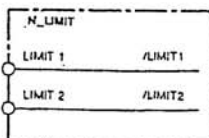
T_CTRL 60x40mm 62mm



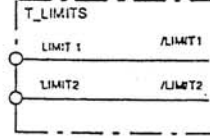
N_CTRL 60x40mm 62mm



N_LIMIT 30x20mm 21mm

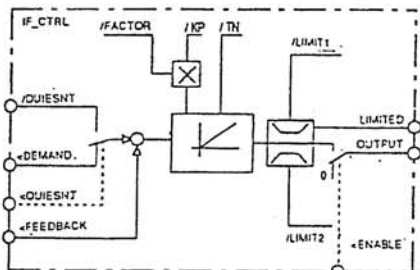


T_LIMITS 30x20mm 21mm

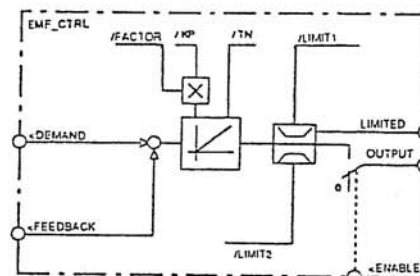


IMRA96 modules Page 2/3

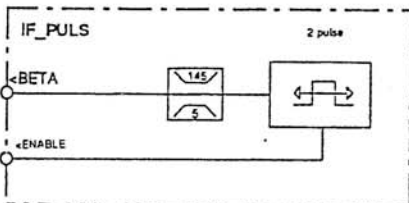
IF_CTRL 60x40mm 62mm



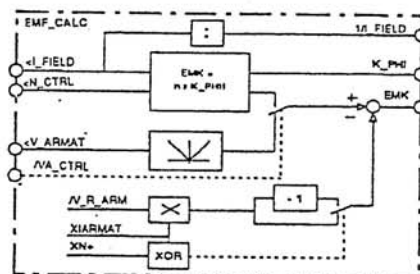
EMF_CTRL 60x40mm 62mm



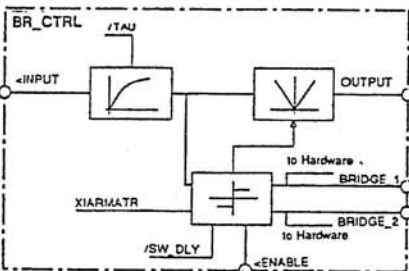
IF_PULS 60x30mm 62mm



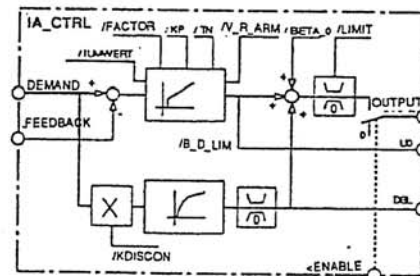
EMF_CALC 60x40mm 62mm



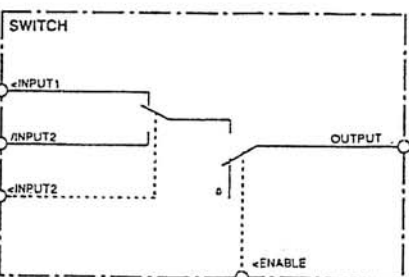
BR_CTRL 60x40mm 62



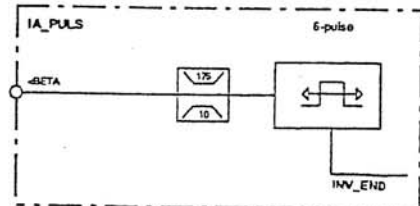
IA_CTRL 60x40mm 62mm



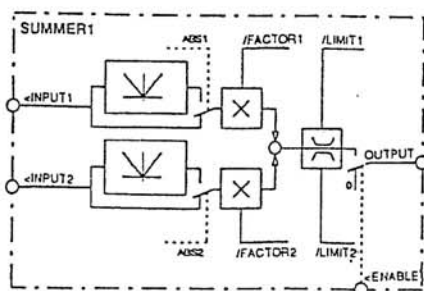
SWITCH 60x40mm 62mm



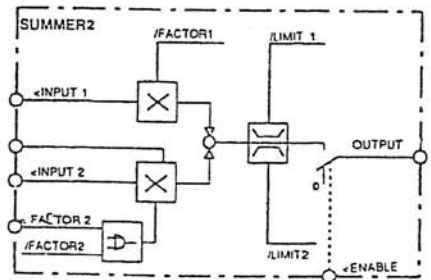
IA_PULS



SUMMER1 60x40mm 62mm

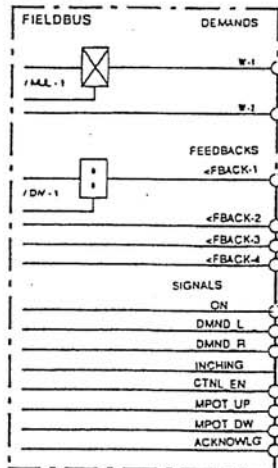


SUMMER2

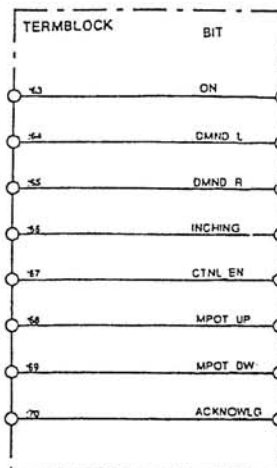


IMRA96 modules
Page 3/3

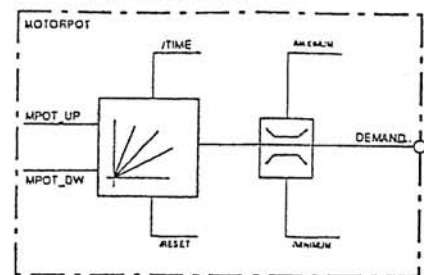
FIELDBUS 40x70mm 41mm



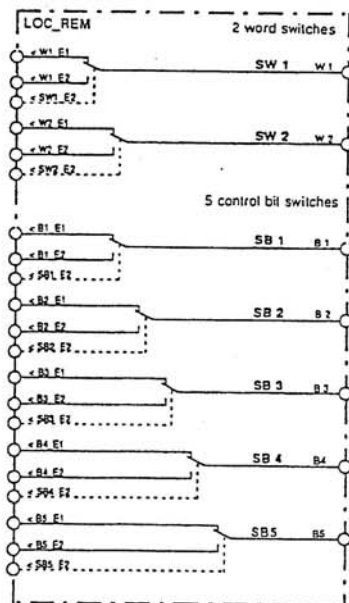
TERMBLOCK 40x70mm 42mm



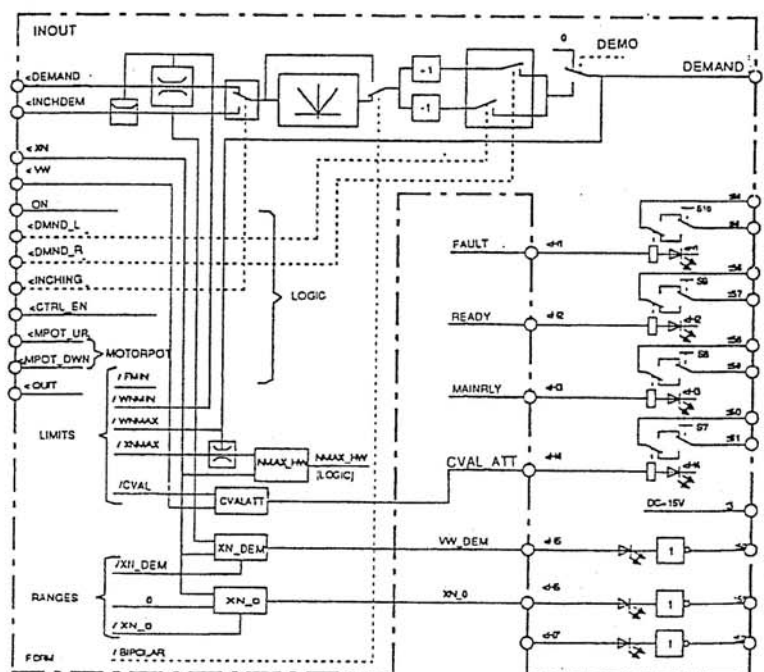
MOTORPOT 60x40mm 61mm



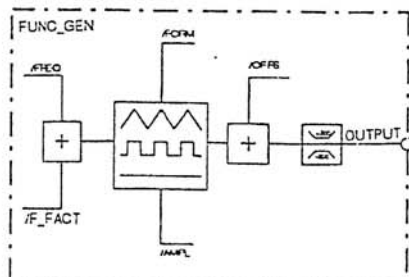
LOC_REM 50x90mm 52mm



INOUT 110x100mm 111mm



FUNC_GEN 60x40mm 61mm



Comments from users

For window envelope to DIN 680

It is our constant aim to improve the content and usefulness of our technical documentation. If you have any suggestions toward improvement or any additional requirements please complete and return this from to:

Converteam GmbH
S3-B
Culemeyerstraße 1
D-12277 Berlin

Sender/Stamp

Company:

Street:

Town:

Telephone:

Telefax:

Comments from users

Document:

Project notes / Operating manual / _____

Title: _____

Ref. No. 029. _____

Print No. _____

Suggestions (please type or print):

[illegible]

Many thanks for your assistance.

Please continue overleaf if necessary.

Converteam GmbH

Culemeyerstraße 1

12277 Berlin (Germany)

Tel.: +49 (0) 30 7622 2656

Fax: +49 (0) 30 7622 2494

a Converteam Group company

www.converteam.com