SIEMENS

2006 North America DC Drives Catalog

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simoreg DC MASTER

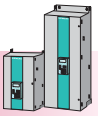
Digital Chassis Converters

SIEMENS

SIMOREG 6RA70 DC MASTER

Overview

Introduction



6RA70 DC MASTER

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A word about Siemens

Siemens AG

The parent company of Siemens Energy & Automation is Siemens AG, headquartered in Munich, Germany. Various Siemens divisions provide a broad spectrum of products, systems, and services worldwide. These include:
electronic components, medical electronics, power engineering, and automation products and systems, as well as public and private telecommunications networks.

Siemens' worldwide sales exceed $75 billion in 2001, ranking it among the world's largest electrical companies. Siemens ranks second in manufacturing. Siemens employs approximately 480000 people in 193 countries, 500 manufacturing facilities in 50 countries on 6 continents. A leading edge company, Siemens annually reinvests between 8 – 10 % of sales in research and development activities, ranking in the number one position in this category, along with companies like Intel.

Siemens U.S.A.

The Siemens family of more than twenty companies, subsidiaries, affiliates, and joint ventures in the United States is well established and growing with annual sales in excess of $16.2 billion. Siemens employs more than 85000 people in the U.S., in ninety-three domestic manufacturing facilities and more than two-hundred thirty sales and service locations.

Siemens Energy & Automation, Inc.

One of the largest Siemens companies in the U.S. is Siemens Energy & Automation, Inc. with over 12000 employees and annual sales in excess of $2 billion.

Siemens Energy & Automation is headquartered near Atlanta, Georgia and has 28 U.S. manufacturing facilities. SEA' s facilities throughout the U.S. manufacture, market, and service a wide variety of electrical and electronic equipment and systems that protect, regulate, control, distribute electric power, convert electric power to mechanical energy, and automate various manufacturing and industrial processes. SEA produces 85 % of its products domestically, and markets them worldwide.

Siemens Energy & Automation products are sold in two general market segments:
industrial and construction. Our business units are organized into four primary operating divisions:
Strategic Machinery Division, Process Industries Division, Industrial Products Division, and Industrial Services Division.

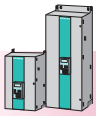
Strategic Machinery Division business unit

The Strategic Machinery Division develops, engineers, manufactures, markets, and services adjustable speed drive and automation products. Our adjustable speed drive and automation products are among the finest in the world. Siemens DC drives have historically offered consistently superior performance and high quality, due to our commitment to continuous improvement in product technologies and production processes.

How the general information is organized

General information

Welcome to Siemens
Siemens policies/protocols
Siemens return goods policy
Siemens repairs & returns for warranty
Siemens technical services
Siemens emergency access
Standard terms and conditions of sale



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Customer service United States

Welcome to Siemens US

If you are a new Siemens Drive Products customer, we thank you for doing business with us. We will work hard to earn your trust and serve your company as if it were our own! If you are currently doing business with us, we thank you for the opportunity to grow with you.

Your primary contact point in the United States for the 6RA70 DC MASTER and all other Siemens drive products are the Regional Sales Offices in the following locations:

Atlanta

5405 Metric Place
Suite 100
Norcross, GA 30092
Phone: 770-452-3400
Fax: 678-297-8409

Dallas

501 Fountain Parkway
2nd Floor
Grand Prairie, TX 75050
Phone: 817-640-4929
Fax: 817-640-9640

Chicago

1901 N. Roselle Road
Suite 210
Schaumburg, IL 60195
Phone: 800-333-7732
Fax: 888-333-8206

Houston

13105 NW Freeway
Suite 950
Houston, TX 77040
Phone: 713-690-3000
Fax: 713-690-1210

Kansas City

6201 College Blvd
Suite 385
Overland Park, KS 66211
Phone: 913-498-4200
Fax: 913-498-4240

Los Angeles

10655 Business Center Dr
Suite C1
Cypress, CA 90630
Phone: 714-252-3000
Fax: 714-527-7230

Philadelphia

323 Norristown Road
Suite 210
Amber, PA 19002
Phone: 800-388-8067
Fax: 215-283-4702

Siemens policies/protocols

Minimum order

SE&A will assess a $25 handling fee on all orders valued at less than $400.

Freight

All of our original product shipments are F.O.B. point of shipment. For standard product orders greater than $1000 shipping from SE&A distribution centers, charges are freight allowed via method selected by SE&A. For orders less than $1000, motors, and non-standard product freight charges are pre-paid and added to the invoice. All air freight charges are the responsibility of the customer. Also, a customer account number is required for third party billing of freight charges.

Emergency/Expedite fees

When customers require urgent delivery, several methods of expedited delivery are available. Each is noted below along with the associated charges:

NEXT FLIGHT OUT –
This service provides same day service where possible. In all cases, the expedited surcharge is $300. The customer is responsible for the associated freight charges.

AFTER HOUR SERVICE –
Orders placed for same day shipment after 5:00 pm eastern time and weekends/holidays are subject to a $300 surcharge. The customer is responsible for the associated freight charges.

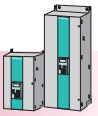
SPARE PARTS FROM INTERNATIONAL LOCATIONS –
Siemens Energy & Automation supports all Siemens Drive Products in the USA, regardless of their country of origin. However, certain products may require shipment from an international emergency warehouse to meet customer delivery requirements. In such cases the minimum order value for such items is $300 net. If the order does not total $300, an additional charge will be added to bring the total order to $300. (The normal $25 surcharge will not apply). Siemens features an international emergency warehouse that can ship many parts within 24 hours. Most parts can arrive in the United States within 2 – 4 days. Your Costomer Service or Sales Representative can check to see if your part is in stock in the emergency warehouse.

CUSTOMER PICK UP –
All customer pick up orders will be ready 2 hours after order is received, and must be picked up within 24 hours. There is no additional charge for this service.

Returns

Standard products fall under the SE&A standard product return guidelines (below). Drive systems in cabinets, built to specification, motors, or other non-standard items do not fall under this policy. Contact your Sales or Customer Service Representative should you have questions regarding return policy.

Customer service United States



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Siemens return goods policy

A Return Goods Request/ Authorization (RGA) is required to accompany all products returned to Siemens Energy & Automation, Inc. (Siemens). This insures that the returned product is properly identified and credited to your account. Unauthorized returns will be refused and returned to the customer with no liability to Siemens.

To provide our customers maximum opportunity for inventory control, we have established three classes of product returns:

- Accommodation return
- Siemens error return
- Non-Conforming product warranty return

Product built to a customer's specifications cannot be returned for credit or exchange, subject to return only when material in Siemens' opinion has express economic value for potential resale. If returned product is a result of error(s) on the part of Siemens, a full credit to your account will be allowed including freight charges. All other returns, freight and handling will be prepaid by customer.

In all cases except when alleged personal injury/product liability is involved, your account will be credited and a credit memo will be issued within 15 working days from receipt of material. Credit is determined either from the original invoice if referenced, or current stock pricing – less restocking charges, cash discount application and repackaging fees where applicable. Shipments returned without referencing a returned goods authorization (RGA) number will be refused by Siemens. Siemens reserves the right to rebill within 90 days from our receipt of material based on results of a physical inspection of the product.

All claims for loss, damage or delays in transit are to be transacted by the consignee directly with the carrier. The issuance of this RETURN GOODS AUTHORIZATION shall not be construed as an acceptance of any responsibility or liability on the part of the Company or as a waiver of any right to make a determination as to the Company's responsibility.

Return goods authorizations will be automatically cancelled and have no further effect unless the returned goods are received by the Company within 60 days after the date of issuance.

Accommodation return

Accommodation returns provide Siemens customers the opportunity to return product ordered in error or in excessive quantities. Products eligible for return must be of current design and revision level, unopened, unused, undamaged, in the original "as-shipped" package and securely packed to be received by Siemens without damage. Software may only be returned when the seal has not been broken. Customized, engineered and/or energized products may not be returned without prior approval and in Siemens' opinion have express economic value for potential resale.

Accommodation returns are subject to a 10 % restocking charge. If cleaning or repackaging is necessary, an additional 15 % per item repackaging charge will be deducted from any credit issued. After inspection of the returned product, your account will be credited for the full invoice value of the merchandise, less applicable charges.

Customer should not deduct credit for products returned from payments. Credit will be processed within 15 days of receipt of material. The customer is responsible for costs, including freight and handling, for returned product to Siemens.

Siemens error return

Siemens error returns provide customers the opportunity to return material within 60 days of shipment in the event of a Siemens order or shipment error. Original purchase order, invoice number and date must be referenced. Products must be unopened, unused, undamaged, in the original "as-shipped" package or in static protection, and securely packed to be received by Siemens without damage. Software may only be returned when seal has not been broken.

A return goods authorization (RGA) number will be issued as authorization to return the product(s) to Siemens. After receipt and inspection of the returned product, a credit will be issued for the full invoice value of the merchandise, or a replacement part provided. If the returned product(s) packaging is deemed not saleable, a 15 % per item charge will be deducted from the credit issued.

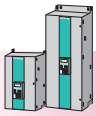
Product should be returned collect by a Siemens approved freight carrier or freight charges may be assessed. Freight charges will be credited if the entire shipment is returned due to Siemens error.

Non-Conforming product warranty return

Non-Conforming product warranty returns enable Siemens customers to return product to the factory for replacement, exchange or credit if found to be non-conforming in accordance with the conditions of the Company's product warranty.

It is at Siemens discretion whether to replace, repair or issue a credit for non-conforming products. The warranty at no cost is conditional, and will be determined by a technical validation of the warranty once the non-conforming item is received in our repair department or authorized service center. Please note, if you should fail to return the non-conforming part within 10 days upon instructions from Siemens, you will be invoiced in full for the replacement part.

Product should be returned collect by a Siemens approved freight carrier, or freight charges may be assessed.



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Customer service United States

Siemens return goods process – Accomodation

A Return Goods Request/ Authorization (RGA) is required to accompany all products returned to Siemens. This insures that the returned product is properly identified and credited to your account. Unauthorized returns will be refused and returned to the customer with no liability to Siemens.

Accommodation return

Accommodation returns provide Siemens customers the opportunity to return product ordered in error or in excessive quantities.

Procedures

A. Customer contacts Customer Service or inside sales person to initiate return of material.

B. Products must be unopened, unused, undamaged, in the original “as-shipped” package or in static protection, and securely packed to be received by Siemens without damage. Software may only be returned when seal has not been broken.

C. Siemens Energy & Automation will process your request and a return goods authorization (RGA) number will be issued as authorization to return the product(s) to Siemens.

D. A copy of your approved RGA and shipping instructions will be faxed to you.

E. Customer ships product to designated Siemens location. A Return Goods Request/Authorization (RGA) is required to accompany all material returned to Siemens.

F. The customer is responsible for costs, including freight and handling, for returned product to Siemens.

G. For all material returned in conformance with this policy, a credit will be issued promptly by Siemens within 15 days of receipt of material.

H. Customers should not take a deduction for material returned until Siemens has issued the above mentioned credit.

I. All returned materials are subject to inspection by Siemens. Returns not complying with this policy will be returned to their sending location.

J. Stock products are subject to a 10 % restocking charge. Customized and engineered products are subject to a negotiated restocking charge.

K. An additional 15 % re-packaging charge will be applied for returned material not suitable for resale, or returned in broken inner cartons requiring inspection and re-packaging. No re-packaging charge of any kind will be applied when material is returned in undamaged, original inner/outer cartons suitable for resale.

Siemens return goods process – Siemens error

A Return Goods Request/ Authorization (RAG) is required to accompany all products returned to Siemens. This insures that the returned product is properly identified and credited to your account. Unauthorized returns will be refused and returned to the customer with no liability to Siemens.

Siemens error return

Siemens error returns provide customers the opportunity to return material within 60 days of shipment in the event of a Siemens order or shipment error.

Procedures

A. Customer contacts Customer Service or inside sales person to initiate return of material. Original purchase order number or invoice number must be available for reference.

B. Products must be unopened, unused, undamaged, in the original “as-shipped” package or in static protection, and securely packed to be received by Siemens without damage. Software may only be returned when seal has not been broken.

C. Siemens will process your request and a return goods authorization (RGA) number will be issued as authorization to return the product(s) to Siemens.

D. A copy of your approved RGA and shipping instructions will be faxed to you.

E. Customer ships product to designated Siemens location. A Return Goods Request/Authorization (RGA) is required to accompany all material returned to Siemens.

F. Material should be returned following the Routing/Preferred Carrier instructions located on the shipping instructions. If these instructions are not followed freight charges may be assessed.

G. For all material returned in conformance with this policy, a credit will be issued by within 15 days of receipt of material or a replacement part provided.

H. Customers should not take a deduction for material returned. Siemens will issue a credit within 15 days of receipt of material.

I. All returned materials are subject to inspection by Siemens. Returns not complying with this policy will be returned to their sending location.

J. An additional 15 % re-packaging charge will be applied for returned material not suitable for resale, or returned in broken inner cartons requiring inspection and re-packaging. No re-packaging charge of any kind will be applied when material is returned in undamaged, original inner/outer cartons suitable for resale.

Siemens return goods process – Non-Conforming (Warranty)

A Return Goods Request/ Authorization (RAG) is required to accompany all products returned to Siemens. This insures that the returned product is properly identified and credited to your account. Unauthorized returns will be refused and returned to the customer with no liability to Siemens.

Non-Conforming product return (Drives)

Non-Conforming product warranty returns enable Siemens customers to return product to the factory for replacement, exchange or credit if found to be non-conforming in accordance with the conditions of the Company’s product warranty.

Procedures

A. Customer contacts Technical Support (1-800-333-7421) to initiate return of material. A list of products requested to return and alleged failure scenarios are communicated to Siemens for processing.

B. Siemens will process your request and a return goods authorization (RGA) number will be issued as authorization to return the product(s) to Siemens.

C. If the return is an emergency, e.g. your equipment is down, and the warranty can be validated commercially, for approved product categories Siemens will ship a replacement part to you at no charge. If you should fail to return the non-conforming part within 10 days upon instructions from Siemens, you will be invoiced in full for the replacement part.

D. A copy of your approved RGA and shipping instructions will be faxed to you.

E. Customer ships product to designated Siemens location. A Return Goods Request/Authorization (RGA) is required to accompany all material returned to Siemens.

F. Material should be returned following the Routing/Preferred Carrier instructions located on the shipping instructions. If these instructions are not followed freight charges may be assessed.

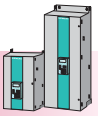
G. Conforming products will be shipped back to the customer.

H. For all material returned in conformance with this policy, a credit will be issued by Siemens after an evaluation of the received material or a replacement part provided.

I. Customers should not take a deduction for material returned.

J. All returned materials are subject to inspection by Siemens. Returns not complying with this agreement will be returned to their sending location.

Customer service United States



Optional warranties

Repair, replacement, and warranty service

All claims for warranty repair or replacement must initially be made to Drives Technical Service at 1-800-333-7421. Should the problem not be solved over the phone, an RGA will be issued to return the defective part. If the warranty can be validated commercially (ship date falls within warranty period) a replacement part can be shipped if available. SE&A will pay for best way freight on such replacements. The customer is responsible for expedited freight delivery.

Once the defective product has been returned, a technical evaluation will be performed to validate the warranty. Should the unit be found to not meet warranty requirements, and purchase order will be requested from the customer.

If your warranty has expired, you may still want to take advantage of our excellent repair and replacement service. Highly trained technicians perform incoming tests to determine the exact failure, repair the equipment, and fully test prior to shipment back to the customer. However, if you elect, we may be able to send you a remanufactured part for 60 % of the list price of a new part less your applicable discount on an exchange basis. Remanufactured parts carry a ninety (90) day warranty. Your Sales or Customer Service Representative can tell you which parts are included in our repair and replacement program. Should you take advantage of this program, please note that the original part must be returned to SE&A within ten (10) days, or an invoice will be issued for the additional 40 %.

Replacement warranty

Should a remanufactured replacement of a defective item be the solution to a warranty claim, the remanufactured part shall be under warranty for the duration of the warranty of the original item or ninety (90) days, whichever is longer. A remanufactured part (other than original warranty replacement) carries a ninety (90) day warranty.

Extended warranty

Drive products offers an extended warranty for all products sold. An extended warranty of 12 months is offered with a surcharge of 5 % of the net price of the product. This extended warranty offer is only available if ordered prior to time of original shipment from Siemens.

Deferred warranty

Siemens also offers a deferred warranty for all products sold. Commissioning must also be purchased to inspect the condition of the drive and supervise the start up. This deferred warranty offer is only available if ordered prior to time of original shipment from Siemens. The deferred warranty is offered for those applications that will have a delayed installation period, but only require a 12 month warranty from the date of commissioning. The chart below is a listing of the warranty periods and fees for the deferred warranty and the extended warranty programs.

Months from	Standard warranty	6 month deferred warranty	12 month deferred warranty
Installation	12	12	12
Manufacturing	18	24	30
% of net	0 %	1 %	2 %

Siemens technical services

The Technical Service Group is responsible for technical service support for customers, field service, and sales engineers. Requests for parts, equipment commissioning, emergency service, or routine maintenance are coordinated and scheduled through this group.

Service coordination and technical support for a wide variety of drive products, including both domestic and international supplied units, are available from this team. Interfacing with the Siemens Service Organization, other Siemens Divisions, and supplier service facilities, this group is the single point of contact in effectively providing remote technical and field service support.

Over the past year, an internal survey showed that greater than 95 % of the problems called in were resolved over the telephone. This level of technical expertise has significantly reduced the number of on-site service calls.

Technical Service is available 24-hours, 7 days a week by dialing 1-800-333-7421; ask for Drives Technical Services and the call will be channeled automatically through a call center which activates the appropriate personnel for both parts and technical support.

Siemens emergency access

The Drive Products Business Unit has an emergency spare parts depot at Atlanta Hartsfield International Airport. Same day delivery requirements are often serviced out of this Depot as well as after hour shipments including weekends and holidays. This has allowed us to expedite emergency shipment, saving several hours in the process.

To activate our Emergency/ After Hours Service, simply dial 1-800-333-7421 and ask for Drives Technical Service and the call will be automatically transferred to our message service, who will in turn page the On-Call Representative.

Tell the operator there is an emergency and you would like to contact after hour's personnel for spare parts or technical service, and we will return your call immediately.

Standard terms and conditions of sale (9/1/2001)

Siemens Energy & Automation, Inc. ("Seller")

1. **WARRANTY**
   (a) Seller warrants that on the date of shipment the goods are of the kind and quality described herein and are free of nonconformities in workmanship and material. This warranty does not apply to goods delivered by Seller but manufactured by others.

   (b) Buyer's exclusive remedy for a nonconformity in any item of the goods shall be the repair or the replacement (at Seller's option) of the item and any affected part of the goods. Seller's obligation to repair or replace shall be in effect for a period of one (1) year from initial operation of the goods but not more than eighteen (18) months from Seller's shipment of the goods, provided Buyer has sent written notice within that period of time to Seller that the goods do not conform to the above warranty. Repaired and replacement parts shall be warranted for the remainder of the original period of notification set forth above, but in no event less than 12 months from repair or replacement. At its expense, Buyer shall remove and ship to Seller any such nonconforming items and shall reinstall the repaired or replaced parts. Buyer shall grant Seller access to the goods at all reasonable times in order for Seller to determine any nonconformity in the goods. Seller shall have the right of disposal of items replaced by it. If Seller is unable or unwilling to repair or replace, or if repair or replacement does not remedy the nonconformity, Seller and Buyer shall negotiate an equitable adjustment in the contract price, which may include a full refund of the contract price for the nonconforming goods.

   (c) SELLER HEREBY DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, EXCEPT THAT OF TITLE. SPECIFICALLY, IT DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, COURSE OF DEALING AND USAGE OF TRADE.

   (d) Buyer and successors of Buyer are limited to the remedies specified in this article and shall have no others for a nonconformity in the goods. Buyer agrees that these remedies provide Buyer and its successors with a minimum adequate remedy and are their exclusive remedies, whether Buyer's or its successors' remedies are based on contract, warranty, tort (including negligence), strict liability, indemnity, or any other legal theory, and whether arising out of warranties, representations, instructions, installations, or nonconformities from any cause.

   (e) Note: This article 1 does not apply to any software which may be furnished by Seller. In such cases, the attached Software License Addendum applies.

2. **PATENTS**
   Seller shall pay costs and damages finally awarded in any suit against Buyer or its vendees to the extent based upon a finding that the design or construction of the goods as furnished infringes a United States patent (except infringement occurring as a result of incorporating a design or modification at Buyer's request), provided that Buyer promptly notifies Seller of any charge of infringement, and Seller is given the right at its expense to settle such charge and to defend or control the defense of any suit based upon such charge. Seller shall have no obligation hereunder with respect to claims, suits or proceedings, resulting from or related to, in whole or in part, (i) the use of software or software documentation, (ii) compliance with Buyer's specifications, (iii) the combination with, or modification of, the goods after delivery by Seller, or (iv) the use of the goods, or any part thereof, in the practice of a process. THIS ARTICLE SETS FORTH SELLER'S ENTIRE LIABILITY WITH RESPECT TO PATENTS.

3. **PERFORMANCE; DELAYS**
   Timely performance by Seller is contingent upon Buyer's supplying to Seller, when needed, all required technical information and data, including drawing approvals, and all required commercial documentation. If Seller suffers delay in performance due to any cause beyond its reasonable control, the time of performance shall be extended a period of time equal to the period of the delay and its consequences. Seller will give to Buyer notice within a reasonable time after Seller becomes aware of any such delay.

4. **SHIPMENT, TITLE AND RISK OF LOSS**
   Unless the delivery terms of this contract expressly provide for F.O.B. destination, shipping/delivery will be F.O.B. Seller's point of shipment with title to the goods and risk of loss or damage passing to Buyer at that point. Buyer will be responsible for shipment during transit and for filing any damage or loss claims directly with the carrier. Seller may make partial shipments.

5. **TAXES**
   Any applicable duties or sales, use, excise, value-added or similar taxes will be added to the price and invoiced separately (unless an acceptable exemption certificate is furnished).

6. **TERMS OF PAYMENT**
   (a) Unless otherwise stated, all payments shall be in United States dollars, and a pro rata payment shall become due as each shipment is made. If shipment is delayed by Buyer, date of notice of readiness for shipment shall be deemed to be date of shipment for payment purposes.

   (b) On late payments, the contract price shall, without prejudice to Seller's right to immediate payment, be increased by 1 1/2 % per month on the unpaid balance, but not to exceed the maximum permitted by law.

   (c) If any time in Seller's judgment Buyer is unable or unwilling to meet the terms specified, Seller may require satisfactory assurance or full or partial payment as a condition to commencing or continuing manufacture or making shipment, and may, if shipment has been made, recover the goods from the carrier, pending receipt of such assurances.

7. **NONCANCELLATION**
   Buyer may not cancel or terminate for convenience, or direct suspension of manufacture, except with Seller's written consent and then only upon terms that will compensate Seller for its engineering, fabrication and purchasing charges and any other costs relating to such cancellation, termination or suspension, plus a reasonable amount for profit.

8. **NUCLEAR**
   Buyer represents and warrants that the goods covered by this contract shall not be used in or in connection with a nuclear facility or application. If Buyer is unable to make such representation and warranty, then Buyer agrees to indemnify and hold harmless Seller and to waive and require its insurers to waive all right of recovery against Seller for any damage, loss, destruction, injury or death resulting from a "nuclear incident", as that term is defined in the Atomic Energy Act of 1954, as amended, whether or not due to Seller's negligence.

9. **LIMITATION OF LIABILITY**
   Neither Seller, nor its suppliers shall be liable, whether in contract, warranty, failure of a remedy to achieve its intended or essential purposes, tort (including negligence), strict liability, indemnity or any other legal theory, for loss of use, revenue or profit, or for costs of capital or of substitute use or performance, or for indirect, special, liquidated, incidental or consequential damages, or for any other loss or cost of a similar type, or for claims by Buyer for damages of Buyer's customers. Seller's maximum liability under this contract shall be the contract price. Buyer and Seller agree that the exclusions and limitations set forth in this article are separate and independent from any remedies which Buyer may have hereunder and shall be given full force and effect whether or not any or all such remedies shall be deemed to have failed of their essential purpose.

10. **GOVERNING LAW AND ASSIGNMENT**
    The laws of the State of Georgia shall govern the validity, interpretation and enforcement of this contract, without regard to its conflicts of law principles. The application of the United Nations Convention on Contracts for the International Sale of Goods shall be excluded. Assignment may be made only with written consent of both parties; provided, however, Seller may assign to its affiliate without Buyer's consent.

11. **ATTORNEY FEES**
    Buyer shall be liable to Seller for any attorney fees and costs incurred by Seller in enforcing any of its rights hereunder.

12. **DISPUTES**
    Either party may give the other party written notice of any dispute arising out of or relating to this contract and not resolved in the normal course of business. The parties shall attempt in good faith to resolve such dispute promptly by negotiations between executives who have authority to settle the dispute. If the matter has not been resolved within 60 days of the notice, either party may initiate nonbinding mediation of the dispute.

13. **STATUTE OF LIMITATIONS**
    To the extent permitted by applicable law, any lawsuit for breach of contract, including breach of warranty, arising out of the transactions covered by this contract, must be commenced not later than twelve (12) months from the date the cause of action accrued.

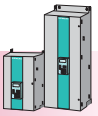
14. **PRICES**
    In the event of a price increase or decrease, the price of goods on order will be adjusted to reflect such increase or decrease. This does not apply to a shipment held by request of Buyer. Goods already shipped are not subject to price increase or decrease. Orders on a bid or contract basis are not subject to this article. Seller's prices include the costs of standard domestic packing only. Any deviation from this standard packing (domestic or export), including U.S. Government sealed packing, will result in extra charges. To determine such extra charges, consult Seller's sales offices. Orders of less than $400 will be charged a $25 handling fee.

15. **ADDITIONAL TERMS OF PAYMENT**
    (a) Invoice payment terms are as shown on latest discount sheets as issued from time to time. Cash discounts are not applicable to notes or trade acceptances, to prepaid transportation charges when added to Seller's invoices or to discountable items if there are undisputed past due items on the account. Portions of an invoice in dispute should be deducted and the balance remitted with a detailed explanation of the deduction. Cash discounts will only be allowed on that portion of the invoice paid within the normal discount period.

    (b) Freight will be allowed to any common-carrier free-delivery point within the United States, excluding Alaska and Hawaii, on shipments exceeding $1000 net or more providing Seller selects the carrier. On shipments to Alaska and Hawaii, freight will be allowed to dockside at the listed port of debarkation nearest the destination point on shipments of $1000 net or more. Buyer shall pay all special costs such as cartage, stevedoring and insurance. Special freight allowances are as shown on latest discount sheets as issued from time to time. Cataloged weights are estimated, not guaranteed. Seller assumes no responsibility for tariff classifications on carriers.

16. **CHANGES IN LAWS AND REGULATIONS**
    Seller's prices and timely performance are based on all applicable laws, rules, regulations, orders, codes, standards or requirements of governmental authorities effective on the date of Seller's proposal. Any change to any law, rule, regulation, order, code, standard or requirement which requires any change hereunder shall entitle Seller to an equitable adjustment in the prices and any time of performance.

Customer service Canada



Welcome to Siemens Canada Ltd.

As a subsidiary of Siemens AG, Siemens in Canada draws on the global network of innovation to generate revenues of more than $2 billion. Good news for our economy and our way of life. From its corporate headquarters in Mississauga, Ontario, Siemens employs 6300 Canadians coast to coast, developing solutions for the entire country. And exporting solutions around the world, in the amount of 60 % of Canadian production.

Siemens after sales support

Call 1-888-303-3353 for technical service, spare parts, return material authorisations and warranty issues.

Customer Interaction Centre for after sales support: provides a national, 24-hours, 7 days a week, bilingual service to respond to all customer calls involving return material authorisations, service requests, spare parts orders and warranty issues as well as product comments. The Customer Interaction Centre can also be contacted via email at cic@siemens.ca.

Siemens technical service

Siemens technical services support all Siemens drives in Canada. Throughout Canada Siemens technical services provide technical service support and fields service. Request for equipment commissioning, emergency service, and routine maintenance are coordinated and scheduled through this group. If technical service is required, please call 1-888-303-3353.

With over a hundred years' experience in providing reliability, safety, and service, Siemens is there.

Siemens repairs and returns

In case a defective part needs to be returned to Siemens Canada Ltd. for repair or credit, please follow these instructions.

Parts sent to Siemens Canada Ltd. not using the procedures outlined below may cause the warranty to be voided or improper credit to be issued.

1. Call 1-888-303-3353 and ask for warranty/defective product returns. The call will be forwarded to the next available Customer Service Representative (CSR). The CSR will provide instruction about how to complete a Field Inspection Report & RMA Request Form (FIR&RMA) with the following important information. The FIR&RMA form shall be faxed to the advised address on the form.
   a) Company name, contact address
   b) Original purchase order number
   c) Model number
   d) Serial number
   e) Detailed fault description
2. A Return Material Authorization form (RMA) will be issued within 24 hours of receipt of your FIR&RMA. The copy of RMA form must accompany the listed items being returned to Siemens. Any item received without the appropriate RMA documentation will not be accepted and returned to the sender collect.

   RMA's are valid for 30 days from date issued. Any returns received after 30 days will be returned to the sender at their expense. A new RMA will have to be requested for the same items before being returned.
3. Electrostatically Sensitive Devices (ESD) handling is to be observed for all electronic-based products. Please use anti-static bags when shipping printed circuit boards back to Siemens. Otherwise the warranty is null or void.
4. If it is a warranty claim, the item will be inspected and the warranty validated, upon receipt. Then the item will be repaired or replaced as appropriate and will be returned at no charge.
5. If it is a non-warranty case, an inspection fee will be charged to cover the cost of evaluating the defective return for possible repair work.

   The item will be inspected and the CSR will issue a quotation for repair. Upon receipt or Purchase Order, the item will be repaired, tested and returned.

Siemens extended warranty

Drive products offer an extended warranty for all products sold. The extended warranty of 12 months is offered with a surcharge of 5 % of the net price of the product. This extended warranty is only available if ordered prior to time of shipment from Siemens.

Months from	Standard warranty	Extended warranty
Installation	12	24
Manufacturing	18	30
% of net	0 %	5 %

Siemens technical training

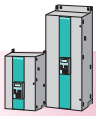
The Siemens technical training centre is committed to providing quality technical courses in the Canadian Electrical and Automation Markets. Siemens develops and gears each course and the related materials to be effective in the competitive Canadian marketplace.

Siemens offers 20 quality courses with expert instructors and dedicated support staff. Our practical, but challenging "hands-on" courses provide the ultimate arena for effective learning and information retention. Training is offered in St. Johns, Dartmouth, Montreal, Mississauga, Calgary, Edmonton, and Vancouver. Custom onsite training tailored to customer requirements and specific requests are also performed.

Following each course, the students can feel confident that they are equipped with the expert knowledge and capabilities to effectively sell or support the product.

Registration or questions on course content can be made to the Training Centre by the following:

Elizabeth Isaac
Training Administrator
Tel.: 905-819-5800 Ext. 2219
Fax: 905-819-5822
Email:
elizabeth.isaac@siemens.ca



6RA70
DC MASTER

Customer service Canada

General terms and conditions of sale

The following terms and conditions of sale shall apply to any sale of goods and services by Siemens Canada Limited (hereinafter called "Siemens"). Purchaser shall be deemed to have full knowledge of the terms and conditions herein and such terms and conditions shall be binding if either the goods and services referred to herein are delivered to and accepted by Purchaser, or if Purchaser does not within five days from the date hereof deliver to Siemens written objection to said terms and conditions or any part thereof.

1. **GENERAL**
In the event of any conflict or inconsistency between the terms and conditions of sale herein and the terms and conditions contained in Purchaser's order or in any other form issued by Purchaser, whether or not any such form has been acknowledged or accepted by Siemens, Siemens' terms and conditions herein shall prevail. No waiver, alteration or modification of these terms and conditions shall be binding upon Siemens unless made in writing and signed by a duly authorized representative of Siemens.

2. **QUOTATIONS**
Unless otherwise stated, Siemens' quotation shall be null and void unless accepted by Purchaser within thirty (30) days from the date of quotation.

3. **PRICES/COST OF TRANSPORTATION**
All quoted prices are based on the current exchange rates, tariffs and costs of manufacture. Unless otherwise stated in the quotation, quoted prices are subject to change by Siemens with or without notice until Purchaser's acceptance. Prices are subject to correction for error. Unless otherwise stated, all prices are f.o.b. factory and include domestic packing. Customary methods of transportation shall be selected by Siemens and such transportation will be at Purchaser's expense. Special methods of transportation will be used upon Purchaser's request and at Purchaser's additional expense provided reasonable notice of Purchaser's transportation requirements are given by Purchaser to Siemens prior to shipment.

4. **TAXES**
Prices do not include Goods & Services Tax, Provincial or Municipal sales, use, value-added or similar tax. Accordingly, in addition to the price specified herein, the amount of any present or future sales, use, value-added or similar tax applicable to the sale of the goods hereunder to or the use of such goods by Purchaser shall be paid by Purchaser to the entire exoneration of Siemens.

5. **DELIVERY**
Delivery schedules are approximate and are based on prevailing market conditions applicable respectively at the time of Siemens' quotation and Siemens' acceptance of Purchaser's order. Delivery shall also depend on the prompt receipt by Siemens of the necessary information to allow maintenance of the manufacturer's engineering and manufacturing schedules. Siemens may extend delivery schedules or may, at its option, cancel Purchaser's order in full or in part without liability other than to return any deposit or prepayment which is unearned by reason of the cancellation.

6. **FORCE MAJEURE**
Siemens shall not be responsible or liable for any loss or damage incurred by Purchaser herein resulting from causes beyond the reasonable control of Siemens including, but without limitation, acts of God, war, invasion, insurrection, riot , the order of any civil or military authority, fire, flood, weather, acts of the elements, delays in transportation, unavailability of equipment or materials, breakdown, sabotage, lock-outs, strikes or labour disputes, faulty castings or forgings, or the failure of Siemens' suppliers to meet their delivery promises. The acceptance of delivery of the equipment by Purchaser shall constitute a waiver of all claims for loss or damage due to any delay whatsoever.

7. **SHIPMENT/DAMAGES OR SHORTAGES IN TRANSPORT/RISK**
Except for obligations stated under "Warranty" herein, Siemens' responsibility for goods ceases upon delivery to the carrier. In the event of loss or damage during shipment, Purchaser's claim shall be against the carrier only. Siemens will, however, give Purchaser any reasonable assistance to secure adjustment of Purchaser's claim against the carrier provided immediate notice of such claim is given by Purchaser to Siemens. Claims for shortages must be made in writing within ten (10) days after receipt of goods by Purchaser. If Siemens does not receive written notification of such shortages within such ten (10) days, it shall be conclusively presumed that the goods were delivered in their entirety. Unless agreed upon otherwise in writing, Siemens reserves the right to make partial shipments and to submit invoices for partial shipments.

8. **TITLE**
Title to the goods or any part thereof shall not pass from Siemens to Purchaser until all payments due hereunder have been duly made in cash, except as otherwise expressly stipulated herein. The goods shall be and remain personal or moveable property, notwithstanding their mode of attachment to realty or other property. If default is made in any of the payments herein, Purchaser agrees that Siemens may retain all payments which have been made on account of the purchase price as liquidated damages, and Siemens shall be free to enter the premises where the goods may be located and remove them as Siemens' property, without prejudice to Siemens' right to recover any further expenses or damages Siemens may suffer by reason of such nonpayment.

9. **LIABILITY**
Siemens shall not be liable for and shall be held harmless by Purchaser from any damage, losses or claims of whatever kind, contractual or delictual, consequential or incidental, direct or indirect, arising out of, in connection with or resulting from the sale governed hereby or the goods, including, but without limitation, the manufacture, repair, handling, installation, possession, use, operation or dismantling of the goods and any and all claims, actions, suits, and proceedings which may be instituted in respect to the foregoing.

10. **WARRANTY**
Goods sold hereunder are covered by a warranty against defects in material and workmanship provided the goods and services are subjected to normal use and service. The applicable warranty period is twelve (12) months from the date of installation or eighteen (18) months from shipping date to Purchaser of any item of the goods, whichever occurs first, or any other warranty period otherwise stipulated in writing by Siemens under this sale. For components not supplied by Siemens, the original manufacturer's warranty shall apply to the extent assignable by Siemens. The obligation under this warranty is limited to the repair or replacement, at Siemens' option, of defective parts f.o.b. point of shipment provided that prompt notice of any defect is given by Purchaser to Siemens in writing within the applicable warranty period and that upon the Purchaser's return of the defective parts to Siemens or, if designated by Siemens, to the location where the works are made, properly packed and with transportation charges prepaid by Purchaser, an inspection thereof shall reveal to Siemens' satisfaction that Purchaser's claim is valid under the terms of this warranty. Purchaser shall assume all responsibility and expense for dismantling, removal, re-installation and freight in connection with the foregoing. The same obligations and conditions extend to replacement parts furnished by Siemens hereunder. Siemens does not assume liability for installation, labour or consequential damages. Siemens makes no warranty other than the one set forth herein. All other warranties, legal, expressed or implied, including but not limited to any expressed or implied warranty of merchantability, of fitness for the intended use thereof or against infringement are hereby expressly excluded.

The applicable warranty ceases to be effective if the goods are altered or repaired other than by persons authorized or approved by Siemens to perform such work. Repairs or replacement deliveries do not interrupt or prolong the term of the warranty. The warranty ceases to be effective if Purchaser fails to operate and use the goods sold hereunder in a safe and reasonable manner and in accordance with any written instructions from the manufacturers.

11. **INSTALLATION**
Unless otherwise expressly stipulated, the goods shall be installed by and at the risk and expense of Purchaser. In the event that Siemens is requested to supervise such installation, Siemens' responsibility shall be limited to exercising that degree of skill customary in the trade in supervising installations of the same type. Purchaser shall remain responsible for all other aspects of the work including compliance with the local regulations.

12. **RETURNED GOODS**
No goods may be returned to Siemens without Siemens' prior written permission. Siemens reserves the right to decline all returns or to accept them subject to a handling/restocking charge. Even after Siemens has authorized the return of goods for credit, Siemens reserves the right to adjust the amount of any credit given to Purchaser on return of the goods based on the conditions of the goods on arrival in Siemens' warehouse. Credit for returned goods will be issued to Purchaser only where such goods are returned by Purchaser and not by any subsequent owner of the goods. Goods will be considered for return only if they are in their original condition and packaging.

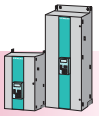
13. **TERMS OF PAYMENT**
Unless otherwise stated, invoices on "open account" shipment are payable within thirty (30) days of invoice date. Unless specifically provided, no cash discount shall be available to Purchaser. When cash discount is offered, the discount price is computed from the date of invoice. Siemens does not offer cash discount on C.O.D. shipments. Should payment not be made to Siemens when due, Siemens reserves the right, until the price has been fully paid in cash, to charge Purchaser with interest on such overdue payments at the rate of eighteen percent (18 %) per annum. The charging of such interest shall not be construed as obligating Siemens to grant any extension of time in the terms of payment.

14. **CHANGES AND CANCELLATION**
Orders accepted by Siemens are not subject to changes or cancellation by Purchaser, except with Siemens' written consent. In such cases where Siemens authorizes changes or cancellation, Siemens reserves the right to charge Purchaser with reasonable costs based upon expenses already incurred and commitments made by Siemens, including, without limitation, any labour done, material purchased and also including Supplier's usual overhead and reasonable profit and cancellation charges from Siemens' suppliers.

15. **THE AGREEMENT**
An acceptance and official confirmation of Purchaser's order by Siemens shall constitute the complete agreement, subject to the terms and conditions of sale herein set forth, and shall supersede all previous quotations, orders or agreements. The law of the Province of Ontario shall govern the validity, interpretation and enforcement of these terms and conditions of sale and of any contract of which these terms and conditions are a part.

SIEMENS Family of Applied Drives

6RA70
DC MASTER



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The Siemens Family of Applied Drives

From stand-alone drives to the most challenging applications Siemens applied series drives offer a truly integrated family of high performance drives that are unmatched from one continent to the next.

SIMOVERT™ MASTERDRIVES VC

AC Series of Vector Control
1 HP to 5000 HP

Applied DC MASTER

Customer-specific, integral solutions are available for the most varied of applications in all industrial sectors.

SIMOREG 6RA70 DC MASTER 7.5 HP – 1000 HP at 500 V DC

Extended designs also available up to 8000 HP

SIMOVERT MASTERDRIVES MC

Motion Control Series
0.5 HP to 355 HP

2000

SIMOREG 6RA70 DC MASTER

Giving DC a new lease on life for the next millennium

Now with:

- More performance
- More HP selections and extended ranges
- More application flexibility
- More communication choices
- More favorably priced solutions

The SIMOREG Lineage

1994

SIMOREG 6RA24

Known throughout the industry as "The Workhorse"

1986

3rd Generation SIMOREG

Among the first digital DC drives in the market

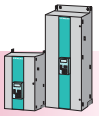
1971

SIMOREG 6RA21 Analog DC Drive

The SIMOREG name is born out of the Siemens line of DC products

SIMOREG 6RA70
Built on over 30 years of successful experience

Overview



Application

The SIMOREG 6RA70 converters are specifically designed to provide precise DC motor speed control over a wide range of machine parameters and load conditions. The modular design that allows them to be tailored exactly to the application at hand also lends them well to many non-standard DC applications.

From a package drive to an integral solution of the most sophisticated project the SIMOREG 6RA70 has proven itself time and time again in industries including:

- Metals
- Paper
- Textile
- Rubber
- Plastics
- Extruding
- Lifting, etc.

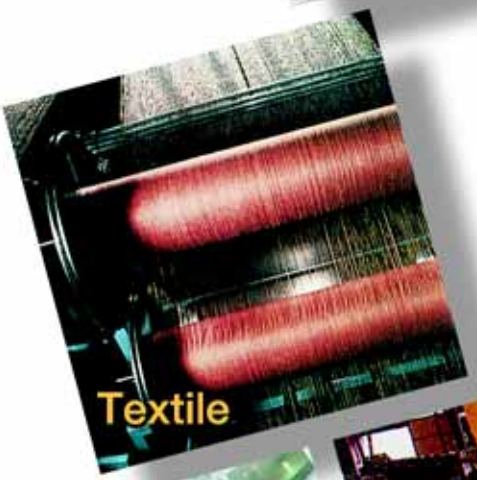
In addition to increased performance and extended capabilities added into the new SIMOREG 6RA70 the standard model offerings have been increased and extended up to 1000 HP at 500 V DC in the compact unit design. With the paralleling capabilities and high HP designs extended ranges up to 8000 HP can be achieved.

The SIMOREG DC MASTER series is completely uniform with regard to

- Communication
- Technology
- BICO software platform
- Identical main board and cardrack
- Operator control and visualization

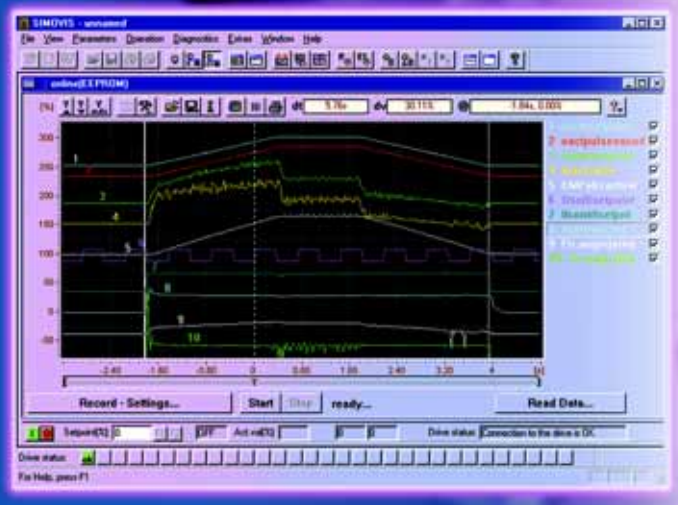
What this means is that if you know one SIMOREG DC MASTER you know them all. And with our easy-to-use start up tool (DriveMonitor) getting to know your first drive could not be easier.

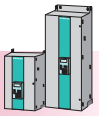
Siemens' worldwide service and sales network enable all our customers to obtain direct access to expert advice and project planning as well as training and service from any part of the world.



SIMOREG 6RA70 DC MASTER

Drive Description





2

SIMOREG 6RA70 converters

SIMOREG 6RA70 converters are fully digital, compact units for connection to a three-phase AC supply. They in turn supply the armature and field of variable-speed DC motors. The range of rated DC currents extends from 15 A to 3000 A in the modular design. Higher HP designs are also available from 2700 A to 14000 A.

Converters for single-quadrant or four-quadrant operation are available to suit individual applications. As the converters feature an integrated parameterization panel, they are autonomous and do not require any additional parameterization equipment. All open-loop and closed-loop control tasks as well as monitoring and auxiliary functions are performed by a microprocessor system.

SIMOREG 6RA70 converters are characterized by their compact, space-saving design. An electronics box containing the closed-loop control board is mounted in the converter door. This box also has space to hold additional boards for process-related expansion functions and serial interfaces. This design makes them especially easy to service since individual components are easily accessible.

External signals (binary inputs/outputs, analog inputs/outputs, pulse encoders, etc.) are connected by way of plug-in terminals. The converter software is stored in a flash EPROM. Software upgrades can easily be loaded via the serial interface of the basic unit.

Customer Preference

For the purpose of versatility and selection the SIMOREG 6RA70 is available in the base drive and power module offering. The base drive panel designs consist of the power module mounted on a base panel with the addition of line fuses, control transformer, and contactor. The base drive panel designs allows for easy customer connection of the power cables to the supplied connection points mounted on top of the assembly.

US overload rating

The converters listed in this guide contain a US rating allowing a 150 % overload for 60 seconds. All base drive components have been selected based on this rating.

Cooling

Converters with rated DC currents up to 100 A are selfcooled, while converters with rated DC currents of 140 A and higher have forced-air cooling (fan assembly).

Fig. 2/1
SIMOREG 6RA70, 15 A Base drive panel

Fig. 2/2
SIMOREG 6RA70, 1660 A Power module

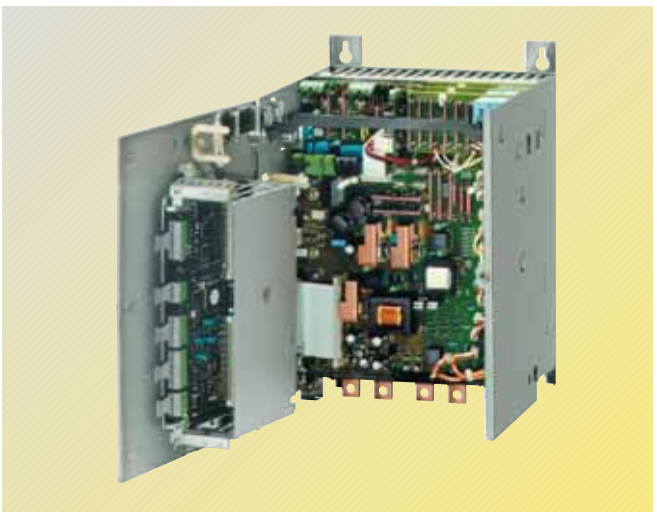


Fig. 2/3
SIMOREG 6RA70, 30 A converter, open door view

Parameterization devices

PMU simple operator panel

All units feature a PMU panel mounted in the converter door. The PMU consists of a five-digit, seven-segment display, three LEDs as status indicators and three parameterization keys.

The PMU also features connector X300 with a USS interface in compliance with the RS232 or RS485 standard.

The panel provides all the facilities required during start-up for making adjustments or settings and displaying measured values. The following functions are assigned to the three panel keys:

- P (select) key
  Switches over between parameter number and parameter value and vice versa, acknowledges fault messages.
- UP key
  Selects a higher parameter number in parameter mode or raises the set and displayed parameter value in value mode. Also selects a higher index on indexed parameters.
- DOWN key
  Selects a lower parameter number in parameter mode or reduces the set and displayed parameter value in value mode. Also selects a lower index on indexed parameters.
- LED functions
  – Ready: Ready to operate, lights up in “Wait for operation enable” state.
  – Run: In operation, lights up when operation is enabled.
  – Fault: Disturbance, lights up in “Active fault” status, flashes when “Alarm” is active.

The quantities output on the five-digit, seven-segment display are easy to understand, e.g.
– percentage of rated value,
– servo gain factor,
– seconds,
– amperes or
– volts.

Through the X300 connector on the PMU communication can be established via the DriveMonitor program for parameterization, monitoring, troubleshooting, and control of the converter by a PC.

OP1S Extended operator panel

The OP1S optional extended operator panel can be mounted either in the converter door or externally, e.g. in the cubicle door. For this purpose, it can be connected up by means of a 5 m long cable. Cables of up to 200 m in length can be used if a separate 5 V supply is available. The OP1S is connected to the SIMOREG via connector X300.

The OP1S can be installed as an economic alternative to control cubicle measuring instruments which display physical measured quantities.

The OP1S features an LCD with 4 x 16 characters for displaying parameter names in plaintext. German, English, French, Spanish and Italian can be selected as the display languages. The OP1S can store parameter sets for easy downloading to other devices.

Keys on OP1S:

- P (Select) key
- UP key
- DOWN key
- Reversing key (not functional on SIMOREG)
- ON key
- OFF key
- Inching key
- Numeric keys (0 to 9)

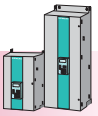
LEDs on OP1S:

- Green: Lights up in “Run”, flashes in “Ready”
- Red: Lights up with “Fault”, flashes with “Alarm”

Fig. 2/4
PMU built in operator panel

Fig. 2/5
OP1S Extended operator panel

Fig. 2/6
SIMOREG 6RA70 converter featuring optional OP1S operator panel



2

Software structure

Two powerful microprocessors (C163 and C167) perform all closed-loop and drive control functions for the armature and field circuit. Closed-loop control functions are implemented in the software as program modules that are “wired up” via parameters.

Connectors

All important quantities in the closed-loop control system can be accessed via connectors. They correspond to measuring points and can be accessed as digital values. 14 bits (16 384 steps) correspond to 100 % in the standard normalization. These values can be used for other purposes in the converters, e.g. to control a setpoint or change a limit. They can also be output via the operator panel, analog outputs and serial interfaces.

The following quantities are available via connectors:

- Analog inputs and outputs
- Inputs of actual-value sensing circuit
- Inputs and outputs of ramp-function generator, limitations, gating unit, controllers, freely available software modules
- Digital fixed setpoints
- General quantities such as operating status, motor temperature, thyristor temperature, alarm memory, fault memory, hours run meter, processor capacity utilization

Binectors

Binectors are digital control signals which can assume a value of “0” or “1”. They are employed, for example, to inject a setpoint or execute a control function. Binectors can also be output via the operator panel, binary outputs or serial interfaces.

The following states can be accessed via binectors:

- Status of binary inputs
- Fixed control bits
- Status of controllers, limitations, faults, ramp-function generator, control words, status words

Intervention points

The inputs of software modules are defined at intervention points using the associated parameters. At the intervention point for connector signals, the connector number of the desired signal is entered in the relevant parameter so as to define which signal must act as the input quantity. It is therefore possible to use both analog inputs and signals from interfaces as well as internal variables to specify setpoints, additional setpoints, limitations, etc.

The number of the binector to act as the input quantity is entered at the intervention point for binector signals. A control function can therefore be executed or a control bit output by means of either binary inputs, controls bits of the serial interfaces or control bits generated in the closed-loop control.

Switchover of parameter sets

4 copies of parameters with numbers ranging from P100 to P599 as well as some others are stored in the memory. Binectors can be used to select the active parameter set. This function allows, for example, up to four different motors to be operated alternately or four different gear changes to be implemented on one converter. The setting values for the following functions can be switched over:

- Definition of motor and pulse encoder
- Optimization of closed-loop control
- Current and torque limitation
- Conditioning of speed controller actual value
- Speed controller
- Closed-loop field current control
- Closed-loop EMF control
- Ramp-function generator
- Speed limitation
- Monitors and limit values
- Digital setpoints
- Technology controller
- Motorized potentiometer
- Friction compensation
- Flywheel effect compensation
- Speed controller adaptation

Switchover of BICO data sets

The BICO data set can be switched over by the control word (binector input). It is possible to select which connector or binector quantity must be applied at the intervention point. The control structure or control quantities can therefore be flexibly adapted.

Motorized potentiometer

The motorized potentiometer features control functions “Raise”, “Lower”, “Clockwise/Counterclockwise” and “Manual/Auto” and has its own ramp-function generator with mutually independent ramp time settings and a selectable rounding factor. The setting range (minimum and maximum output quantities) can be set by means of parameters. Control functions are specified via binectors.

In Automatic mode (“Auto” setting), the motorized potentiometer input is determined by a freely selectable quantity (connector number). It is possible to select whether the ramping times are effective or whether the input is switched directly through to the output.

In the “Manual” setting, the setpoint is adjusted with the “Raise setpoint” and “Lower setpoint” functions. It is also possible to define whether the output must be set to zero or the last value stored in the event of a power failure. The output quantity is freely available at a connector, e.g. for use as a main setpoint, additional setpoint or limitation.

Closed-loop functions in armature circuit

Speed setpoint

The source for the speed setpoint and additional setpoints can be freely selected through parameter settings, i.e. the setpoint source can be programmed as:

- Analog values 0 to ±10 V, 0 to ±20 mA, 4 to 20 mA
- Integrated motorized potentiometer
- Binectors with functions: Fixed setpoint, inch, crawl
- Serial interfaces on basic unit
- Supplementary boards

The normalization is such that 100 % setpoint (product of main setpoint and additional setpoints) corresponds to the maximum motor speed.

The speed setpoint can be limited to a minimum or maximum value by means of a parameter setting or connector. Furthermore, “adding points” are included in the software to allow, for example, additional setpoints to be injected before or after the ramp-function generator. The “Setpoint enable” function can be selected with a binector. After smoothing by a parameterizable filter (PT1 element), the total setpoint is transferred to the setpoint input of the speed controller. The ramp-function generator is effective at the same time.

Actual speed value

One of four sources can be selected as the actual speed signal.

- *Analog tachometer*
  The voltage of the tacho-generator at maximum speed can be between 8 and 270 V. The voltage/maximum speed normalization is set in a parameter.
- *Pulse encoder*
  The type of pulse encoder, the number of marks per revolution and the maximum speed are set via parameters. The evaluation electronics are capable of processing encoder signals (symmetrical: With additional inverted track or asymmetrical: Referred to ground) up to a maximum differential voltage of 27 V.

  The rated voltage range (5 V or 15 V) for the encoder is set in a parameter. With a rated voltage of 15 V, the SIMOREG converter can supply the voltage for the pulse encoder. 5 V encoders require an external supply. The pulse encoder is evaluated on the basis of three tracks, i.e. track 1, track 2 and zero marker. Pulse encoders without a zero marker may also be installed. The zero marker allows an actual position to be acquired. The maximum frequency of the encoder signals must not exceed 300 kHz. Pulse encoders with at least 1024 pulses per revolution are recommended (to ensure smooth running at low speeds).
- *Operation without tachometer and with closed-loop EMF control*
  No actual-value sensor is needed if the closed-loop EMF control function is employed. Instead, the converter output voltage is measured in the SIMOREG. The measured armature voltage is compensated by the internal voltage drop in the motor (I*R compensation). The degree of compensation is automatically determined during the current controller optimization run. The accuracy of this control method is determined by the temperature-dependent change in resistance in the motor armature circuit and equals approximately 5 %. In order to achieve greater accuracy, it is advisable to repeat the current controller optimization run when the motor is warm. Closed-loop EMF control can be employed if the accuracy requirements are not particularly high, if there is no possibility of installing an encoder and if the motor is operated in the armature voltage control range.

  Caution: The drive cannot be operated in EMF-dependent field- weakening mode when this control method is employed.
- *Freely selectable actual speed signal*
  Any connector number can be selected as the actual speed signal for this operating mode. This setting is selected in most cases if the actual speed sensor is implemented on a technological supplementary board.

  Before the actual speed value is transferred to the speed controller, it can be smoothed by means of a parameterizable smoothing (PT1 element) and two adjustable band filters. The band filters are mostly used in order to filter out resonant frequencies caused by mechanical resonance. The resonant frequency and filter quality can be selected.

Ramp-function generator

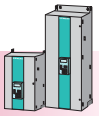
The ramp-function generator converts the specified setpoint after a step change into a setpoint signal that changes constantly over time. Ramp-up and ramp-down times can be set independently of one another. The ramp-function generator also features a lower and upper transition rounding (jerk limitation) which take effect at the beginning and end of the ramp time respectively.

All time settings for the ramp-function generator are mutually independent.

3 parameter sets are provided for the ramp-function generator times. These can be selected via binary selectable inputs or a serial interface (via binectors). The generator parameters can be switched over while the drive is in operation. The value of parameter set 1 can also be weighted multiplicatively via a connector (in order to change generator data by means of a connector). When ramp-function generator time settings of zero are entered, the speed setpoint is applied directly to the speed controller.

Speed controller

The speed controller compares the speed setpoint and actual value and, if these two quantities deviate, applies a corresponding current setpoint to the current controller (operating principle: Closed-loop speed control with subordinate current controller). The speed controller is a PI controller with additional selectable D component. A switchable speed droop can also be parameterized. All controller characteristics can be set independently of one another. The value of K_p (gain) can be adapted as the function of a connector signal (external or internal).



2

Closed-loop functions in armature circuit

The P gain of the speed controller can be adapted as a function of actual speed, actual current, setpoint/actual value deviation or winding diameter. To achieve a better dynamic response in the speed control loop, a feedforward control function can be applied by, for example, adding a torque setpoint quantity after the speed controller as a function of friction or drive moment of inertia. The friction and moment of inertia compensation values can be calculated in an automatic optimization run.

The output quantity of the speed controller directly after enabling can be set via a parameter.

Depending on how parameters are set, the speed controller can be bypassed and the converter operated under torque or current control. Furthermore, it is possible to switch between closed-loop speed control/ closed-loop torque control in operation by means of selection function “Master/slave switch-over”. The function can be selected as a binector via a binary assignable-function terminal or a serial interface. The torque setpoint is applied by means of a selectable connector and can thus be supplied by an analog assignable-function terminal or a serial interface.

In “slave drive” operation (under torque or current control), a limiting controller is active. Here, the limiting controller can intervene on the basis of an adjustable, parameterized speed limit in order to prevent the drive from accelerating too far. In this case, the drive is limited to an adjustable speed deviation.

Torque limitation

Depending on parameterization, the speed controller output acts as either the torque setpoint or current setpoint. In closed-loop torque control mode, the speed controller output is weighted with machine flux F and then transferred as a current setpoint to the current limitation. Torque-control mode is mostly used in conjunction with field weakening so that the maximum motor torque can be limited independently of speed.

The following functions are available:

- Independent setting of positive and negative torque limits via parameters.
- Switchover of torque limit via binector as a function of a parameterizable changeover speed.
- Free input of torque limit by means of a connector, e.g. via analog input or serial interface.

The lowest input quantity is always applied as the current torque limit. Additional torque setpoints can be added after the torque limit.

Current limitation

The purpose of the current limitation set after the torque limit is to protect the converter and motor. The lowest input quantity is always applied as the current limit.

The following current limit values can be set:

- Independent setting of positive and negative current limits via parameters (setting of maximum motor current).
- Free input of current limit via a connector, e.g. from an analog input or serial interface.
- Separate setting of current limit via parameters for shutdown and fast stop.
- Speed-dependent current limitation: Parameters can be set to implement an automatically triggered, speed-dependent reduction in the current limitation at high speeds (commutation limit curve of motor).
- I^2t monitoring of power section: The temperature of the thyristors is calculated for all current values. When the thyristor limit temperature is reached, the converter current is either reduced to rated DC current or the converter shut down with fault message, depending on how the appropriate response parameter is set. This function is provided to protect the thyristors.

Current controller

The current controller is a PI controller with mutually independent P gain and reset time settings. The P or I component can also be deactivated (to obtain pure P controller or pure I controller). The actual current is acquired on the three-phase AC side by means of current transformers and applied to the current controller after A/D conversion via a burden and rectifying circuit. The resolution is 10 bits for converter rated current. The current limiting output is applied as the current setpoint.

The current controller output transfers the firing angle to the gating unit, the feedforward control function acts in parallel.

Feedforward control

The feedforward control function in the current control loop improves the dynamic response of the control, allowing rise times of between 6 and 9 ms to be achieved in the current control loop. The feedforward control operates as a function of the current setpoint and motor EMF and ensures that the necessary firing angle is transferred speedily to the gating unit, in both intermittent and continuous DC operation or when the torque direction is reversed.

Auto-reversing module

The auto-reversing module (only on converters for four-quadrant drives) acts in conjunction with the current control loop to define the logical sequence of all processes required to reverse the torque direction. One torque direction can be disabled by a parameter setting if necessary.

Gating unit

The gating unit generates the gate pulses for the power section thyristors in synchronism with the line voltage. Synchronization is implemented independently of the rotating field and electronics supply and is measured on the power section. The gating pulse position timing is determined by the output values of the current controller and feedforward control. The firing angle setting limit can be set in a parameter.

The gating unit is automatically adjusted to the connected line frequency within a frequency range of 45 to 65 Hz.

Closed-loop functions in field circuit

EMF controller

The EMF controller compares the EMF (induced motor voltage) setpoint and actual value and specifies the setpoint for the field current controller, providing an EMF-dependent closed-loop field-weakening control. The EMF controller operates as a PI controller, the P and I components can be set independently of one another. The controller can also be operated as a pure P or pure I controller. A feedforward control operates in parallel to the EMF controller. This applies feedforward control as a function of speed to the field current setpoint by means of an automatically recorded field characteristic (see optimization runs). An adding point is located after the EMF controller, at which additional field current setpoints can be entered via a connector, e.g. analog input or serial interface. The limitation for the field current setpoint is then applied (maximum and minimum setpoint limits can be set independently of one another). The limitation is implemented via a parameter or connector, in which case the minimum is applied as the upper limit and the maximum for the lower limit.

Field-current controller

The current controller for the field is a PI controller with independent settings for K_p and T_n. It can also be operated as a pure P or pure I controller. A feedforward control operates in parallel to the field current controller. This calculates and sets the firing angle for the field circuit as a function of current setpoint and line voltage. The feedforward control supports the current controller and ensures a good dynamic response in the field circuit.

Gating unit

The gating unit generates the gate pulses for the power section thyristors in synchronism with the line voltage in the field circuit. Synchronization is measured on the power section and is not therefore dependent on the electronics supply. The gate pulse position timing is determined by the output values of the current controller and feedforward control. The firing angle setting limit can be set in a parameter. The gating unit is automatically adjusted to the connected line frequency within a frequency range of 45 to 65 Hz.

Optimization run

6RA70 converters are supplied with parameters set to the factory settings. Automatic optimization runs can be selected by means of special key numbers to support setting of the controllers.

The following controller functions can be set in an automatic automatization run:

- Current controller optimization run for setting current controllers and feedforward controls (armature and field circuit).
- Speed controller optimization run for setting characteristic data for speed controller.
- Automatic recording of friction and moment of inertia compensation for feedforward control of speed controller.
- Automatic recording of field characteristic for an EMF-dependent closed-loop field-weakening control and automatic optimization of EMF controller in field-weakening operation.

Furthermore, all parameters set automatically during optimization runs can be altered afterwards on the operator panel.

Monitoring and diagnosis

Display of operational data

The operating status of the converter is displayed via parameter r000. Approximately 50 parameters are provided for displaying measured values. An additional 300 signals from the closed-loop control can be selected in the software (connectors) for output on the display unit. Examples of displayable measured values: Setpoints, actual values, status of binary inputs/outputs, line voltage, line frequency, firing angle, inputs/outputs of analog terminals, input/output of controllers, display of limitations.

Trace function

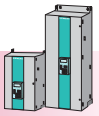
The trace function can be selected to store up to 10 measured quantities with 128 measuring points each. A measured quantity or the activation of a fault message can be parameterized as a trigger condition. It is possible to record the pre-event and post-event history by programming a trigger delay. The sampling time for the measured-value memory can be parameterized to between 3 and 300 ms.

Measured values can be output via the operator panels or serial interfaces.

Fault messages

A number is allocated to each fault message. The time at which the event occurred is also stored with the fault message, allowing the fault cause to be pinpointed promptly. The most recent 8 fault messages are stored with fault number, fault value and hours count for diagnostic purposes.

Fig. 2/7
SIMOREG converter family



Monitoring and diagnosis

When a fault occurs

- the binary output function "Fault" is set to LOW (selectable function),
- the drive is switched off (controller disable and current I = 0, pulse disable, relay "Line contactor CLOSED" drops out) and
- an F with a fault number appears on the display, LED "Fault" lights up.

Fault messages can be acknowledged on the operator panel, via a binary assignable-function terminal or a serial interface. When the fault has been acknowledged, the system switches to the "Starting lockout" status. "Starting lockout" is cancelled by OFF (L signal at terminal 37).

Automatic restart: The system can be restarted automatically within a parameterizable time period of 0 to 2 s. If this time is set to zero, a fault message is activated immediately (on power failure) without a restart. Automatic restart can be parameterized in connection with the following fault messages: Phase failure (field or armature), undervoltage, overvoltage, failure of electronics power supply, undervoltage on parallel SIMOREG unit.

Fault/error messages are divided into the following categories:

- Line fault: Phase failure, fault in field circuit, undervoltage, overvoltage, line frequency < 45 or > 65 Hz
- Interface fault: Basic unit interfaces or interfaces to supplementary boards are malfunctioning.
- Drive fault: Monitor for speed controller, current controller, EMF controller, field current controller has responded, drive blocked, no armature current
- Electronic motor overload protection (I^2t monitor for motor) has responded
- Tacho-generator monitor and overspeed signal
- Start-up error
- Fault on electronics board
- Fault message from thyristor check: This fault message will occur only if the thyristor check is activated via the appropriate parameter. The check function ascertains whether the thyristors are capable of blocking and firing.
- Fault messages from motor sensors (with terminal expansion option); Monitor of brush length, bearing condition, air flow, motor temperature, has responded
- External faults via binary assignable-function terminals

Fault messages can be deactivated individually. The default setting for some fault messages is "deactivated" so that they need to be activated in the appropriate parameter.

Alarms

Special states are indicated by alarms. These states do not lead to drive shutdown nor do the alarms need to be acknowledged, but are automatically reset when the cause of the problem has been eliminated.

When one or several alarms occur,

- the binary output function "Alarm" is set to LOW (selectable function) and
- the alarm is indicated by a flashing "Fault" LED.

Alarms are divided into the following categories:

- Motor overtemperature: The calculated I^2t value of the motor has reached 100 %.
- Alarms from motor sensors (only with terminal expansion option): Monitor of bearing condition, motor fan, motor temperature, has responded.
- Drive alarms: Drive blocked, no armature current.
- External alarms via binary assignable-function terminals.
- Alarms from supplementary boards.

Functions of inputs and outputs

Analog selectable inputs

After conversion to a digital value, the quantity at the analog inputs can be flexibly adjusted in terms of normalization, filtering, sign selection and offset via parameters. Since these values are available as connectors, the analog inputs can also act as a main setpoint or an additional setpoint or limitation.

Analog outputs

The actual current is output as a real-time quantity at terminal 12. The output can be parameterized as a bipolar quantity or absolute value, with selectable polarity.

Selectable analog outputs are provided for the output of other analog signals, in the form of a bipolar signal or absolute value. The normalization, offset, polarity and a filtering time can also be parameterized. The required output quantities are selected by means of connector numbers specified at intervention points. Possible outputs are, for example, actual speed, ramp-function generator output, current setpoint, line voltage, etc.

Functions of inputs and outputs

Binary inputs

- *Switch-on/Shutdown (OFF1) via terminal 37*
  This terminal function is ANDed with the control bit of the serial interface. With an H signal applied to terminal 37, the main contactor (terminal 109/110) is energized via an internal sequence control. If an H signal is applied to terminal 38 (enable operation), then the controllers are enabled. The drive accelerates at the speed setpoint up to operating speed. With an L signal at terminal 37, the drive is decelerated along the deceleration ramp down to speed $n < n_{min}$. When the brake control delay has expired, the controllers are disabled and the main contactor de-energized when $I = 0$. The field current is then reduced to its standstill value (parameterizable) after a parameterizable delay following main contactor dropout has expired.
- *Enable operation via terminal 38*
  This function is ANDed with the control bit of the serial interface. The controllers are enabled with an H signal applied to terminal 38. With an L signal at terminal 38, the controllers are disabled and, at $I = 0$, the pulses are disabled too. The "Enable operation" signal has high priority, i.e. if it changes to "L" during operation, the effect is always $I = 0$, causing the drive to coast to a standstill.

Binary selectable inputs: Further binary input terminals are provided for optional function selections. A binector number is assigned to each assignable-function terminal for use for control functions.

Examples of binary input functions:

- Voltage disconnect (OFF2): With an OFF2 (low) signal, the controllers are disabled instantaneously, the armature circuit current reduced and, when $I = 0$, the main contactor de-energized. The drive coasts down in an uncontrolled manner.
- Fast stop (OFF3): With a fast stop (low) signal, the speed setpoint at the speed controller input is set to zero and the drive braked along the current limit (separate current limit can be parameterized for fast stop). When $n < n_{min}$, $I = 0$ is input on expiry of the brake control delay time and the main contactor finally de-energized.
- INCH: The inching function is available with an L signal at terminal 37, an H signal at terminal 38 and activation of inching mode. In active inching mode, the main contactor is energized and the drive accelerated to a parameterized inching setpoint. When the inching signal is cancelled, the drive is braked down to $n < n_{min}$; the controllers are then disabled and the main contactor de-energized after a parameterizable delay (0 to 60 s) has elapsed. It is also possible to select whether the ramp-function generator must be active in inching mode or whether a ramp-up time = ramp-down time = 0 should be applied.

Binary outputs

Selectable signalling functions are available at binary output terminals (open emitter output). Any binector quantity - chosen via the appropriate selection parameter - can be output at each terminal. The polarity of the output signal and a settable delay (0 to 15 s) can also be parameterized.

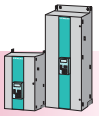
Examples of binary output functions:

- Fault: An L signal is output when a fault message is active.
- Alarm: An L signal is output when an alarm is active.
- $n < n_{min}$: An H signal is output at speeds of less than n_{min}. This signal is used, for example, to active a zero-speed message.
- Switch-on command for a mechanical brake: A motor brake can be activated via this signal.

When the drive is switched on with the "Drive ON" function and "Enable operation" signal, an H signal is output to release the brake; output of the internal controller enable signal is delayed for a parameterizable period (corresponding to mechanical brake release time). When the drive is stopped via the "Shutdown" or "Fast stop" function, an L signal to close the brake is output when a speed of $n < n_{min}$ is reached. At the same time, the internal controller enable signal remains active for a parameterizable time period (corresponding to mechanical brake closing time). $I = 0$ is then input, the pulses disabled and the main contactor de-energized.

A further operating mode can be selected for the "Close brake" signal (L signal at binary selectable output). With this option, there is no delay until $n < n_{min}$ is reached when "Internal controller disable" is applied (drive is at zero current), but, instead, the (operating) brake is activated at speeds greater than n_{min}.

An internal controller disable signal is output in response to fault messages, voltage disconnection or cancellation of the "Enable operation" signal at terminal 38 during operation.



Safety shutdown (E-STOP)

The task of the E-STOP function is to open the relay contacts (terminals 109/110) for energizing the main contactor within about 15 ms, independently of semiconductor components and the functional status of the microprocessor board (basic electronics). If the basic electronics are operating correctly, the closed-loop control outputs an I = 0 command to de-energize the main contactor. When an E-STOP command is given, the drive coasts to a standstill.

The E-STOP function can be triggered by one of the following methods:

- Switch operation: E-STOP is activated when the switch between terminals 105 and 106 opens.
- Pushbutton operation: Opening an NC contact between terminals 106 and 107 triggers the E-STOP function and stores the shutdown operation. Closing an NO contact between terminals 106 and 108 resets the function.

When the E-STOP function is reset, the drive switches to the "Starting lockout" state. This status needs to be acknowledged through activation of the "Shutdown" function, e.g. by opening terminal 37.

Note: The E-STOP function is not an EMERGENCY STOP function according to EN 60 204-1.

Serial interfaces

The following serial interfaces are available:

- One serial interface on connector X300 on the PMU for a USS protocol to the RS232 or RS485 standard. For connection of optional OP1S operator panel or for PC-based DriveMonitor.
- One serial interface at terminals of basic electronics board, two-wire or four-wire RS485 for USS protocol or peer-to-peer connection.
- One serial interface at terminals of terminal expansion board (option), two-wire or four-wire RS485 for USS protocol or peer-to-peer connection.
- PROFIBUS DP on a supplementary card (optional).
- SIMOLINK on a supplementary card (optional) with fiber-optic connection.
- CAN protocol (**C**ontroller **A**rea **N**etwork) on a supplementary card (optional).
- CBD protocol (**C**ommunication **B**oard **D**eviceNet) on a supplementary card (optional).

Physical characteristics of interfaces

- RS232: ±12 V interface for point-to-point connection.
- RS485: 5 V normal mode interface, noise-proof, for an additional bus connection with a maximum of 31 bus nodes.

USS™ protocol

Disclosed SIEMENS protocol, easy to program on external systems, e.g. on PC, any master interfaces can be used. The drives operate as slaves on a master. Drives are selected via a slave number.

The following data can be exchanged via the USS protocol:

- PKW data for writing and reading parameters.
- PZD data (process data) such as control words, setpoints, status words, actual values.

Connector numbers are entered in parameters to select the transmit data (actual values), the receive data (setpoints) represent connector numbers that can be programmed to act at any intervention points.

Peer-to-peer protocol

The peer-to-peer protocol is used to link one converter to another. With this mode, data are exchanged between converters, e.g. to build a setpoint cascade, via a serial interface. Since a serial interface is employed as a four-wire line, it is possible to receive data from the upstream converter, condition them (e.g. through multiplicative weighting) and then send them to the downstream converter. Only one serial interface is used for the whole operation.

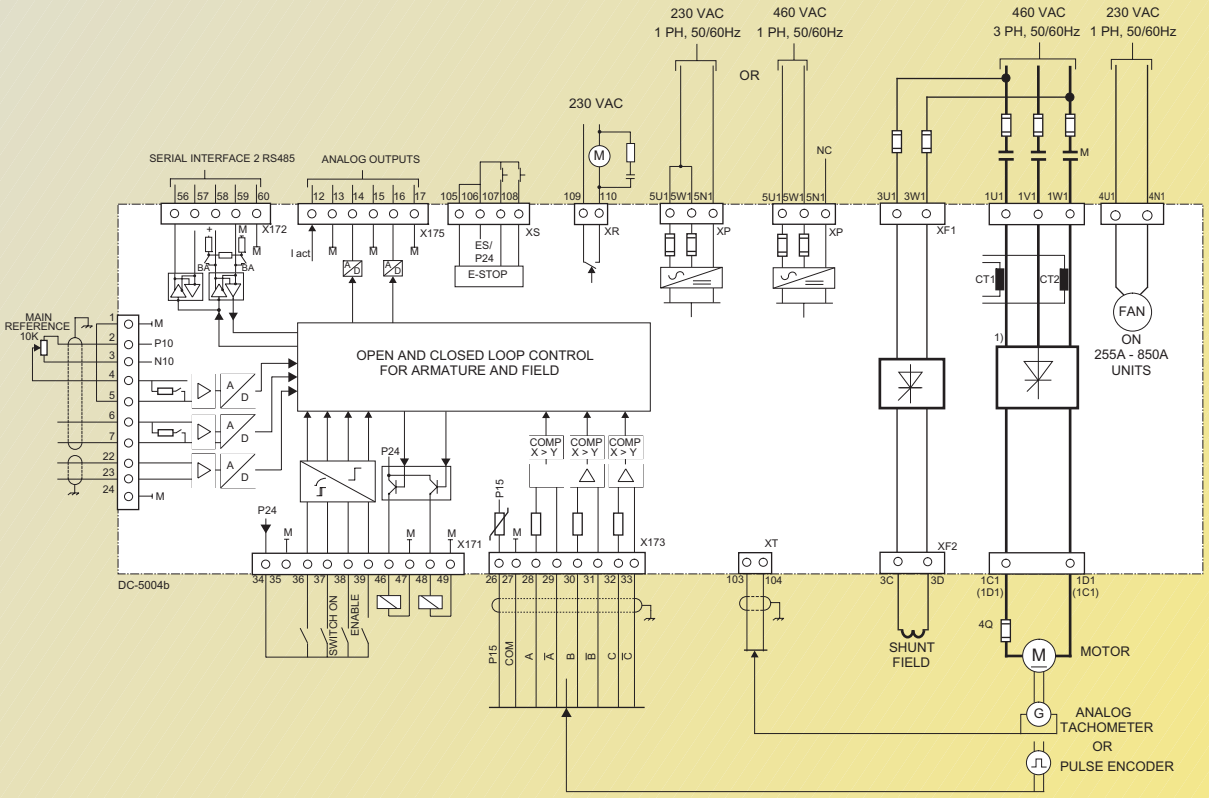
The following data can be exchanged between converters:

- Transmission of control words and actual values.
- Reception of status words and setpoints.

Up to five data words are transmitted in each direction. Data are exchanged on the basis of connector numbers and intervention points.

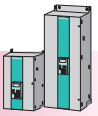
The serial interfaces can be operated simultaneously. For example, the first interface can be used as an automation link (USS protocol) for open-loop control, diagnostics and specification of the master setpoint. A second interface operates in conjunction with the peer-to-peer protocol to act as a setpoint cascade.

6RA70..-6F, 15 A to 850 A



1) Note:
Branch circuit fuses are internal on 850 A power module.

Fig. 2/8
Power module block diagram 15 A to 850 A



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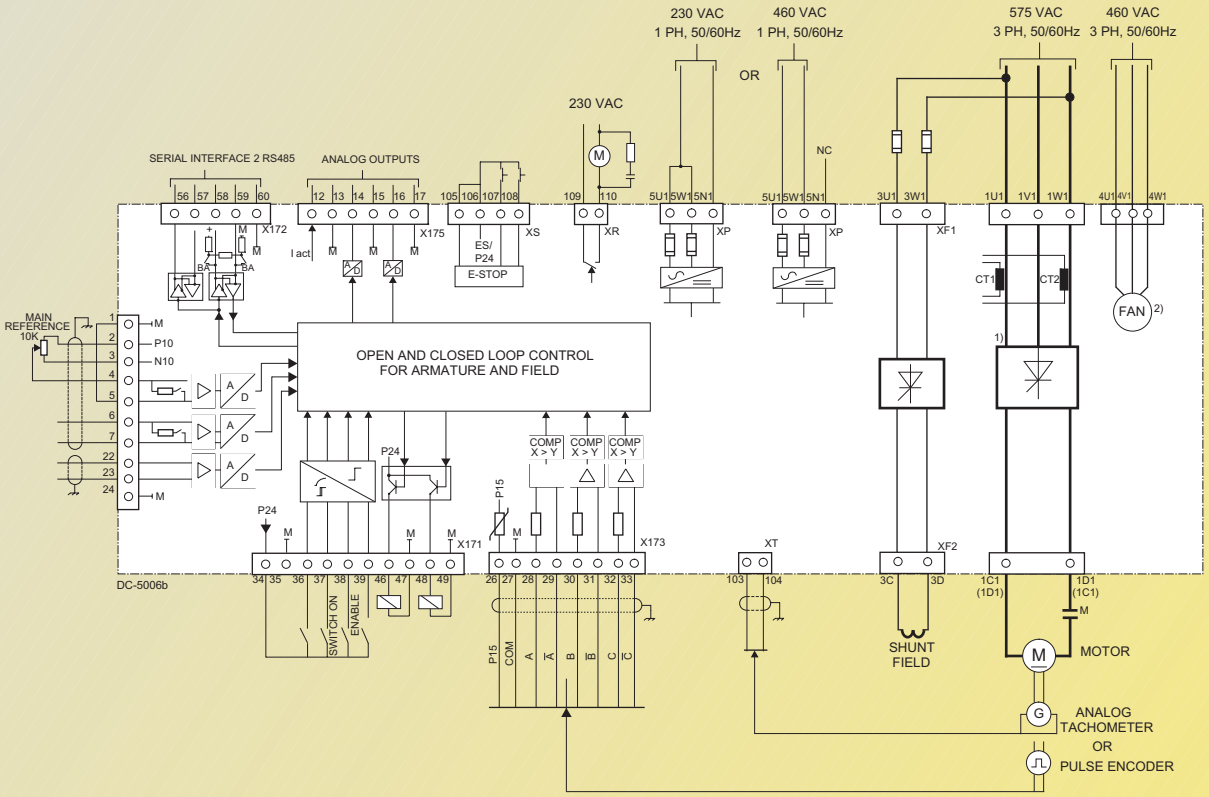
6RA70..-4G, 1180 A and above



1) Note:
Branch circuit fuses are internal to power modules.

2) Note:
Fan must rotate counter-clockwise when viewed from above.

Fig. 2/9
Power module block diagram 1180 A and above

6RA70..-2F, 15 A to 30 A

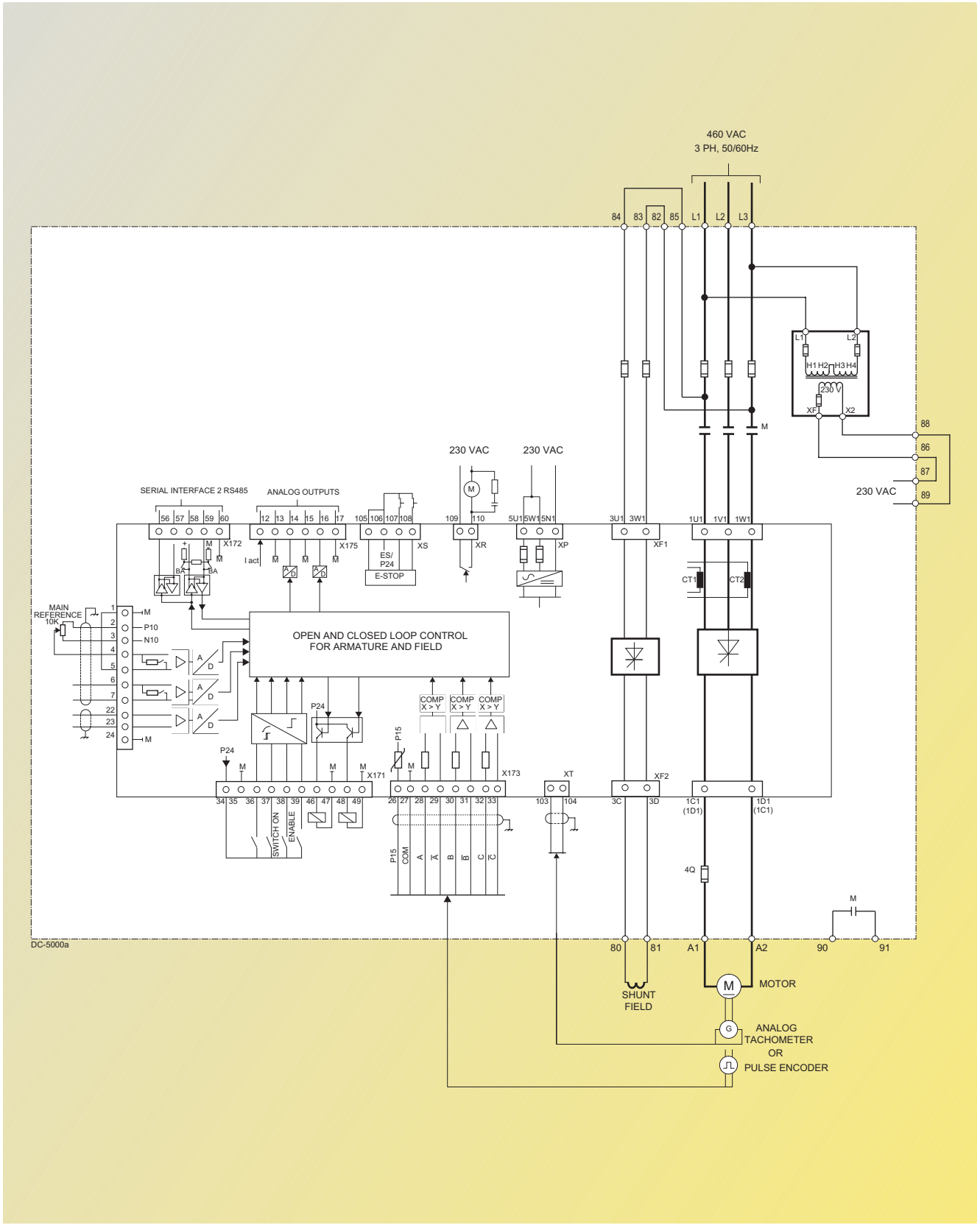
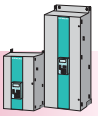


Fig. 2/10
Base drive panel block diagram 15 to 30 A



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6RA70..-2F, 60 A to 255 A

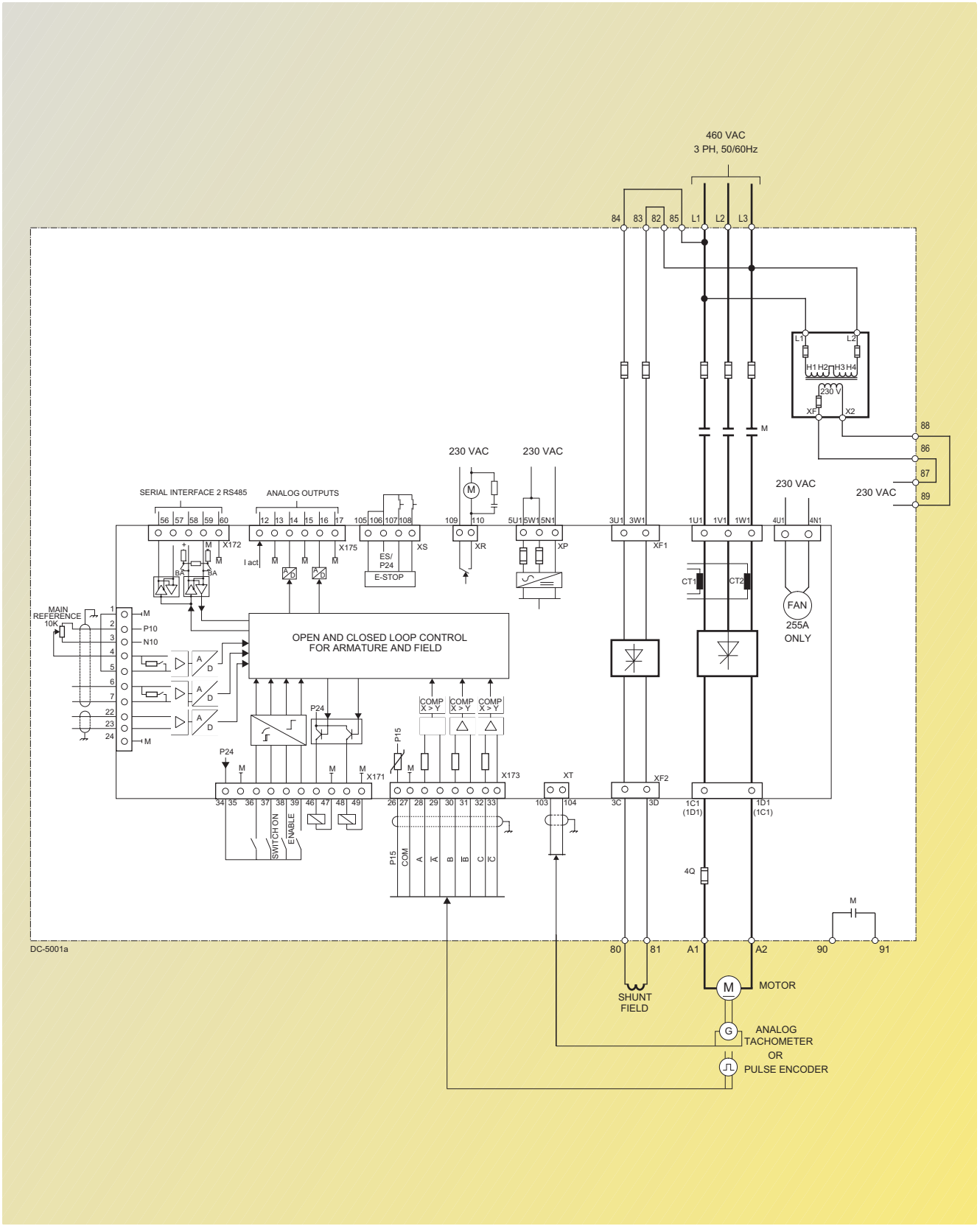


Fig. 2/11
Base drive panel block diagram 60 A to 255 A

6RA70..-2F, 430 A to 510 A

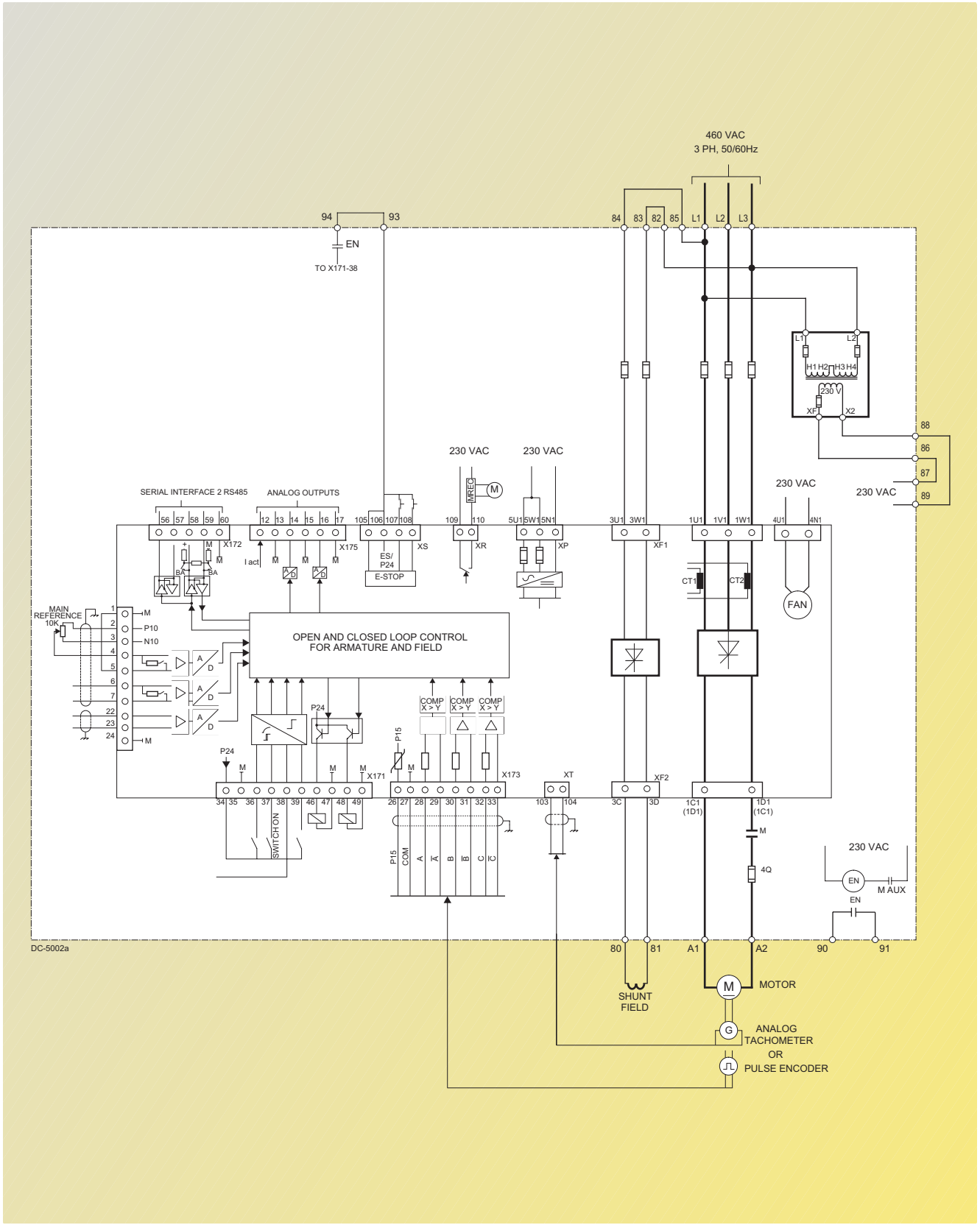
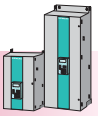


Fig. 2/12
Base drive panel block diagram 430 A to 510 A



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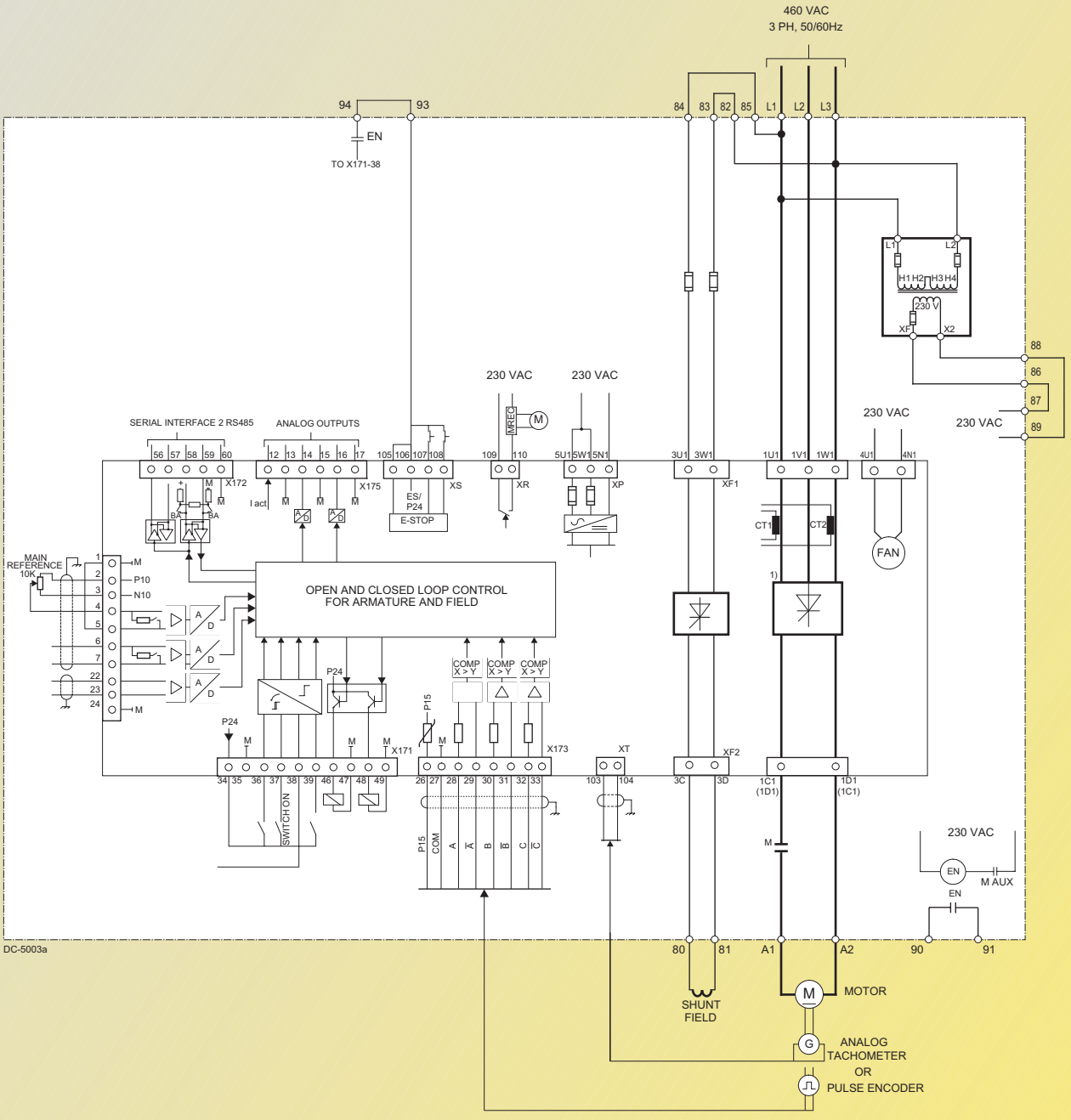
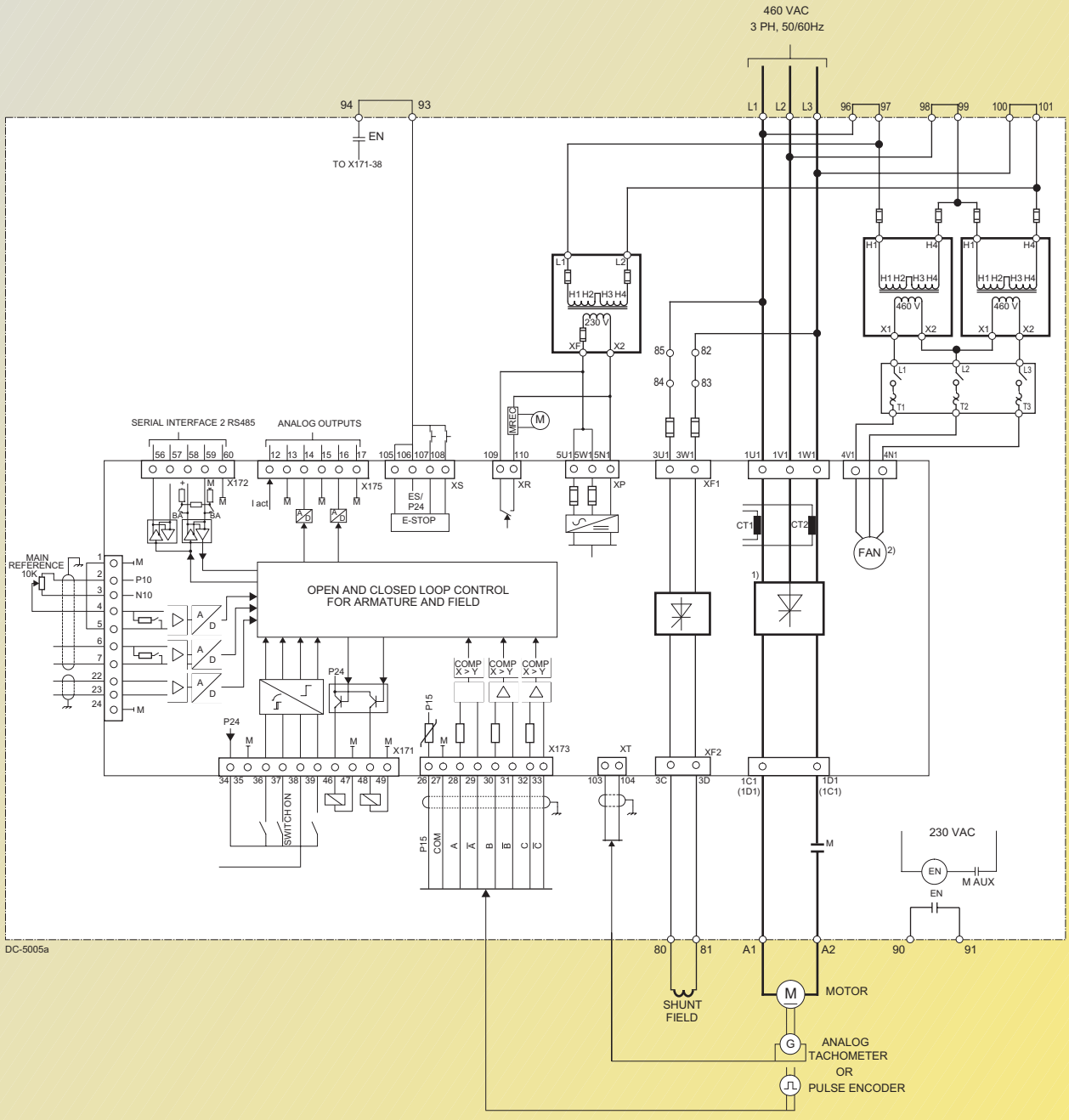
6RA70..-2F, 850 A



1) Note:
Branch circuit fuses are internal to power modules.

Fig. 2/13
Base drive panel block diagram 850 A

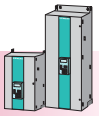
6RA70..-2F, 1180 A and 1660 A and 1680 A



1) Note:
Branch circuit fuses are internal to power modules.

2) Note:
Fan must rotate counter-clockwise when viewed from above.

Fig. 2/14
Base drive panel block diagram 1180 A and 1660 A, 1680 A



Terminal assignments

Type	Terminal design	Function	Terminal	Connection values/comments
Power section	The converters are designed for a permanent power supply connection according to DIN VDE 0160 Section 6.5.2.1.	**Power module**		
	PE conductor connection: Minimum cross-section 10 mm^2	Armature line input	1U1 1V1 1W1	See technical data
	The connection cross-sections must be determined according to the applicable regulations, e.g. DIN VDE 100 Part 523, DIN VDE 0276 Part 1000.	Protective conductor PE	e	
		Armature circuit/ motor connection	1C1 (1D1) 1D1 (1C1)	
		Base drive		
		Incoming supply	L1 L2 L3	
		Protective conductor PE	e	
		Armature circuit/ motor connection	A1 A2	
Field circuit		**Power module**		2-ph. AC 400 to 460 V (+15 %/–20 %)
		Mains connection	XF1-2/3U1 XF1-1/3W1	
				300 V rated DC voltage with 2-ph. AC 460 V mains connection
		Field winding connection	XF2-2/3C XF2-1/3D	
Electronics power supply [1]	Type 49 plug-in terminal Max. cross-section 1.5 mm^2, stranded	**Power module**		2-ph. AC 380 to 460 V (+15 %/–25 %); I_{rated} = 1 A 1-ph. AC 190 to 230 V (+15 %/–25 %): I_{rated} = 2 A
		Incoming supply	XP/5U1 XP/5W1 XP/5N1	
Fan [2]		**Power module**		Further information see technical data
		Incoming supply	4UA1 (4N1) 4V1 4W	
		Protective conductor PE	e	
Safety shutdown (E-STOP)	MSTB2.5 plug-in terminal Max cross-section 2.5 mm^2	Supply for safety shutdown	XS/106	DC 24 V, max. load 50 mA, short-circuit-proof, evaluation via fault message F028
		Safety shutdown – Switch – Pushbutton – Reset	 XS/105 [3] XS/107 [3] XS/108 [3]	 I_e = 20 mA NC contact I_e = 30 mA NO contact I_e = 10 mA
Analog inputs, tacho inputs	MSTB2.5 plug-in terminal Max. cross-section 2.5 mm^2	Tacho connection 8 to 270 V	XT/103	±270 V; >143 kΩ Signs can be reversed and signals switched through by means of binary input functions.
		Analog ground M	XT/104	

1) Note: For converters with a power section supply voltage that lies outside the tolerance range (note max. permissible power section supply voltage), the electronics power supply, field circuit mains connection and fan connection must be adapted to AC 460 V via a transformer.

An autotransformer is recommended for power section supply voltages up to 500 V. An isolating transformer must be used for power section supply voltages exceeding 500 V. This isolating transformer must have a center tap that is connected to protective earth PE.

2) On forced-ventilated converters ≥ 255 A.

3) Note: Either terminal 105 or terminals 107 + 108 may be used! Terminal 105 is connected to terminal 106 in the delivery state.

CUD1 Block diagram

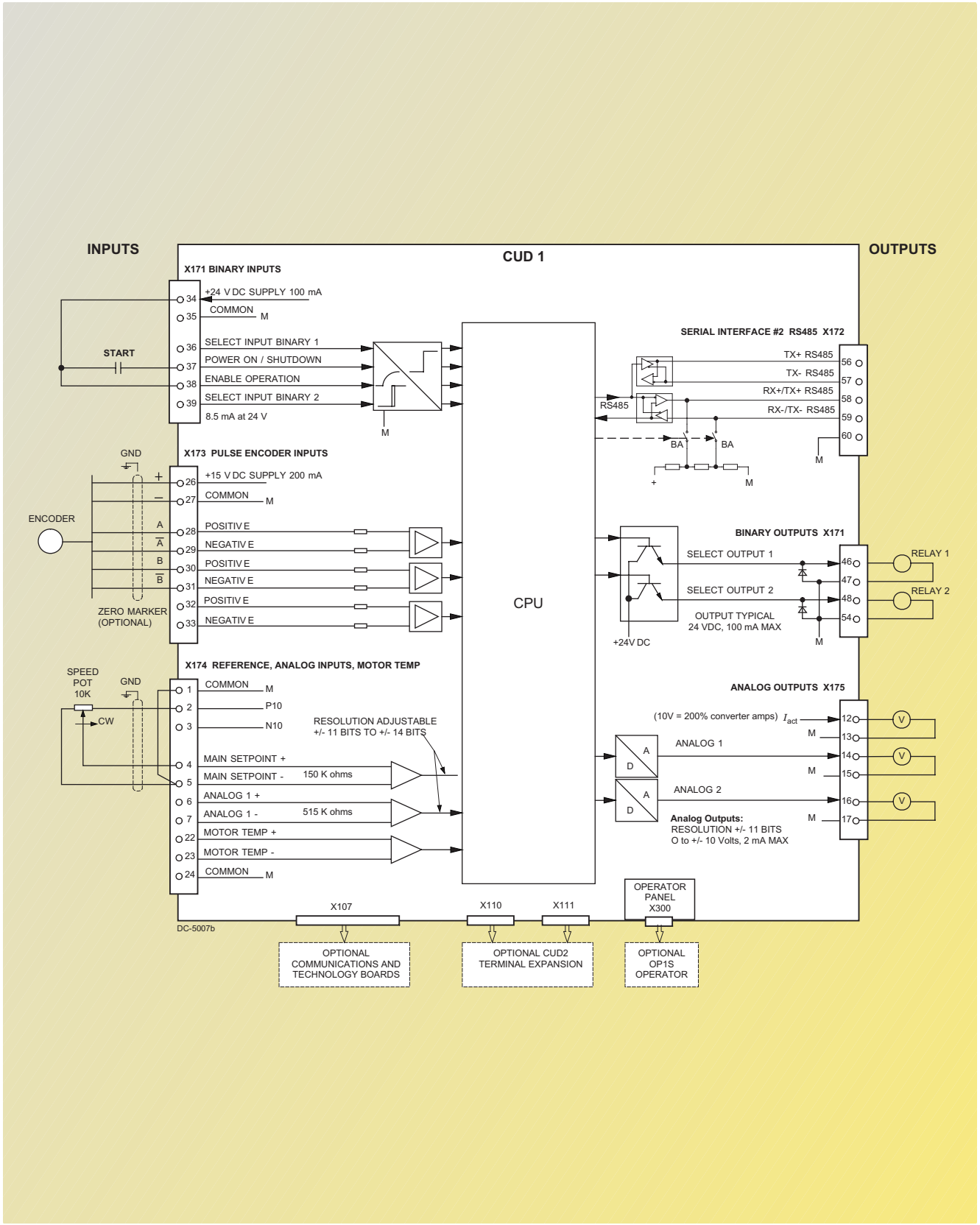
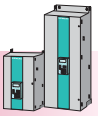


Fig. 2/15
CUD1 Block diagram with typical customer connections



Terminal assignments CUD1

Type	Terminal design	Function	Terminal	Connection values/comments
Analog inputs, reference voltage	Plug-in (screw-type) terminal Max. cross-section 1.5 mm^2	Reference: – M – P10 – N10	 X174/1 X174/2 X174/3	 ±1 % at 25 °C (stability 0.1 % per 10 °K); 10 mA short-circuit-proof
		Selectable input: – Main setpoint + – Main setpoint –	 X174/4 X174/5	 Differential input Parameter settings: ±10 V; 150 kΩ [1] Resolution can be parameterized up to approx. 555 µV (±14 bits) 0 to 20 mA; 300 Ω 4 to 20 mA; 300 Ω
		Selectable input: – Analog 1+ – Analog 1–	 X174/6 X174/7	 Differential input Parameter settings: ±10 V; 150 kΩ [1] Resolution can be parameterized up to approx. 555 µV (±14 bits) 0 to 20 mA; 300 Ω 4 to 20 mA; 300 Ω
				Signs can be reversed and signals switched through by means of binary input functions.
				Common mode suppression: ±15V
Pulse encoder input	Plug-in (screw-type) terminal Max. cross-section 1.5 mm^2	Supply (+13.7 V to +15.2 V)	X173/26	200 mA; short-circuit-proof (electronic protection)
		Pulse encoder ground M	X173/27	
		Track 1: – Positive terminal – Negative terminal	 X173/28 X173/29	 Load: ≤5.25 mA at 15 V (w/o switching losses, see para. cable, cable length, shield connection [2])
		Track 2: – Positive terminal – Negative terminal	 X173/30 X173/31	 Switching hysteresis: Pulse/pause ratio: 1:1
		Zero marker: – Positive terminal – Negative terminal	 X173/32 X173/33	 Level of input pulses: [2] Track offset: See Table 1/2 [2] Pulse frequency: See Table 1/3 [2] Cable length
Other analog inputs	Plug-in (screw-type) terminal Max. cross-section 1.5 mm^2	Motor temperature: – Positive terminal – Negative terminal	 X174/22 X174/23	 Sensor acc. to P490, index 1 Sensor acc. to P490, index 1 PTC or KTY84-130
		Analog ground M	X174/24	
Analog outputs	Plug-in (screw-type) terminal Max. cross-section 1.5 mm	Actual current Analog ground M	X175/12 X175/13	0 ± 10 V corresponds to 0 ± 200 % Converter rated DC current Max. load 2 mA, short-circuit-proof
		Analog selectable output 1 Analog ground M	X175/14 X175/15	0 ± 10 V, max. 2 mA, short-circuit-proof Resolution ±11 bits
		Analog selectable output 2 Analog ground M	X175/16 X175/17	0 ± 10 V, max. 2 mA, short-circuit-proof Resolution ±11 bits

1) Resolution can be parameterized up to approx. 555 µV (±14 bits)

2) See Section "Characteristic data of pulse tacho evaluation electronics"

Terminal assignments CUD1

Type	Terminal design	Function	Terminal	Connection values/comments
Binary control inputs	Plug-in (screw-type) terminal Max. cross-section 1.5 mm^2	Supply	X171/34	24 V DC, max. load 100 mA, internal supply referred to internal ground
		Digital ground M	X171/35	
		Switch-on/shutdown	X171/37	• H signal: Switch-on [1] Line contactor CLOSED + (with H signal at terminal 38), acceleration along ramp-function generator ramp to operating speed. • L signal: Shutdown [1] Deceleration along ramp-function generator ramp to $n < n_{min}$ (P370) + controller disable + line contactor OPEN.
		Enable operation	X171/38	• H signal: Controller enabled [1] • L signal: Controller disabled [1] The L signal also acts at a higher level on ”Inch” and ”Crawl”.
		Binary selectable input	X171/39	[1]
		Binary selectable input (fault acknowledgement)	X171/36	The group message is acknowledged on a positive edge. The converter remains in the “Fault” state until the fault has been eliminated and acknowledged and then switches to the “Starting lockout” state. The “Starting lockout” state can be reset by applying an L signal to terminal 37. [1]
Binary control outputs	Plug-in (screw-type) terminal Max. cross-section 1.5 mm^2	Ground M: – Binary selectable outputs – Binary selectable outputs	 X171/47 X171/54	
		Selectable output “$\overline{\text{Fault}}$”	X171/46	• H signal: No fault [2] • L signal: Fault [2] Short-circuit-proof 100 mA [2]
		Binary selectable output 2	X171/48	Short-circuit-proof 100 mA [2]
		Relay for line contactor: – Common potential – NO contact	 XR/109 XR/110	Load rating: ≤ AC 250 V, 4 A; cos Φ = 1 ≤ AC 250 V, 2 A; cos Φ = 0,4 ≤ DC 30 V, 2 A
Serial interface 1 RS232/X300 [3][4][5]		Housing earth	X300/1 [6]	
		Receive cable RS232 standard (V.24)	X300/2 [6]	
		Send and receive cable, two-wire RS485, pos. diff. input/output	X300/3 [6]	
		$\overline{\text{BOOT}}$, control signal for software update	X300/4 [6][9]	
		Ground	X300/5 [6]	
		5 V voltage supply for OP1S	X300/6 [6]	
		Send cable RS232 standard (V.24)	X300/7 [6]	
		Send and receive cable, two-wire RS485, pos. diff. input/output	X300/8 [6]	
		Ground	X300/9 [6]	
Serial interface 2 RS485 [7][8]	Plug-in (screw-type) terminal Max. cross-section 1.5 mm^2	TX+	X172/56	RS485, 4-wire send cable, positive differential input
		TX–	X172/57	RS485, 4-wire send cable, negative differential input
		RX+/TX+	X172/58	RS485, 4-wire receive cable, positive differential input, 2-wire send/receive cable, positive differential input
		RX–/TX–	X172/59	RS485, 4-wire receive cable, negative differential input, 2-wire send/receive cable, negative differential input
		M	X172/60	Ground

1) H signal: +13 to +33 V*
L signal: –33 to +3 V
or terminal open*
*for binary control inputs 8.5 mA at 24 V

2) H signal: +16 to +30 V
L signal: 0 to +2 V

3) 9-pin SUBMIN D socket

4) Cable length:
– Up to 15 m acc. to EIA RS232-C standard
– Up to 30 m Capacitive load max. 2.5 nF (cable and receiver)

5) A serial connection to a PLC or PC can be made using connector X300 on the PMU, allowing the converter to be controlled and operated from a central control center or room.

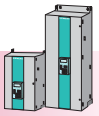
6) Connector pin

7) Cable length:
– For baud rate of 187.5 kBd: 600 m
– For baud rate of ≤ 93.75 kBd: 1200 m

8) Please observe DIN 19 245, Part 1: In particular, the potential difference between the data reference potentials M of all interfaces must not exceed –7 V/+12 V. If this cannot be guaranteed, then equipotential bonding must be provided.

9) For SIMOREG 6RA70, no function.

Notes

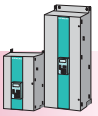


SIMOREG 6RA70 DC MASTER

Selection & Ordering Data

3

Flow diagram for selection process



Mandatory Information

Step 1

Determine if Base Drive Panel or Power Module will be required

A base drive panel includes the power module along with fuses, control transformer, and contactor all mounted and prewired on a backplane for convenient panel installation with a single 3-phase source connection.
See chapter 2 for details on all models.

Step 2

Verify Supply & Control voltage requirements

Base drive panels require only a single 3-phase power source to supply the armature, field, control voltage, and fan. On a typical base drive panel application a 460 V AC 3-phase source would control a DC motor with a 500 V DC armature and a 300 V DC field.
For details see chapter 2.

Step 3

Determine Current Rating

Specification charts in chapter 6 contain US current ratings and HP relation.
US current ratings offer a 150% overload for 60 seconds.

Step 4

Determine if application requires a 1 Quad or 4 Quad converter

4 Quad allows the converter to motor and regenerate power in both directions.
1 Quad converters will only allow armature current to flow in the motoring direction and usually coast to decelerate. For a 1 Quad converter to change the direction of a DC motor a field reversal circuit is needed. See field reversal kits in chapter 5.

Step 5

Select appropriate model number from selection tables

See selection tables in this chapter.

Step 6

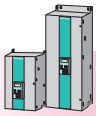
Determine if CUD2 Terminal Expansion Board is needed

CUD2 includes additional analog and binary I/O along with a paralleling and serial interface.
The optional CUD2 board mounts directly onto the main CUD1 board.
See terminal expansion board description in chapter 4 for details and ordering information.

Step 7

Determine if Extended Technology Software option CUD1 is needed

This software option opens many extended technology functions and applications.
In addition to offering a technology regulator, numerous mathematical and Boolean logic function blocks are offered to handle winding and other higher level applications.
See description in chapter 4 for details and ordering information.



6RA70
DC MASTER

Flow diagram for selection process

Mandatory Information

Step 8

Determine if Line Reactors are required

Line reacters provide the recommended impedance between converter and incoming supply.
See chapter 5 for details and ordering information.

Step 9

Determine if additional system components are needed

Isolation transformers, field reversing kits, and dynamic braking offerings are available for loose mounting.
See chapter 5 for details and ordering information.

Step 10

Determine if optional Alpa-Numeric Operator Panel (OP1S) is requested

The SIMOREG 6RA70 is completely autonomous and can be completely programmed from the built-in operator panel. For ease of commissioning and an expanded alphanumeric display the OP1S optional operator panel with storage capabilities can be easily attached to the SIMOREG 6RA70.
See chapter 4 for OP1S description and ordering information.

Step 11

Determine if Communication Board will be implemented

USS and peer to peer communications with RS485 and RS232 ports are standard and no option boards are required for the SIMOREG 6RA70.
For PROFIBUS, SIMOLINK™ and many other communication options see chapter 4 for description and ordering information.

Step 12

Determine if Technology Board or other option is needed for this application

The T400 technology board has standard application-specific software packages along with the ability to add customized software to handle even the most challenging applications. Expansion boards such as the EB1 and EB2 are also available to increase the functionality of the SIMOREG 6RA70.
See chapter 4 for description and ordering information.

Step 13

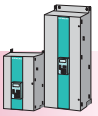
If an Option Board in Step 11 or 12 is selected the following adapters apply

The LBA local bus adapter is required if any board other than the CUD1 or CUD2 is to be used in the electronics box. The LBA is sold separately and easily fitted into the electronics box.
The ADB adapter board is necessary if any half-size option board such as the CBP2 or SLB is to be inserted into the electronics box. The ADB is sold separately and easily fits into the electronics box after the LBA has been installed.
See chapter 4 for further details and ordering information.

Step 14

Place your order with the assurance that you are getting the top performing DC Drive in the Industry with exceptional worldwide support.

Drive enclosures and motor-drive packages are readily available from Siemens to complete our DC offerings. Contact your local Siemens sales office for additional information.

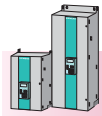


Power modules

Power modules are available in single and four quadrant designs from 15 A to 3000 A ratings. Through the use of the paralleling interface on the CUD2 option board designs of up to six paralleled power modules are possible.

For international use power modules of various voltage ratings are available. Refer to Appendix A for a complete list of power modules with US and international IEC current ratings. Consult factory for details and pricing.

Fig. 3/1
Power modules 15 A through 3000 A



6RA70
DC MASTER

Power module selection

Selection and ordering data

Power module
Single quadrant, non-regenerative

Horsepower 240 V DC	Horsepower 500 V DC	Rated Armature A	Rated Field A	Catalog No. 1)2)4)
3 HP	7.5 HP	15 A DC	5 A DC	**6RA7018-6FS22-0Z+X01**
7.5 HP	15 HP	30 A DC	10 A DC	**6RA7025-6FS22-0Z+X01**
15 HP	30 HP	60 A DC	10 A DC	**6RA7028-6FS22-0Z+X01**
25 HP	60 HP	100 A DC	10 A DC	**6RA7031-6FS22-0Z+X01**
40 HP	75 HP	140 A DC	15 A DC	**6RA7075-6FS22-0Z+X01**
60 HP	125 HP	210 A DC	15 A DC	**6RA7078-6FS22-0Z+X01**
75 HP	150 HP	255 A DC	25 A DC	**6RA7082-6FS22-0Z+X01**
125 HP	250 HP	430 A DC	25 A DC	**6RA7085-6FS22-0Z+X01**
150 HP	300 HP	510 A DC	30 A DC	**6RA7087-6FS22-0Z+X01**
250 HP	500 HP	850 A DC	30 A DC	**6RA7091-6FS22-0Z+X01**
350 HP	700 HP	1180 A DC	40 A DC	**6RA7093-4GS22-0Z+X01**
500 HP	1000 HP	1660 A DC	40 A DC	**6RA7095-4GS22-0Z+X01**
500 HP	1000 HP	1680 A DC	85 A DC	**6RA7096-4GS22-0Z+X01**

Power module
Four quadrant, regenerative 3)

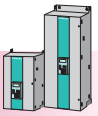
Horsepower 240 V DC	Horsepower 500 V DC	Rated Armature A	Rated Field A	Catalog No. 1)2)4)
3 HP	7.5 HP	15 A DC	5 A DC	**6RA7018-6FV62-0Z+X01**
7.5 HP	15 HP	30 A DC	10 A DC	**6RA7025-6FV62-0Z+X01**
15 HP	30 HP	60 A DC	10 A DC	**6RA7028-6FV62-0Z+X01**
25 HP	60 HP	100 A DC	10 A DC	**6RA7031-6FV62-0Z+X01**
40 HP	75 HP	140 A DC	15 A DC	**6RA7075-6FV62-0Z+X01**
60 HP	125 HP	210 A DC	15 A DC	**6RA7078-6FV62-0Z+X01**
75 HP	150 HP	255 A DC	25 A DC	**6RA7082-6FV62-0Z+X01**
125 HP	250 HP	430 A DC	25 A DC	**6RA7085-6FV62-0Z+X01**
150 HP	300 HP	510 A DC	30 A DC	**6RA7087-6FV62-0Z+X01**
250 HP	500 HP	850 A DC	30 A DC	**6RA7091-6FV62-0Z+X01**
350 HP	700 HP	1180 A DC	40 A DC	**6RA7093-4GV62-0Z+X01**
500 HP	1000 HP	1660 A DC	40 A DC	**6RA7095-4GV62-0Z+X01**
500 HP	1000 HP	1680 A DC	85 A DC	**6RA7096-4GV62-0Z+X01**

1) SIMOREG drive controllers will be shipped without options installed.

2) DC motor, drive enclosure, contactor, most fuses, and control transformer not included.

3) Designed for operation with straight shunt wound motors.

4) Model numbers in this section come equipped with the S00 extended technology function enabled.

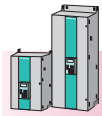


Base drive panel models

Base drive panel models are available in single and four quadrant designs from 15 A to 1660 A ratings. These models feature the 6RA70 power module, line fuses, contactor, control transformer, and connections mounted on a back panel.

Drive packages consisting of a base drive controller and motor along with drive enclosures are also available. Consult factory for details and pricing.

Fig. 3/2
Base drive panel examples of 15 A, 210 A and 510 A models



6RA70
DC MASTER

Base drive panel selection

Selection and ordering data

Base drive panel
Single quadrant, non-regenerative

Horsepower 240 V DC [1]	500 V DC	Rated Armature A	Catalog No. [2][3]
3 HP	7.5 HP	15 A DC	**6RA7013-2FS22-0**
7.5 HP	15 HP	30 A DC	**6RA7018-2FS22-0**
15 HP	30 HP	60 A DC	**6RA7025-2FS22-0**
25 HP	60 HP	100 A DC	**6RA7030-2FS22-0**
40 HP	75 HP	140 A DC	**6RA7072-2FS22-0**
60 HP	125 HP	210 A DC	**6RA7075-2FS22-0**
75 HP	150 HP	255 A DC	**6RA7077-2FS22-0**
125 HP	250 HP	430 A DC	**6RA7082-2FS22-0**
150 HP	300 HP	510 A DC	**6RA7083-2FS22-0**
250 HP	500 HP	850 A DC	**6RA7087-2FS22-0**
350 HP	700 HP	1180 A DC	**6RA7091-2FS22-0**
500 HP	1000 HP	1660 A DC	**6RA7094-2FS22-0**

Base drive panel
Four quadrant, regenerative [4]

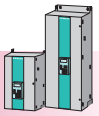
Horsepower 240 V DC [1]	500 V DC	Rated Armature A	Catalog No. [2][3]
3 HP	7.5 HP	15 A DC	**6RA7013-2FV62-0**
7.5 HP	15 HP	30 A DC	**6RA7018-2FV62-0**
15 HP	30 HP	60 A DC	**6RA7025-2FV62-0**
25 HP	60 HP	100 A DC	**6RA7030-2FV62-0**
40 HP	75 HP	140 A DC	**6RA7072-2FV62-0**
60 HP	125 HP	210 A DC	**6RA7075-2FV62-0**
75 HP	150 HP	255 A DC	**6RA7077-2FV62-0**
125 HP	250 HP	430 A DC	**6RA7082-2FV62-0**
150 HP	300 HP	510 A DC	**6RA7083-2FV62-0**
250 HP	500 HP	850 A DC	**6RA7087-2FV62-0**
350 HP	700 HP	1180 A DC	**6RA7091-2FV62-0**
500 HP	1000 HP	1660 A DC	**6RA7094-2FV62-0**

1) Standard voltage configuration as shipped is 460 V AC. See Technical manual for 230 V AC connection.

2) SIMOREG drive controllers will be shipped without options installed.

3) DC motor and drive enclosure not included.

4) Designed for operation with straight shunt wound motors.



High HP designs

6RA70 high HP designs are available in single and four quadrant models with continuous current ratings of 2700 A, 5000 A, and 7500 A in six pulse designs. High HP designs with up to 14000 A ratings are also available in the 12-pulse design.

These converters have input ratings up to 700 V AC and can operate on DC motors with up to a 750 V DC armature rating. Typical short term overload ratings of 150 % for 60 s and 180 % for 30 s are common for these units.

High HP 6RA70 designs are mounted in robust Siemens 8MF enclosure systems and can be ordered in various designs to meet the customers needs. For additional information on the high HP 6RA70 designs contact your local Siemens Sales Office.

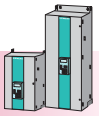
Fig. 3/3
7500 A four quadrant 6RA70 high HP design

Horsepower ratings	Rated Armature A	Catalog No.
Single quadrant, non-regenerative		
Numerous design options are available, consult factory for details and selection.		
Four quadrant, regenerative		
Numerous design options are available, consult factory for details and selection.		

SIMOREG 6RA70 DC MASTER

Electronic Options & Accessories

4



OP1S User-friendly operator control panel

The OP1S operator control panel is an optional input/output device which can be used for controlling, displaying, and parameterizing the units. Parameterization is menu-guided and is performed by selecting the parameter number and then entering the parameter value. Plain-text displays greatly facilitate parameterization.

Parameter and parameter value descriptions, as well as text displays in English, German, Spanish, French and Italian, are included in the standard version.

The OP1S has a non-volatile memory and is capable of permanently storing complete parameter sets. It can therefore be used for archiving parameter settings and for transferring parameter sets from one unit to another.

On the rear of the OP1S is a 9-pin SUB D connector which power is supplied and communication with the connected units takes place.

The OP1S operator control panel can be plugged directly onto the SUB D socket of the PMU on the converter door.

The OP1S operator panel can also be used as a remote-control device. The cable between the PMU and the OP1S must not exceed 50 m. If longer than 5 m, a standard 5 V power supply with a current capability of at least 400 mA must be included on the OP1S end as shown in Fig. 4/3.

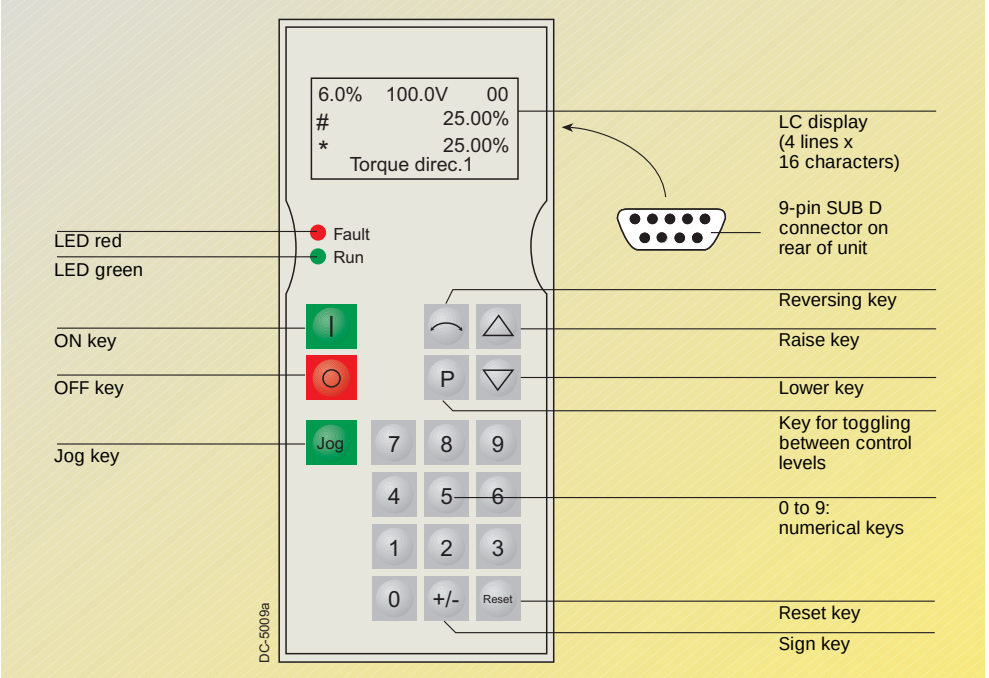


Fig. 4/1
View of the OP1S

Pin	Designation	Description
OP1S connections via RS485		
1		
2		
3	RS485 p	Data via RS485 interface
4		
5	N5V	Ground
6	P5V	5 V aux. voltage supply
7		
8	PS485 N	Data via RS485 interface
9		Reference potential

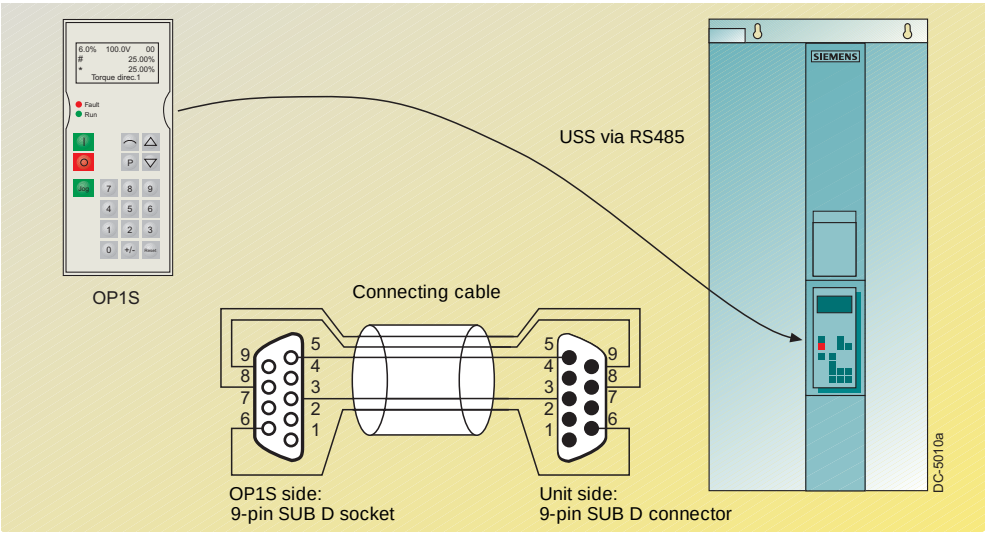


Fig. 4/2
OP1S point-to-point connection

OP1S User-friendly operator control panel

The OP1S and the unit to be operated communicate with each other via a serial interface (RS485) using the USS protocol (see Fig. 4/2). During communication, the OP1S assumes the function of a master and the connected units of slaves. The OP1S can be operated at transfer speeds of 9.6 kbit/s and 19.2 kbit/s and is capable of communicating with up to 31 slaves (address 1 to 31). It can therefore be used in a point-to-point link (operator control of one unit) or with a bus configuration (operator control of several units).

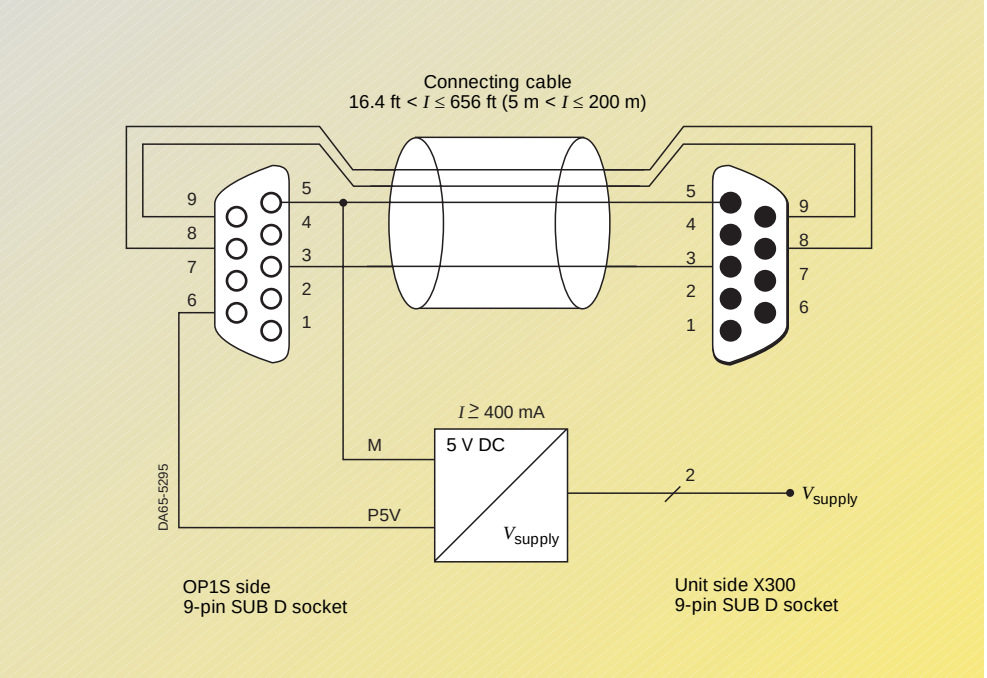
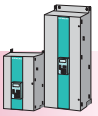


Fig. 4/3
OP1S in a point-to-point link with up to 200 m of cable

Selection and ordering data

Description	Catalog No.
OP1S Operator control panel	**6SE7090-0XX84-2FK0**
AOP1 Door mounting adapter (9.8 ft (3 m) cable included)	**6SX7010-0AA00**
Connecting cable PMU-OP1 9.8 ft (3 m)	**6SE7010-0AB03**
Connecting cable PMU-OP1 16.4 ft (5 m)	**6SE7010-0AB05**

Technology software



Each SIMOREG 6RA70 contains an extended software package that is released for use by means of a PIN code. This extended software package can be used to perform many high level task and control schemes without the need for a PLC or technology board. Numerous applications including winders, extended control logic, and draw/ratio speed cascades can be implemented using this software package. The following is a list of the software modules and technology controller functions included in the extended technology software.

Software modules

The following software modules are available:

- Three connector/binector converters
- Three binector/connector converters
- One technology controller
- Ten PI controllers
- One simple ramp-function generator
- Fifteen adders/subtracters
- Four sign inverters
- Two switchable sign inverters
- Six dividers
- Twelve multipliers
- Three high-resolution multipliers/dividers
- Four absolute-value generators with filter
- Three limit-value monitors with filter
- Seven limit-value monitors without filter
- Three limiters
- Four maximum selection with three inputs
- Four minimum selection with three inputs
- Four averaging blocks
- Two tracking/storage elements
- Two analog signal memories
- Two tracking/storage elements
- Ten analog signal selector switches
- Nine characteristic blocks
- One velocity/speed calculator
- One speed/velocity calculator
- 28 AND elements, each with three inputs
- 20 OR elements, each with three inputs
- 16 inverters
- Four EXCLUSIVE OR elements, each with two inputs
- Twelve NAND elements, each with three inputs
- 14 RS flipflops
- Four D flipflops
- Ten timers
- Five binary signal selector switches
- One dead zone
- Eight alarm triggers
- Thirty-two fault triggers
- Three multipliers
- Three integrators
- Three DTI elements
- Ten derivative/delay elements (lead/lag blocks)

Technology controller

The technology controller can be used for higher-level closed-loop controls, such as tension, position or pressure controllers. The output can be wired freely and can act, for example, as a main setpoint, additional setpoint or current limit.

The technology controller is a PID controller with separate settings for the closed-loop control characteristics. A droop setting is also available.

Connector numbers can be entered freely to select the source for setpoint and actual value. A filter (PT1 element) can be parameterized at the setpoint and actual value inputs.

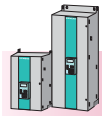
The technology controller output can be limited by mutually independent, positive and negative values, which can be parameterized or input via freely selectable connectors. The output signal can be weighted multiplicatively (parameterized or via connector signal) after the limiting stage.

Selection and ordering data

Description	Catalog No.
Extended technology software S00 [1])	**6RX1700-0AS00**

** The 6RA70 converters listed in chapter 3 are shipped from the factory with the S00 option enabled.*

1) When ordering this option you must supply the model number and serial number of the unit you wish to enable the extended software function on. Each unit contains 500 free hours of use.



6RA70
DC MASTER

CUD2 Terminal expansion board

The optional terminal expansion board (CUD2) is mounted on the basic electronics assembly (CUD1) and does not require any additional built-in components. This board provides a range of additional inputs and outputs.

In addition to the expanded I/O the CUD2 provides an additional RS485 serial interface along with a parallel interface for paralleling up to 5 power modules.

Terminals on optional terminal expansion board

- 4 binary selectable inputs via optocouplers, can also be used as interface to motor
- 4 binary selectable inputs to ground
- 2 analog inputs to ground, ±10-bit resolution
- One analog input for evaluation of motor temperature via PTC or KTY84
- 2 P24 binary outputs, open emitter, to ground, 100 mA load rating
- 2 analog outputs to ground, ±10 V, 2 mA load rating, ±11-bit resolution
- One serial interface, two- and four-wire RS485, max. 187.5 kBd
- One parallel interface (2 connectors) for parallel connection of SIMOREG
- P24 power supply for driving binary inputs
- 8 terminals for converter ground

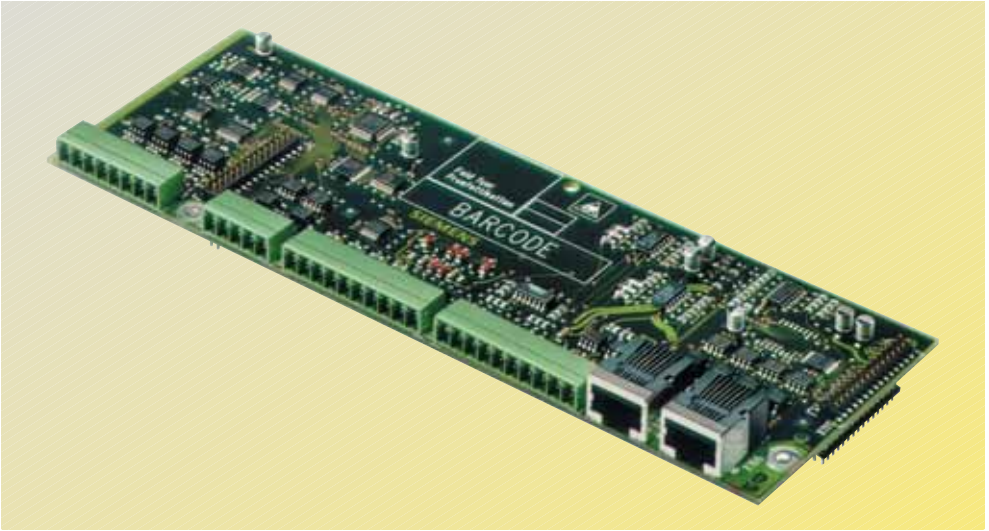


Fig. 4/4
CUD2 Terminal expansion board

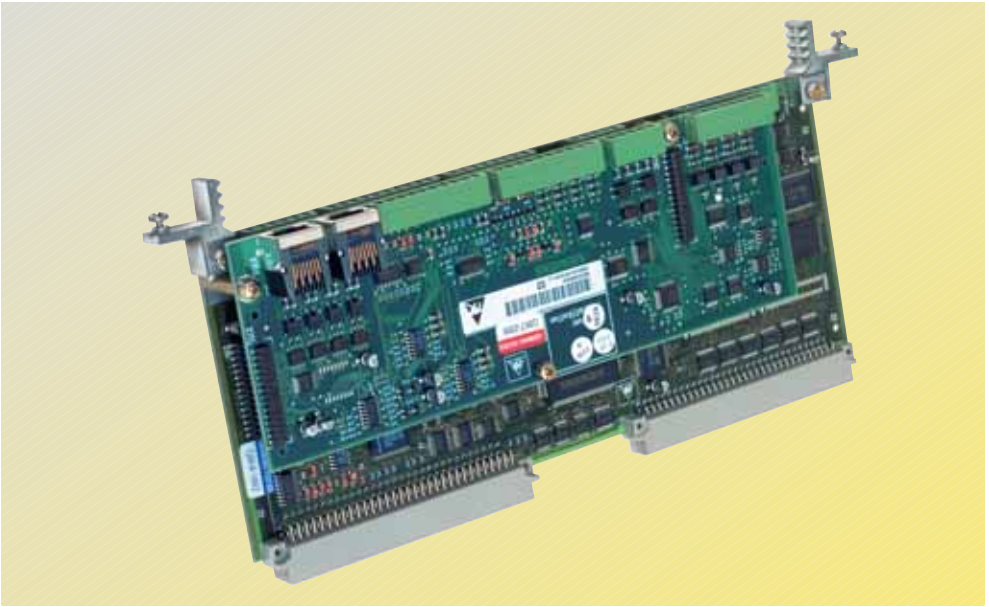


Fig. 4/5
CUD2 shown mounted on the CUD1 basic electronic board

Selection and ordering data

Description	Catalog No.
CUD2 Terminal expansion board	**6RX1700-0AK00**

Terminal assignments · Optional CUD2 control connections

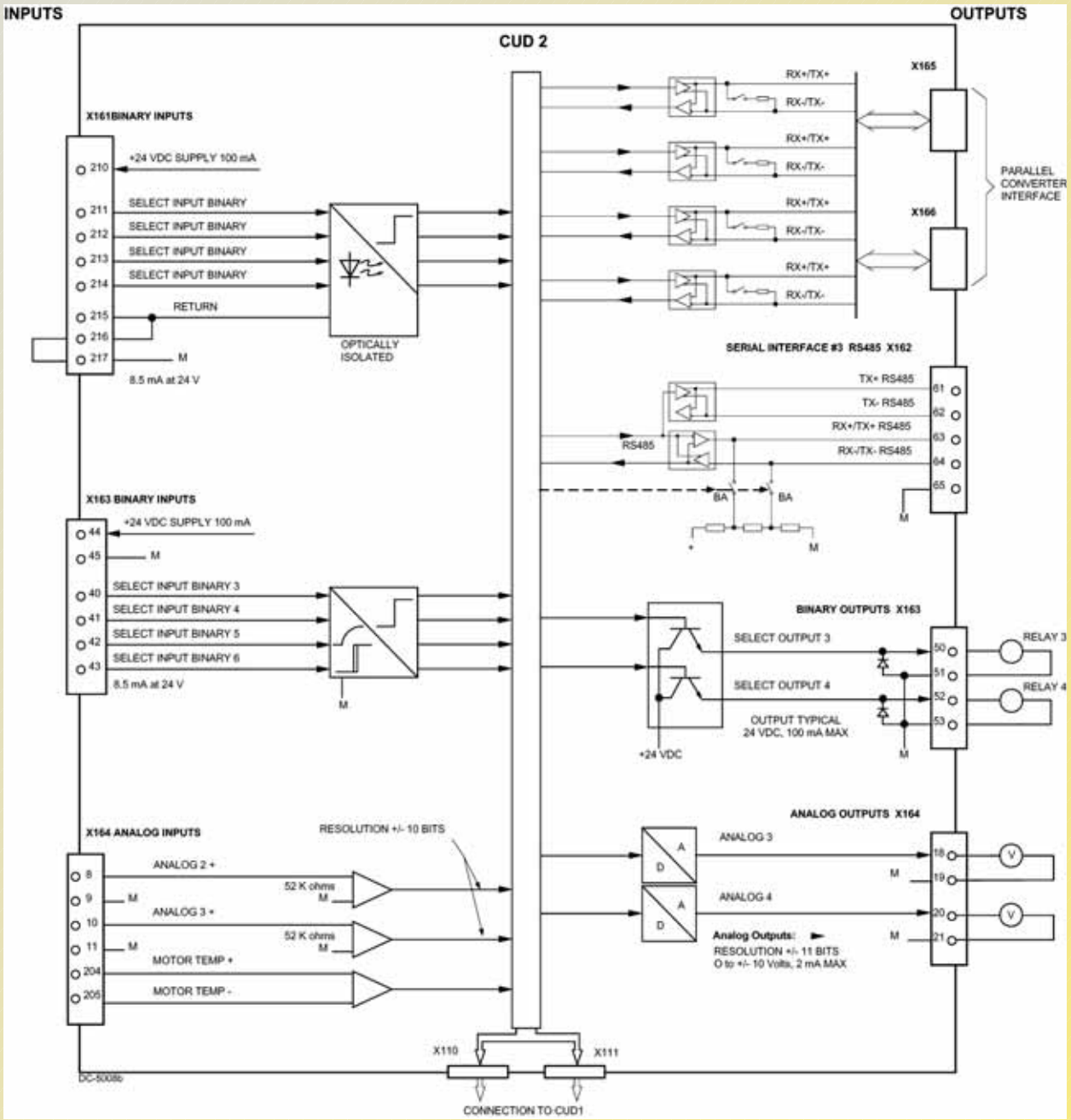


Fig. 4/6
CUD2 Terminal expansion board block diagram

Terminal assignments · Optional CUD2 control connections

Type	Terminal design	Function	Terminal	Connection values/comments
Motor interface	Plug-in (screw-type) terminal Max. cross-section 1.5 mm^2	Motor temperature: – Positive terminal – Negative terminal	 X164/204 X164/205	 Sensor acc. to P490, index 2 Sensor acc. to P490, index 2
		Supply of binary inputs	X161/210	DC 24 V, max. load Internal supply referred to internal ground, effective when ground M_GT is connected to internal ground (wire jumper closed between terminals 216 and 217)
		Binary input Binary input Binary input Binary input	X161/211 X161/212 X161/213 X161/214	Motor data evaluation or data evaluation
		Ground M_GT: – Binary inputs – Binary inputs	 X161/215 X161/216	 Can be separated from internal ground Wire jumper between terminals 216 and 217 open
		M	X161/217	Wire jumper between terminals 216 and 217 open
Analog inputs	Plug-in (screw-type) terminal Max. cross-section 1.5 mm^2	Analog selectable input 2 Analog ground Analog selectable input 3 Analog ground	X164/8 X164/9 X164/10 X164/11	±10 V, 52 kΩ Resolution: ±10 bits Signs can be reversed and signals switched through by means of binary input functions
Analog outputs	Plug-in (screw-type) terminal Max. cross-section 1.5 mm^2	Analog selectable output 3 Analog ground Analog selectable output 4 Analog ground M	X164/18 X164/19 X164/20 X164/21	0 ± 10 V, max. 2 mA, short-circuit-proof, measuring ±11 bit
Binary control inputs	Plug-in (screw-type) terminal Max. cross-section 1.5 mm^2	Supply	X163/44	DC 24 V, max. load 100 mA, internal supply referred to internal ground
		Digital ground M	X163/45	1)
		Selectable input: – Binary 3 – Binary 4 – Binary 5 – Binary 6	 X163/40 X163/41 X163/42 X163/43	 1) 1) 1) 1)
Binary control outputs	Plug-in (screw-type) terminal Max. cross-section 1.5 mm^2	Ground M: – Binary selectable outputs – Binary selectable outputs	 X163/51 X163/53	
		Selectable output: – Binary 3 – Binary 4	 X163/50 X163/52	 2) short-circuit-proof 100 mA
Serial interface 3 RS485 3)4)	Plug-in (screw-type) terminal Max. cross-section 1.5 mm^2	TX+	X162/61	RS485, 4-wire send cable, positive differential input
		TX–	X162/62	RS485, 4-wire send cable, negative differential input
		RX+/TX+	X162/63	RS485, 4-wire receive cable, positive differential input, 2-wire send/receive cable, positive differential input
		RX–/TX–	X162/64	RS485, 4-wire receive cable, negative differential input, 2-wire send/receive cable, negative differential input
		M X172/65		Ground

1) H signal: +13 to +33 V*
L signal: –33 to +3 V
or terminal open*

* for binary control inputs 8.5 mA at 24 V

2) H signal: +13 to +30 V
L signal: 0 to +2 V

3) Cable length:
– For baud rate of 187.5 kBd: 1967 ft (600 m)
– For baud rate of ≤ 93.75 kBd: 3938 ft (1200 m)

4) Please observe DIN 19 245, Part 1:
In particular, the potential difference between the data reference potentials M of all interfaces must not exceed –7 V/+12 V. If this cannot be guaranteed, then equipotential bonding must be provided.

Overview

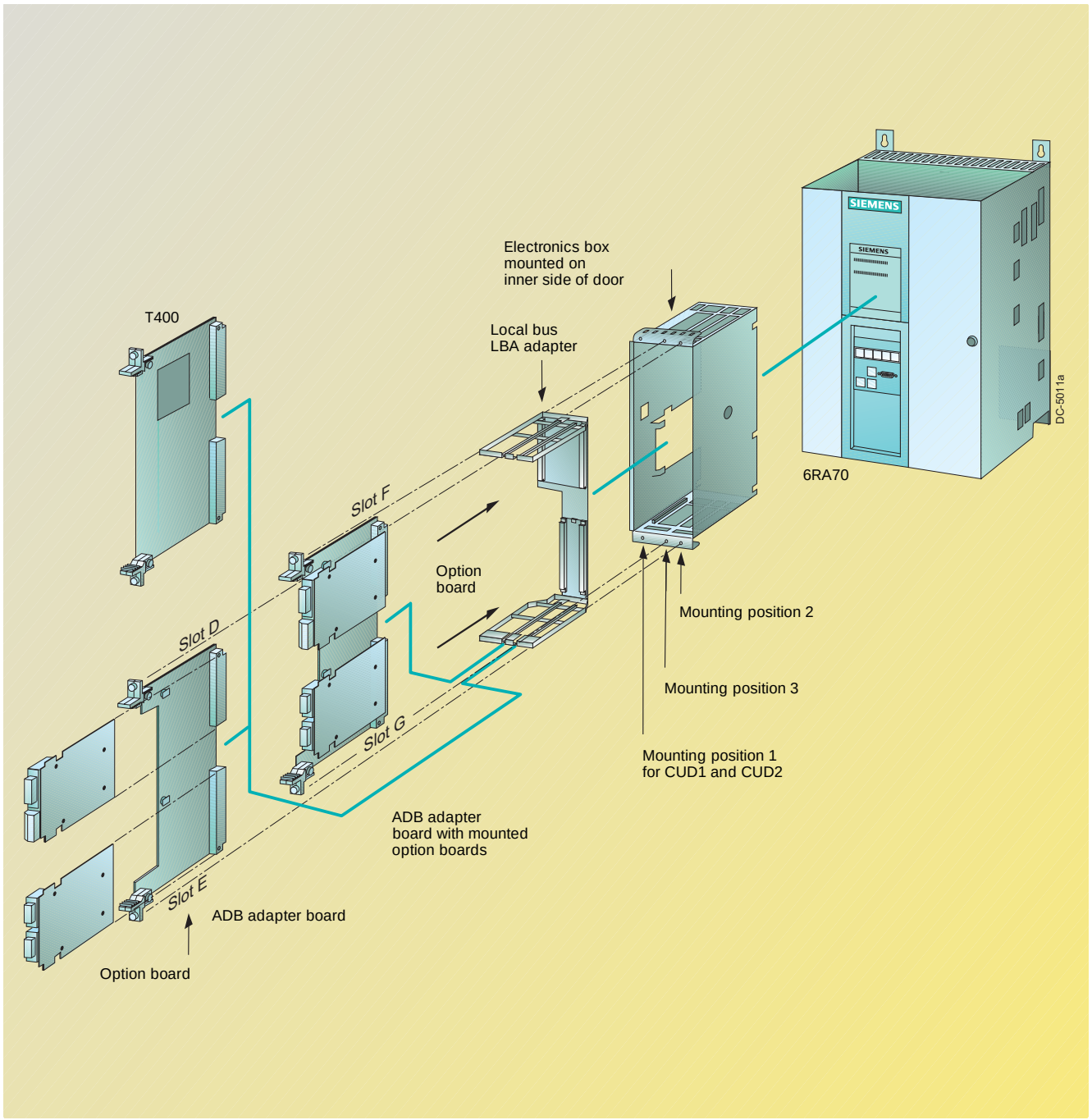


Fig. 4/7
Integrating/Mounting option boards

There are four slots available for mounting option boards in the electronics box of SIMOREG 6RA70 converters. The slots are designated with the letters D to G.

If slots D to G are needed, the LBA (**L**ocal **B**us **A**dapter) must first be installed.

An adapter board is necessary for slots D and E and additionally for F and G if half size option boards are used.

Mounting of optional supplementary boards

Supplementary option boards are inserted in the slots of the electronics box. Option **LBA** (local bus adapter, backplane wiring) is required to fit supplementary option boards. The designations of board locations and slots are shown in the following diagram.

Supplementary option boards may be inserted in any slots subject to one restriction, i.e. that board location 2 is filled before location 3.

Note

- A technology board must always be installed in board location 2 of the electronics box.
- If a technology board is used in conjunction with a communication board, then the communication board must be fitted in slot G. In this configuration the communication data flows directly between the communication board and the T400.
- It is not possible to operate boards EB1, EB2, SLB and SBP in conjunction with a technology board.
- The data of large-format boards are always output under slot E or slot G, i.e. the software version of a technology board, for example, is displayed in r060.003.
- In addition to the LBA, miniature-format boards (CBP2, SLB, EB1, etc.) also require an ADB (adapter board, support board). Due to their very compact physical dimensions, these boards must be inserted in an ADB before they can be installed in the electronics box.
- No more than 2 supplementary boards of the same type may be installed in one converter (e.g. 2 EB1s).

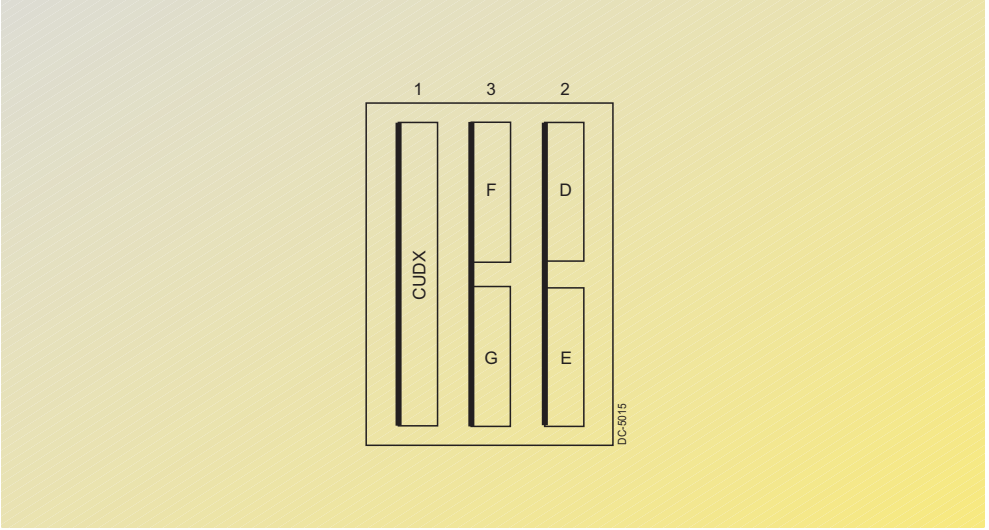


Fig. 4/8
Arrangement of board locations 1 to 3 and slots D to G in electronics box

Electronics box possible position assignments

Board	LBA required	ADB required	Location1	Location 2		Location 3	
				D	E	F	G
CUD1	N	N	Y	N	N	N	N
CUD2	N	N	Y	N	N	N	N
CBP2	Y	Y	N	Y	Y	Y	Y
CBC	Y	Y	N	Y	Y	Y	Y
CBD	Y	Y	N	Y	Y	Y	Y
SLB	Y	Y	N	Y	Y	Y	Y
SBP	Y	Y	N	Y	Y	Y	Y
SCB1	Y	N	N		Y		Y
T400	Y	N	N		Y		N
EB1	Y	Y	N	Y	Y	Y	Y
EB2	Y	Y	N	Y	Y	Y	Y

LBA Local bus adapter

The electronics box can easily be retrofitted with the backplane bus adapter LBA (**L**ocal **B**us **A**dapter), for use of positions 2 and 3. Full size option boards or the optional boards plugged onto the ADB (**A**dapter **B**oard) can be combined in the electronics box with the CUD1 control board in slot 1. The CUD1 must be removed to install the LBA.

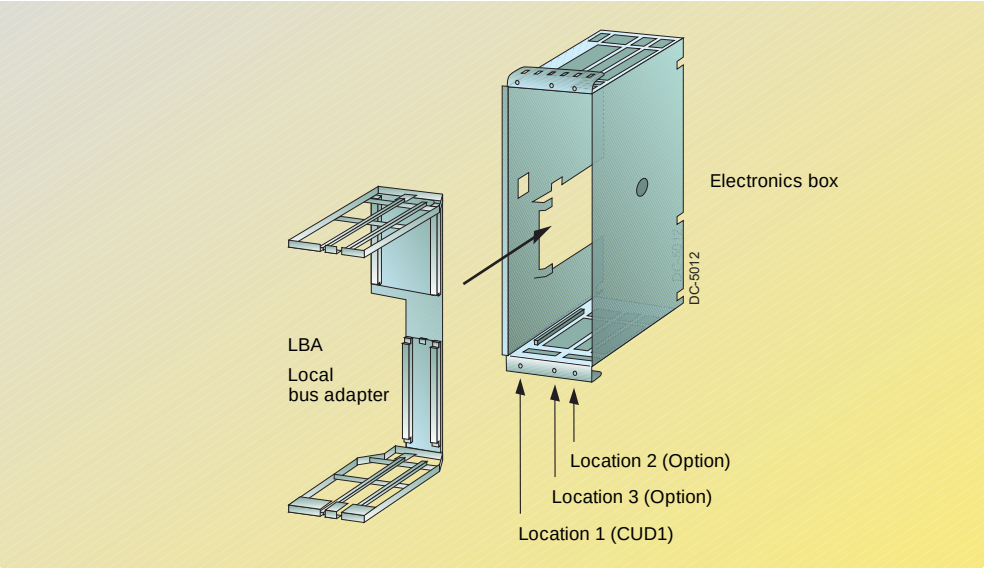


Fig. 4/9
LBA Local bus adapter

Selection and ordering data

Description		Catalog No.
LBA	Local bus adapter	**6SE7090-0XX84-4HA0**

ADB Adapter board

The ADB (**A**dapter **B**oard) is for connecting half size option boards such as the CBP2 or SLB into slots 2 or 3 of the electronics box. Two half size option boards can be installed on one ADB. Installation of an LBA is required for use of the ADB.

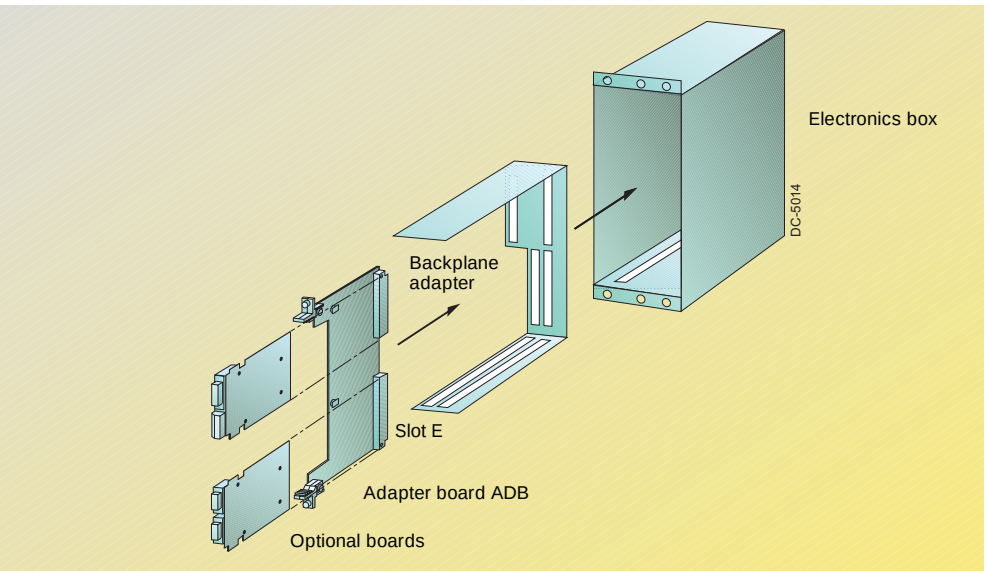


Fig. 4/10
ADB Adapter board

Selection and ordering data

Description		Catalog No.
ADB	Adapter board	**6SX7010-0KA00**

SBP Pulse encoder evaluation board

The SBP (**S**ensor **B**oard **P**ulse) optional board allows a second pulse encoder to be connected to the SIMOREG converter.

Suitable pulse encoders

All commercially available pulse encoders can be connected to this optional board. Their pulses can be processed as either bipolar or unipolar, TTL- or HTL-level signals.

Encoder signals up to a pulse frequency of 410 kHz (4096 pulses per rev. at 6000 rev/min) can be evaluated. Encoder monitoring can also be implemented through evaluation of the check track.

The supply voltage for the connected encoder can be set to 5 V or 15 V.

Temperature sensor

The temperature sensor connection on the board is not evaluated in the SIMOREG system.

Connections

Signal cables are connected to terminal strips X400 and X401.

Connectable cross-section: 2.5 mm^2 (AWG12)

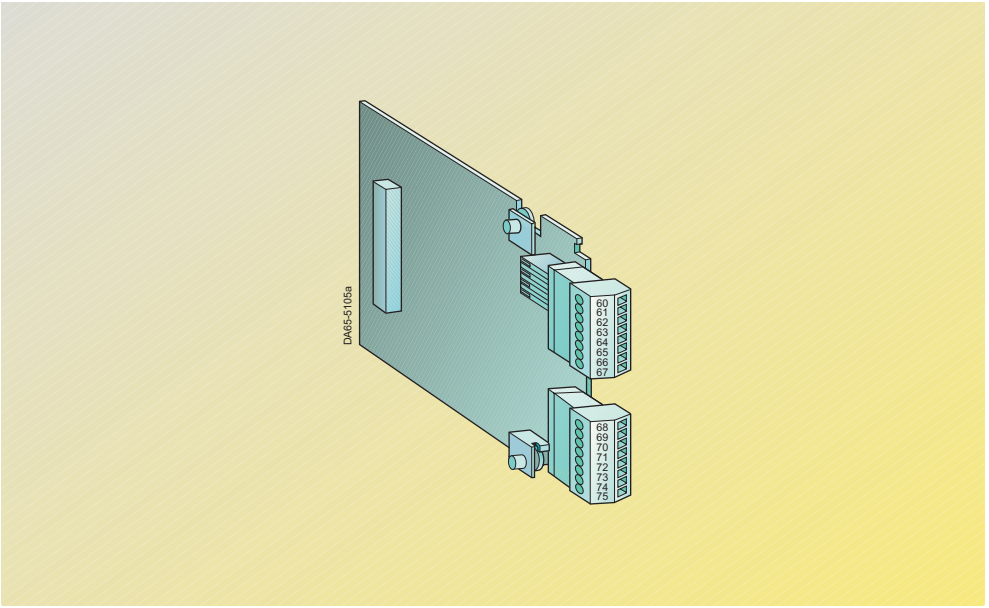


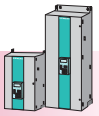
Fig. 4/11
SBP Pulse encoder evaluation board

Terminal assignments on terminal strip X400

Terminal	Designation	Meaning	Range
60	+V_{SS}	Power supply for pulse encoder	5/15 V I_{max} = 250 mA
61	–V_{SS}	Power supply ground	
62	–Temp	Negative (–) terminal KTY84/PTC100	
63	+Temp	Positive (+) terminal KTY84/PTC100	3 mA Accuracy ±1 %
64	Coarse/fine ground	Ground	
65	Coarse pulse 1	Digital input for coarse pulse 1	
66	Coarse pulse 2	Digital input for coarse pulse 2	
67	Fine pulse 2	Digital input for fine pulse	

Terminal assignments on terminal strip X401

Terminal	Designation	Meaning	Range
68	Track A+	Positive (+) terminal Track A	TTL/HTL/HTL unipolar
69	Track A–	Negative (–) terminal Track A	TTL/HTL/HTL unipolar
70	Track B+	Positive (+) terminal Track B	TTL/HTL/HTL unipolar
71	Track B–	Negative (–) terminal Track B	TTL/HTL/HTL unipolar
72	Zero pulse+	Positive (+) terminal Zero track	TTL/HTL/HTL unipolar
73	Zero pulse–	Negative (–) terminal Zero track	TTL/HTL/HTL unipolar
74	CTRL+	Positive (+) terminal Check track	TTL/HTL/HTL unipolar
75	CTRL–	Negative (–) terminal Check track	TTL/HTL/HTL unipolar



SBP Pulse encoder evaluation board

Voltage range of encoder inputs and of digital inputs

See tables for data.

Note

The inputs are not floating.

Coarse pulses are smoothed with 0.7 ms and fine pulses with approximately 200 ns.

The LBA and ADB are required for mounting the SBP into the electronics box.

Voltage range of encoder inputs

	RS422 (TTI)	HTL bipolar	HTL unipolar
Voltage range – Input		Max. 33 V Min. –33 V	
Voltage range + Input		Max. 33 V Min. –33 V	
Switching level Differential voltage – LOW	Min. –150 mV	Min. –2 V	Min. 4 V
Switching level Differential voltage – HIGH	Max. 150 mA	Max. 2 V	Max. 8 V

Voltage range of digital inputs

	Rated value	Min.	Max.
Voltage range LOW	0 V	–0.6 V	3 V
Voltage range HIGH	13 V	24 V	33 V
Input current LOW	≤ 2 mA		
Input current HIGH	10 mA	8 mA	12 mA

Selection and ordering data

Description	Catalog No.
SBP Pulse encoder board	**6SX7010-0FA00**

EB1 Expansion board

With the EB1 (**E**xpansion **B**oard 1), it is possible to expand the number of digital and analog inputs and outputs.

The EB1 expansion board has the following:

- 3 digital inputs
- 4 bidirectional digital inputs/outputs
- 1 analog input with differential signal which can be used as a current/voltage input
- 2 analog inputs (single-ended) which can also be used as digital inputs
- 2 analog outputs
- 1 input for the external 24 V power supply for the digital outputs

The EB1 expansion board can be integrated into the electronics box. The LBA and ADB are required for mounting.

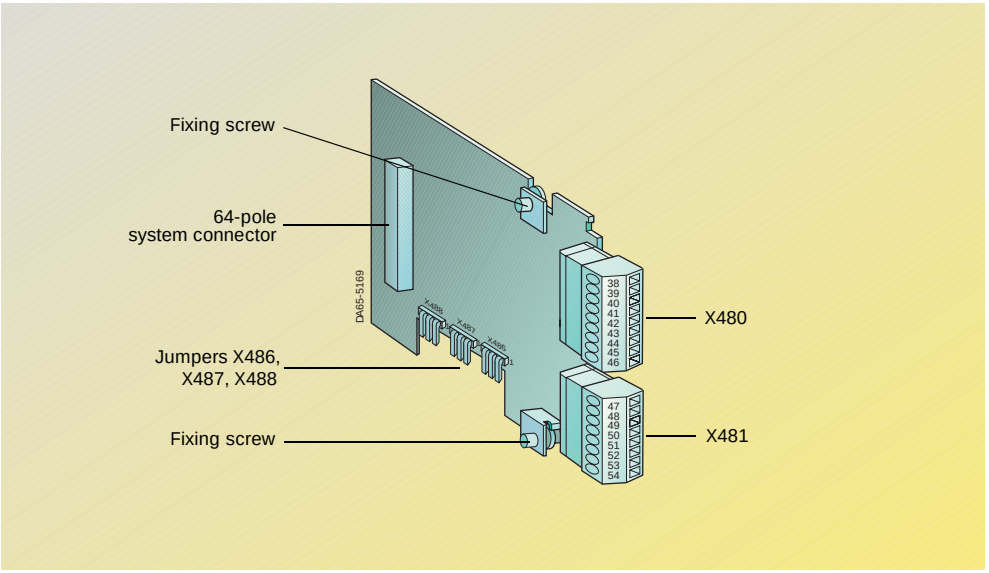


Fig. 4/12
EB1 expansion board

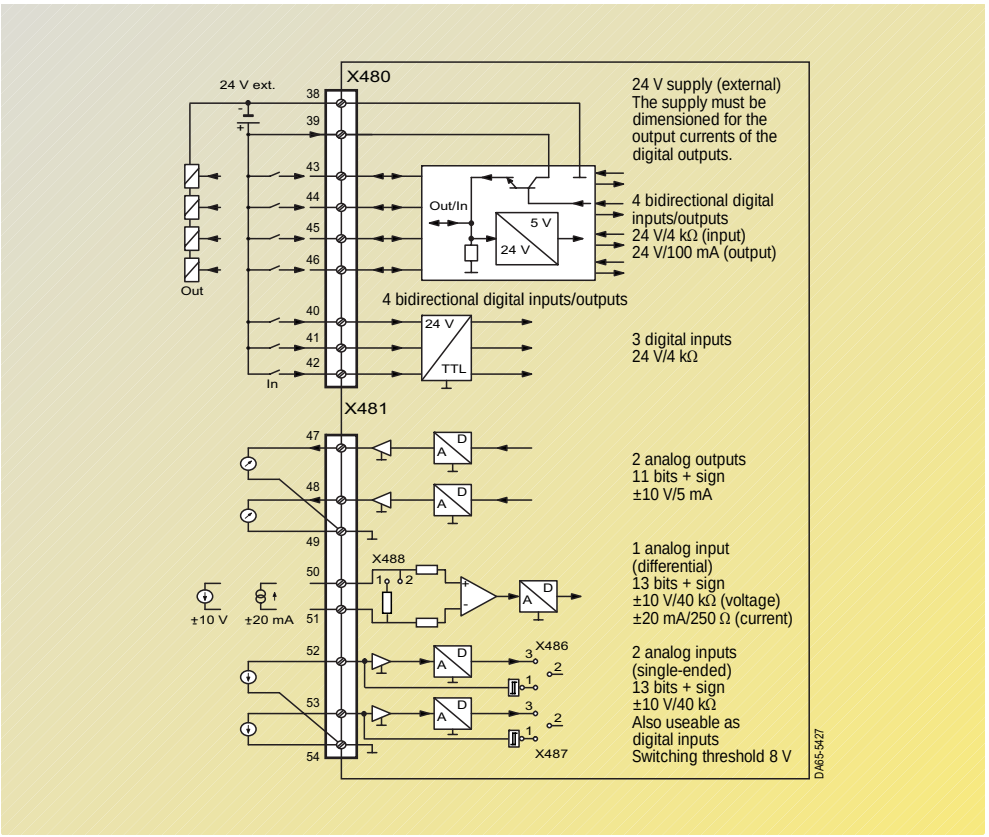
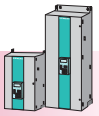


Fig. 4/13
Circuit diagram of the EB1 expansion board



EB1 Expansion board

Connection X480

The following connections are provided on the terminal strip:

- 3 digital inputs
- 4 bidirectional inputs/outputs

The ground cables are protected by a reactor. Terminal 46 is at the top, when fitted.

Note:

An external 24 V supply is necessary and must be dimensioned for the currents of the digital outputs.

Terminal	Designation	Description	Range
38	M	Ground digital	0 V
39	P24 ext.	Ext. 24 V supply	20 V to 33 V
40	DI1	Digital input 1	24 V, R_i = 4 kΩ
41	DI2	Digital input 2	24 V, R_i = 4 kΩ
42	DI3	Digital input 3	24 V, R_i = 4 kΩ
43	DIO1	Digital input/output 1	As input: 24 V, 4 kΩ
44	DIO2	Digital input/output 2	As output: Output voltage P24 ext. 100 mA
45	DIO3	Digital input/output 3	
46	DIO4	Digital input/output 4	

Max. connectable cross-section: 1.5 mm^2 (AWG 16)

Connection X481

The following connections are provided on the terminal strip:

- 1 differential analog input with signal, which can be used as a current and voltage input
- 2 analog inputs (single-ended) which can also be used as digital inputs
- 2 analog inputs

The ground cables are protected by a coil/inductor. Terminal 47 is at the top, when fitted.

Terminal	Designation	Description	Range
47	AO1	Analog output 1	±10 V, 5 mA
48	AO2	Analog output 2	±10 V, 5 mA
49	AOM	Ground analog output	0 V
50	AI1P	Analog input 1 +	Voltage: ±10 V, 40 kΩ
51	AI1N	Analog input –	Current: ±20 mA, 250 Ω
52	AI2	Analog input 2	±10 V, 40 kΩ
53	AI3	Analog input 3	±10 V, 40 kΩ
54	AIM	Ground analog input	0 V

Max. connectable cross-section: 1.5 mm^2 (AWG 16)

Technical data

Designation	Value
Digital inputs	DI1, DI2, DI3
• Voltage range LOW • Voltage range HIGH • Input resistance • Smoothing • Electrical isolation	0 V (–33 V to +5 V) +24 V (13 V to 33 V) 4 kΩ 250 µs None
Bidirectional digital inputs/outputs	DIO1, DIO2, DIO3, DIO4
As input • Voltage range LOW • Voltage range HIGH • Input resistance As output • Voltage range LOW • Voltage range HIGH	 0 V (–33 V to +5 V) +24 V (13 V to 33 V) 4 kΩ <2 V >P24 ext. –2.5 V
Analog input (differential input)	AI1P, AI1N
• Input range Voltage Current • Input resistance Voltage Current • Hardware smoothing • Resolution	 ±11 V ±20 mA 40 kΩ to ground 250 Ω to ground 220 µs 13 bits + sign
Analog input (single-ended)	AI2, AI3, AIM
• Input range • Input resistance • Hardware smoothing • Resolution	±11 V 40 kΩ to ground 220 µs 13 bits + sign
Analog output	AO1, AO2, AOM
• Voltage range • Input resistance • Hardware smoothing • Resolution	±10 V 40 kΩ to ground 10 µs 11 bits + sign

Selection and ordering data

Description	Catalog No.
EB1 Expansion board 1	**6SX7010-0KB00**

EB2 Expansion board

With the EB2 expansion board (**E**xpansion **B**oard 2), the number of digital and analog inputs and outputs can be expanded.

The EB2 expansion board has

- 2 digital inputs
- 1 relay output with changeover contacts
- 3 relay outputs with make contact
- 1 analog input with differential signal which can be used as current input or voltage input
- 1 analog output
- 24 V power supply for the digital inputs

The EB2 expansion board can be integrated into the electronics box. The LBA and ADB are required for mounting.

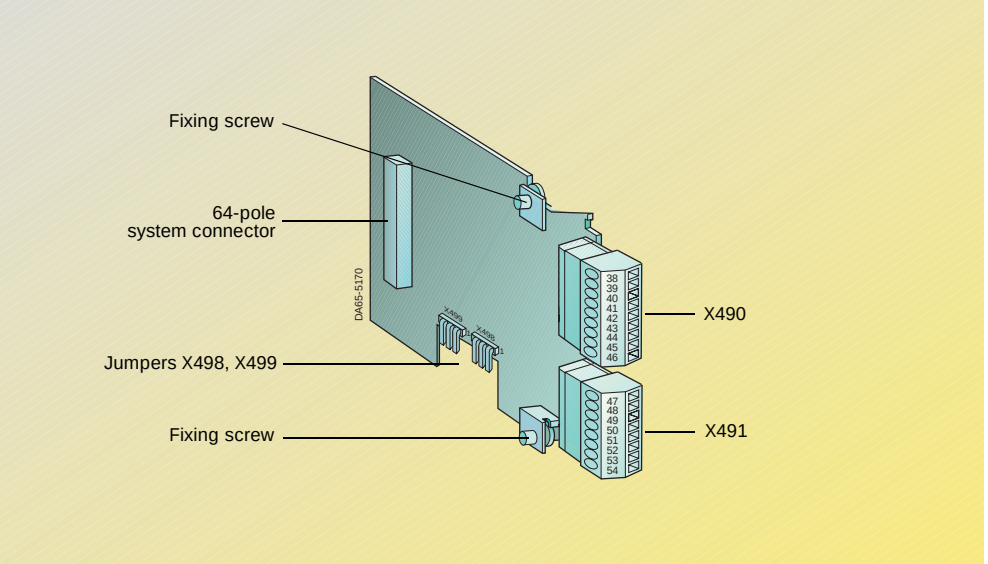


Fig. 4/14
EB2 expansion board

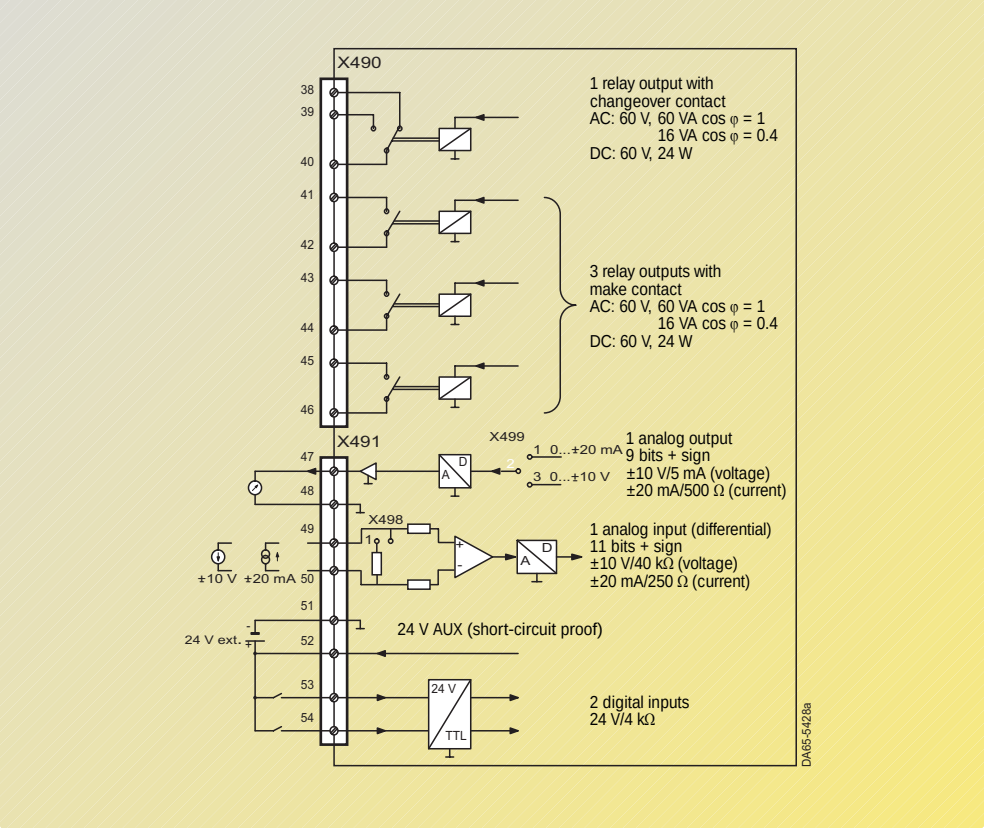
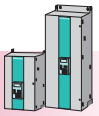


Fig. 4/15
Circuit diagram of the EB2 expansion board



EB2 Expansion board

Connection X490

Load capability of the relay contacts	
Type of contact	Changeover contact
Max. switching voltage	60 V AC, 60 V DC
Max. switching capacity	16 VA at 60 V AC (cos φ = 0.4) 60 VA at 60 V AC (cos φ = 1.0) 3 W at 60 V AC 24 W at 60 V AC

Terminal	Designation	Description
38	DO13	Relay output 1, break contact
39	DO12	Relay output 1, make contact
40	DO11	Relay output 1, reference contact
41	DO22	Relay output 2, make contact
42	DO21	Relay output 2, reference contact
43	DO32	Relay output 3, make contact
44	DO31	Relay output 3, reference contact
45	DO42	Relay output 4, make contact
46	DO41	Relay output 4, reference contact

Max. connectable cross-section: 1.5 mm^2 (AWG 16)

Connection X491

The ground cables are protected by a reactor.

Note:

The analog input can be used as a voltage or current input. A jumper switch is used for changing over.

Terminal	Designation	Description	Range
47	AO	Analog output	±10 V, 5 mA ±20 mA, 500 Ω
48	AOM	Ground analog output	
49	AI1P	Analog input +	±10 V, 40 kΩ ±20 mA, 250 Ω
50	AI1N	Analog input –	
51	DIM	Ground digital input	0 V
52	P24AUX	24 V supply	24 V
53	DI1	Digital input 1	24 V, R_i = 4 kΩ
54	DI2	Digital input 2	24 V, R_i = 4 kΩ

Max. connectable cross-section: 1.5 mm^2 (AWG 16)

Technical data

Designation	Value
Digital inputs	DI1, DI2, DIM
• Voltage range LOW	0 V (–33 V to +5 V)
• Voltage range HIGH	+24 V (13 V to 33 V)
• Input resistance	4 kΩ
• Smoothing	250 µs
• Electrical isolation	None
Digital outputs (relays)	DO1., DO2., DO3., DO4.
• Type of contact	Changeover contact
• Max. switching voltage	60 V AC, 60 V DC
• Max. switching capacity	
– at 60 V AC:	16 VA (cos φ = 0.4) 60 VA (cos φ = 1.0)
– at 60 V DC:	3 W 24 W
• Min. permissible load	1 mA, 1 V
Analog input (differential input)	AI1P, AI1N
• Input range	
Voltage	±11 V
Current	±20 mA
• Input resistance	
Voltage	40 kΩ to ground
Current	250 Ω to ground
• Hardware smoothing	220 µs
• Resolution	11 bits + sign
Analog output	AO, AOM
• Voltage range	±10 V, ±0 – 20 mA
• Input resistance	40 kΩ to ground
• Hardware smoothing	10 µs
• Resolution	9 bits + sign

Selection and ordering data

Description	Catalog No.
EB2 Expansion board 2	**6SX7010-0KC00**

SCI1 and SCI2 Interface boards

Interface boards SCI1 or SCI2 (**S**erial **C**ommunication **I**nterface 1 or 2) and interface board SCB1 can be used to assemble a serial I/O system with a fiber-optic conductor that can expand the binary and analog inputs and outputs considerably. In addition, the fiber-optic conductor reliably decouples the devices according to DIN VDE 0100 and DIN VDE 0160 (PELV function, e.g. for NAMUR).

The fiber-optic conductor of between 0.3 m and 10 m in length connects the modules in a ring. Both the SCI1 and the SCI2 require an external 24 V supply (1 A each).

All inputs and outputs of the interface boards can be parameterized.

Interface boards SCI1 and SCI2 can be snapped onto a mounting rail at a suitable location in the switchgear cabinet.

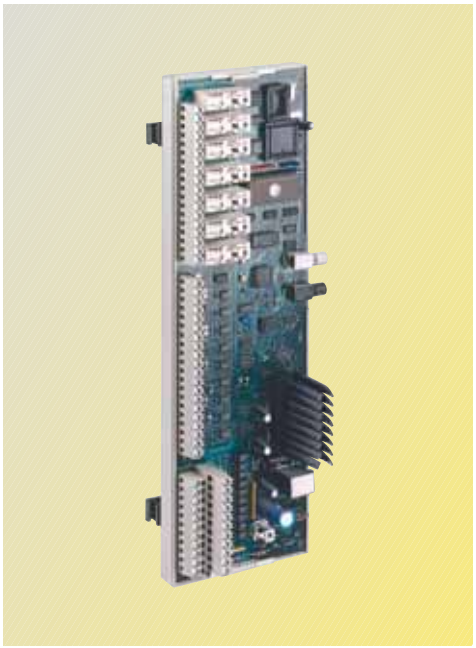


Fig. 4/16
Interface board SCI1

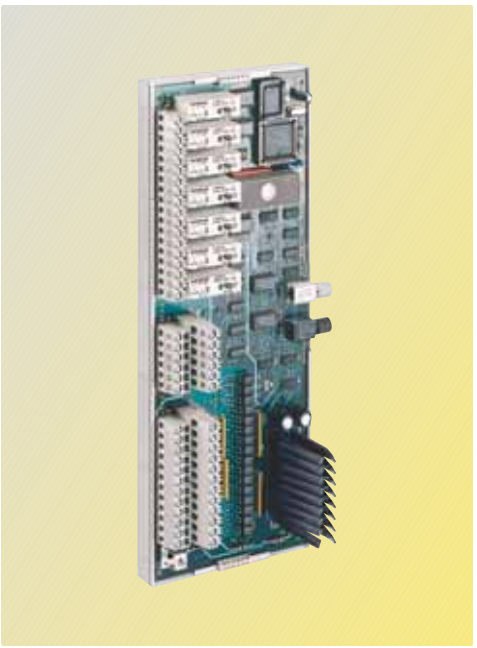


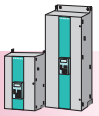
Fig. 4/17
Interface board SCI2

Inputs and outputs

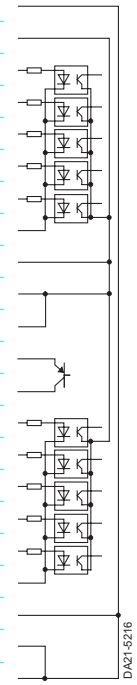
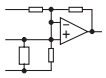
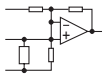
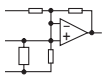
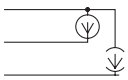
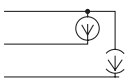
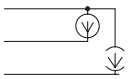
Functions	SCI1	SCI2	Description
Binary inputs	10	16	Isolated optocoupler inputs in 2 circuits 24 V DC, 10 mA
Binary outputs of which	8	12	Load rating:
Relay changeover	4	4	250 V AC, 2000 VA ($\cos\varphi$ =1)
Relay NO	3	3	100 V DC, 240 W
Transistor outputs	1	5	240 V DC, max. 100 mA, short-circuit proof, open emitter for controlling optocouplers or relay
Analog inputs	3	–	Voltage signals: 0 to ±10 V Current signals: 0 to ±20 mA; 4 to 20 mA; 250 Ω resistive load Non-floating inputs
Analog outputs	3	–	Output signals: 0 to ±10 V, 0 to ±20 mA, 4 to 20 mA Non-floating Max. cable length 100 m with shielded cable Max. resistive load 500 Ω
Supply voltage: Reference voltage			
+10 V	1	–	Load rating 5 mA short-circuit proof
-10 V	1	–	Load rating 5 mA short-circuit proof
24 V DC	2	2	Short-circuit proof output for binary inputs or outputs, load rating 280 mA

Technical Data

Fixing	Standard mounting rail
Rated input voltage, external	24 V DC (–17 %, +25 %), 1 A
Degree of protection	IP 00
Dimensions H x W x D	SCI1: 3.74 in x 11.8 in x 3.15 in (95 mm x 300 mm x 80 mm) SCI2: 3.74 in x 9.84 in x 3.15 in (95 mm x 250 mm x 80 mm)



Control terminal strip on interface board SCI1

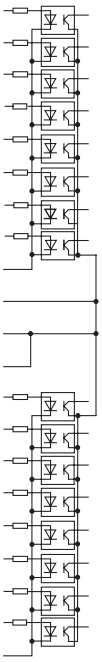
Terminal	No.:	Internal Circuit	Function, Notes	
X427	A1		Auxiliary voltage P 24 V DC, 200 mA for binary inputs	
	A2		Auxiliary voltage M for binary inputs	
	A3		Binary input 6	
	A4		Binary input 7	
	A5		Binary input 8	
	A6		Binary input 9	
	A7		Binary input 10	
	A8		Reference point for binary inputs 6 to 10	
	A9		Auxiliary voltage M for binary inputs	
	A10		Power supply M (connection of external supply)	
	A11		Power supply M (connection of external supply)	
	B1		Binary output 8, driver P 24 V DC	
	B2		Binary output 8, driver 100 mA external, short-circuit proof	
	B3		Binary input 1	
	B4		Binary input 2	
	B5		Binary input 3	
	B6		Binary input 4	
	B7		Binary input 5	
	B8		Reference point for binary inputs 1 to 5	
	B9		Auxiliary voltage P 24 V DC for binary inputs	
	B10		Power supply P 24 V DC (connection of external supply)	
	B11	DA21-5216	Power supply P 24 V DC (connection of external supply)	
X428	1	—	+10 V/5 mA for potentiometer; short-circuit proof	
	2	—	–10 V/5 mA for potentiometer; short-circuit proof	
	3		Analog input 1:	Voltage (0 to +/–10 V)
	4			Ground
	5			Current (0/4 to 20 mA, resistive load 250 Ω)
	6		Analog input 2:	Voltage (0 to +/–10 V)
	7			Ground
	8			Current (0/4 to 20 mA, resistive load 250 Ω)
	9		Analog input 3:	Voltage (0 to +/–10 V)
	10			Ground
	11			Current (0/4 to 20 mA, resistive load 250 Ω)
	12		Analog output 1:	Ground
	13			Voltage (0 to +/–10 V, max. 5 mA)
	14			Current (0/4 to +/–20 mA, max. 500 Ω)
	15		Analog output 2:	Ground
	16			Voltage (0 to +/–10 V, max. 5 mA)
	17			(0/4 to +/–20 mA, max. 500 Ω)
	18		Analog output 3:	Ground
	19	DA21-5217		Voltage (0 to +/–10 V, max. 5 mA)
	20			Current (0/4 to +/–20 mA, max. 500 Ω)

Control terminal strip on interface board SCI1

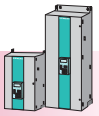
Terminal	No.:	Internal Circuit	Function, Notes	
X429	1		Binary output 1:	NO 100 V DC/250 V AC;
	2			240 W/2000 VA; min.: 24 V, 10 mA
	3		Binary output 2:	NO 100 V DC/250 V AC;
	4			240 W/2000 VA; min.: 24 V, 10 mA
	5		Binary output 3:	NO 100 V DC/250 V AC;
	6			240 W/2000 VA; min.: 24 V, 10 mA
	7		Binary output 4:	changeover
	8			100 V DC/250 V AC; 240 W/2000 VA;
	9			Minimum load: 24 V, 10 mA
	10		Binary output 5:	changeover
	11			100 V DC/250 V AC; 240 W/2000 VA;
	12			Minimum load: 24 V, 10 mA
	13		Binary output 6:	changeover
	14			100 V DC/250 V AC; 240 W/2000 VA;
	15			Minimum load: 24 V, 10 mA
	16		Binary output 7:	changeover
	17			100 V DC/250 V AC; 240 W/2000 VA;
	18			Minimum load: 24 V, 10 mA

DA21-5218

Control terminal strip on interface board SCI2

Terminal	No.:	Internal Circuit	Function, Notes
X437	A1		Binary input 9
	A2		Binary input 10
	A3		Binary input 11
	A4		Binary input 12
	A5		Binary input 13
	A6		Binary input 14
	A7		Binary input 15
	A8		Binary input 16
	A9		Reference point for binary inputs 9 to 16
	A10		Auxiliary voltage M for binary inputs
	A11		Power supply M (connection of external supply)
	A12		Power supply M (connection of external supply)
	B1		Binary input 1
	B2		Binary input 2
	B3		Binary input 3
	B4		Binary input 4
	B5		Binary input 5
	B6		Binary input 6
	B7		Binary input 7
	B8		Binary input 8
	B9		Reference point for binary inputs 1 to 8
	B10		Aux. volt. P 24 V DC, 280 mA/0 to 40 °C, 400 mA/20 °C, 200 mA/55 °C in combination with X438/A5 for binary inputs
	B11		Power supply P 24 V DC (connection of external supply)
	B12		Power supply P 24 V DC (connection of external supply)

DA21-5219



Control terminal strip on interface board SCI2

Terminal	No.:	Internal Circuit	Function, Notes	
X438	A1		Binary output 11, driver 24 V DC	
	A2		Binary output 11, driver 100 mA external, short-circuit proof	
	A3		Binary output 12, driver 24 V DC	
	A4		Binary output 13, driver 100 mA external, short-circuit proof	
	A5		Aux. volt. P 24 V DC, 280 mA/0 to 40 °C, 400 mA/20 °C, 200 mA/55 °C in combination with X437/B10 for binary outputs	
	A6		Auxiliary voltage M for binary outputs	
	B1		Binary output 8, driver 24 V DC	
	B2		Binary output 8, driver 100 mA external, short-circuit proof	
	B3		Binary output 9, driver 24 V DC	
	B4		Binary output 9, driver 100 mA external, short-circuit proof	
	B5		Binary output 10, driver 24 V DC	
	B6		Binary output 10, driver 100 mA external, short-circuit proof	
X439	1		Binary output 1:	NO 100 V DC/250 V AC;
	2			240 W/2000 VA; min.: 24 V, 10 mA
	3		Binary output 2:	NO 100 V DC/250 V AC;
	4			240 W/2000 VA; min.: 24 V, 10 mA
	5		Binary output 3:	NO 100 V DC/250 V AC;
	6			240 W/2000 VA; min.: 24 V, 10 mA
	7		Binary output 4:	changeover
	8			100 V DC/250 V AC; 240 W/2000 VA;
	9			Minimum load: 24 V, 10 mA
	10		Binary output 5:	changeover
	11			100 V DC/250 V AC; 240 W/2000 VA;
	12			Minimum load: 24 V, 10 mA
	13		Binary output 6:	changeover
	14			100 V DC/250 V AC; 240 W/2000 VA;
	15			Minimum load: 24 V, 10 mA
	16		Binary output 7:	changeover
	17			100 V DC/250 V AC; 240 W/2000 VA;
	18			Minimum load: 24 V, 10 mA

Selection and ordering data

Description		Order No.:
SCI1	Interface board Binary and analog inputs/outputs Supplied unassembled incl. 10 m fiber-optic cable	**6SE7090-0XX84-3EA0**
SCI2	Interface board Binary inputs and outputs Supplied unassembled incl. 10 m fiber-optic cable	**6SE7090-0XX84-3EF0**

T400 Technology board

The T400 is used to implement supplementary process-specific functions (e.g. for tension and position controls, winders, reels, synchro and positioning controls, hoisting gear and drive-related open-loop control functions). Frequently used supplementary process-specific functions are available as pre-programmed standard configurations.

Users who wish to implement specialist applications or market their own technological know-how can create their own process solution on the T400 using the CFC configuring language, a feature of SIMATIC STEP 7.

Process-specific functions are configured with CFC and then executed cyclically by the processor. The closed-loop control sampling time is about 1 ms.

A virtually instantaneous parallel interface (dual-port RAM) allows data to be exchanged between the basic unit and T400. All signals can be directly connected to terminals on the T400. A 15 V/100 mA pulse power supply is available.

An external DC 24 V supply must be available to drive the binary inputs and outputs. This voltage can be supplied by the basic unit provided the total current at the terminals does not exceed 150 mA.

The configuration is parameterized by means of

- the PMU operator control and parameterization panel,
- the OP1S user-friendly operator control panel,
- a PC with DriveMonitor on the basic unit [1]),
- an interface board,
- altered parameter settings can be stored permanently in the EEPROM.

The T400 board can be installed in the electronics box of SIMOREG converters. The LBA bus adapter is needed for this purpose.

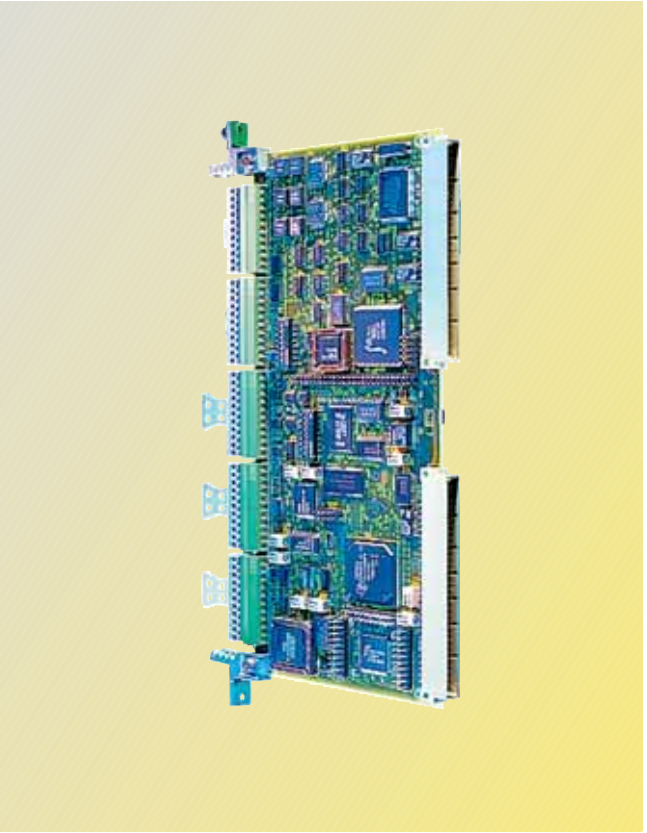
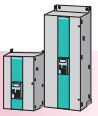


Fig. 4/18
T400 Technology board

1) The DriveMonitor service program enables the entire parameter set of a standard configuration to be read or written via a PC or programming device.



T400 Technology board

Features

The T400 has the following features:

- Two analog outputs
- Five analog inputs
- Two binary outputs
- Eight binary inputs, four of which can be used to call alarm tasks
- Four bidirectional binary inputs or outputs
- Two incremental encoder inputs with zero pulse
  – Encoder 1 for HTL (15 V) encoder
  – Encoder 2 for HTL (15 V) or TTL/RS422 encoder (5 V)
- For each incremental encoder: One coarse pulse input for suppression of zero pulse, coarse pulse inputs (simultaneous) also available as binary inputs
- No isolation of inputs/outputs
- Serial interface 1 with RS232 and RS485 transmission format: Protocol can be selected via switch on board:
  – Service protocol DUST1 for start-up (CFC test mode, “Service IBS”, TELEMASTER) and program download with 19.2 kbaud and RS232 transmission format
  – USS protocol, 2-wire, with selectable RS232 or RS485 transmission format; max. 38.4 KB; configurable as slave for parameterization with OP1S or SIMOVIS or as master for OP2 operator panel connection
- Serial interface 2 with RS485 transmission format and protocol that is selectable through configuring of appropriate function block:
  – Peer-to-peer, for high-speed process link, 4-wire
  – USS protocol, configurable as slave for parameterization with OP1S or SIMOVIS (2- or 4-wire) or as master for OP2 operator panel connection (2-wire)
  Baud rates [kbd]: 9.6/19.2/38.4/93.75/187.5

  Note:
  If serial interface 2 (peer, USS) is used, the 2nd absolute encoder cannot be operated since both applications utilize the same terminals.
- Absolute encoder 1 with SSI or EnDat protocol (RS485) for positioning applications;
- Absolute encoder 2 with SSI or EnDat protocol (RS485) for positioning applications;

  Note:
  If serial interface 2 (peer, USS) is used, the 2nd absolute encoder cannot be operated since both applications utilize the same terminals.
- Wide variety of synchronizing options:
  – Synchronization of T400 with MASTERDRIVES (Cux, CBx) or second T400
  – T400 supplies synchronizing signals for MASTERDRIVES (CUx, CBx) or second T400
- Operation without fan
- 3 LEDs for operational status displays
- Hardlock PAL: Receptacle for 28-pin EPLD submodule as copy protection for user program (as on 32-bit CPU boards);
- Soldered-in Flash memory (2 MB) for downloadable program codes (no MS5x memory module needed)
- 4 MB DRAM as main memory for program and data
- 32 KB permanent modification memory
- 128 byte NOVRAM for data storage during Power OFF
- Cache: 4 KB program, 4 KB data
- Clock cycle (external/internal): 32/32 MHz

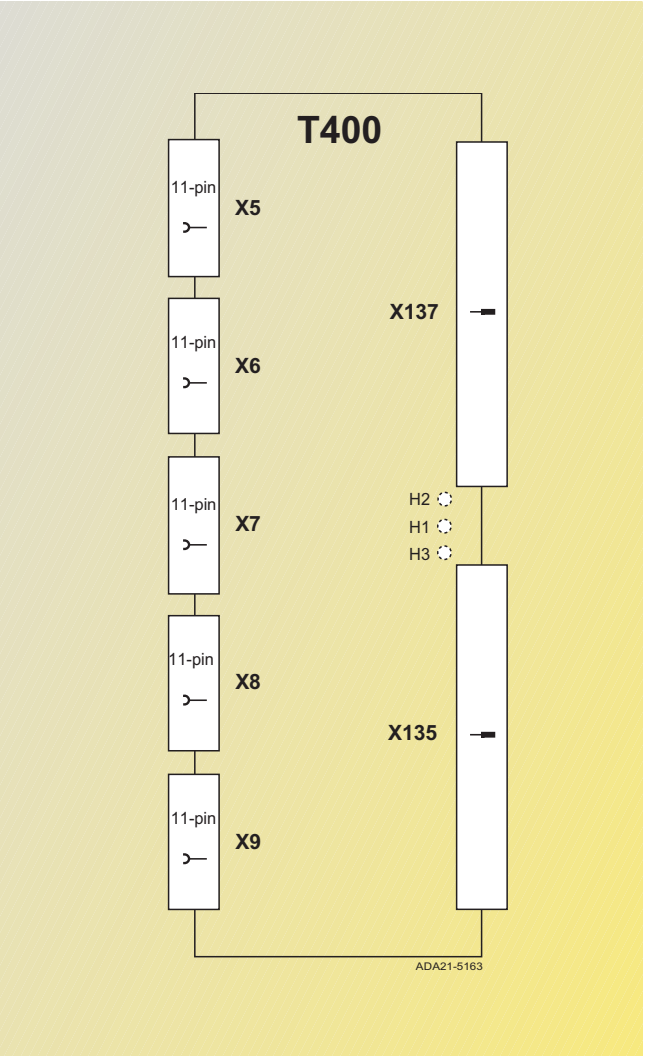
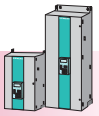


Fig. 4/19
T400 technology board

T400 Technology board

Type	Features	
General	Isolation of inputs/outputs	No
	Space required	1 slot
	Dimensions (W x H x D) in mm	267 x 140 x 14
	Weight	0.4 kg
Power supply	Voltage supply/typ. power consumption	+ 5 V ± 5 %: 1.1 A +15 V ± 4 %: 140 mA + max. 100 mA encoder supply –15 V ± 3 %: 140 mA
Analog outputs	Number	2
	Output range	±10 V
	Short-circuit protection	Yes
	Short-circuit current	±10 mA
	Resolution	12 bits (4.88 mV)
	Accuracy, absolute	±3 bits
	Linearity error	<1 bit
	Voltage rise time	4.2 V/µs
	Delay time	3.5 µs
Analog inputs	Number	2 differential inputs, 3 unipolar
	Input range	±10 V
	Measuring principle	Sampling
	Conversion time	12 µs
	Input impedance	20 kΩ
	Input filter (–3 dB limit frequency)	1.5 kHz
	Resolution	12 bit (4.88 mV)
	Accuracy, absolute	±3 bit
	Linearity error	<1 bit
Binary outputs	Number	2 + max. 4 (bidirect.)
	Ext. supply voltage:	
	• Rated value	DC 24 V
	• Permissible range	DC 15 to 33 V
	• for “0” signal	max. 0.1 V
	• for “1” signal	Ext. supply voltage –0.3 V
	Output current	Max. 50 mA/output
	Output current, ext.	50 mA + output currents
	Supply voltage	
	Switching frequency/ohmic load	5 kHz
	Overload protection	Yes (limited to 100 mA)
	Max. switching delay	70 µs
Binary inputs and coarse signals	Number	8 + max. 4 (bidirect.) + max. 2 (coarse pulses)
	Input voltage:	
	• Rated value	DC 24 V
	• for “0” signal	–1 to +6 V or input open
	• for “1” signal	+13 to +33 V
Input current	Input current:	
	• for “0” signal	–
	• for “1” signal	8 mA typ.
	Input smoothing (time constant)	0.1 ms
5 V, 15 V incremental encoder	Number	2
	Signal voltage (rated value):	
	• “Encoder 1”	15 V (HTL only) unipolar
	• “Encoder 2”	5 V or 15 V unipolar or differential
	Max. pulse frequency	1.5 MHz
	Input filter	Configurable on function block (NAV)
5 V incremental encoder	Signal voltage for differential inputs (RS422 encoder):	
	• for “0” signal	<–0.2 V
	• for “1” signal	>0.2 V
	Signal voltage for unipolar inputs (TTL encoder):	
	• for “0” signal	<0.8 V
	• for “1” signal	>2.3 V
	Input current	15 mA (limited)
15 V incremental encoder	Signal voltage for differential inputs	
	• for “0” signal	–30 V to 4 V
	• for “1” signal	8 V to 30 V
	Signal voltage for unipolar inputs	
	• for “0” signal	<5 V
	• for “1” signal	>8 V
	Input current	15 mA (limited)
Absolute encoder	Number	max. 2
	of connectable encoders	Single-turn or multi-turn encoder With SSI (synchronous-serial) or EnDat interface
	Signal voltage	5 V acc. to RS422
	Data transfer rate	100 kHz to 2 MHz
	Data display	Dual, Gray, Gray Excess Code



T400 Technology board

Standard configurations

Standard configurations for commonly used application types are available as pre-installed configurations. The standard configuration can be adapted to suit a specific plant by means of parameterization.

Components and features of standard configuration

- Peer-to-peer communication (digital setpoint cascade)
- The T400 with standard configuration can be operated with and without a communication board (e.g. CBP2)

  A communication board can be used to
  1. specify T400 control commands and setpoints via a bus system (e.g. PROFIBUS DP) or a point-to-point connection,
  2. read actual values and status words and to read and write technology parameters.
- Inputs, outputs and process data can be “wired up” to the DPRAM to provide access to all important
- SIMOREG data, thereby ensuring highly flexible configuring
- Non-volatile storage of all important operating data
- All parameters can be reset to IPL status
- Parameters can be set via PC with DriveMonitor linked to basic unit interface

Available standard configurations

- Standard configuration for axial winders
- Standard configuration for angular synchronism controls

Standard configuration for axis winder with T400

Scope of applications:

- Foil plants
- Paper machines
- Paper finishing machines
- Coating machines
- Printing presses of all types (foil, paper)
- Wire-drawing machines
- Reels in metalworking (e.g. straightening machines, treatment plants, etc.)

Features:

- Suitable for wind-on and wind-off coils, with and without on-the-fly roller change
- Suitable for direct and indirect tension control
- Compensating roller or tension capsule-type dynamometer can be connected
- Diameter calculation with ”Set diameter” and ”Stop”, plus non-volatile storage of diameter measurement
- Adaptation of tension and speed controllers as a function of diameter
- Polygon-based friction compensation, speed-dependent
- Acceleration compensation as a function of diameter, material width and gear stage
- Ramp-function generator for acceleration on on-the-fly roller change followed by shutdown
- Pulse encoder for path velocity measurement can be connected
- Initial diameter can be measured via contact pulse encoder
- Tension controller can be applied either to the speed controller or directly to the torque control
- V = constant control can be implemented
- Winder-specific open-loop control with alarm and fault evaluation
- Inching and crawling operation
- Two motorized potentiometers for optional use
- Smooth, overshoot-free shutdown via braking characteristic

Standard configuration for angular synchronism control with T400

Scope of application:

- Substitute for mechanical and electrical shafts, e.g. on gantry traversing mechanisms, feed and discharge machines on furnaces or looms
- Substitute for gear units with fixed or variable gear ratio, e.g. change-gear units, installed at transition points on conveyor belts or at transition point between one machine section and the next, such as on packaging machines, book spine gluing machines
- Phase-locked synchronism, also applicable for mutual engagement of two machine parts. Also suitable for printing or folding of bags, round stock, etc.

Features:

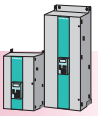
- Angular synchronism with gear ratio adjustable within wide limits
- Offset angle setting between drives as a function of coarse and fine pulse markers for angle sensing (synchronization)
- Synchronization signals can be supplied by proximity-type switches (e.g. BEROs™) or pulse encoders (zero pulse)
- Modification of angle setting by setpoint input
- Different offset angles can be specified for both directions of rotation (automatic switchover on direction reversal). This option must be applied for synchronization if the switching positions of the fine pulse marker are different for clockwise and anti-clockwise rotation of drive (or machine part acting as synchronization partner) and need to be compensated. Another example is a crane runway on which the fine pulse marker is two-dimensional.
- Backstop function
- Overspeed and blocking protection
- Inching operation
- Adaptation of position controller based on gear ratio
- Setpoint (speed setpoint) can be supplied by pulse encoder, for example, in cases where speed setpoint is not available via terminal or interface
- A maximum of ten slave drives can be connected if pulse encoder cable length < 328 ft (100 m), n < 3000 rev/min

T400 Technology board

T400 terminal assignments				Connector	Connector pin	Terminal
+24 V external (for binary inputs and outputs)				X5	1	45
Bidirectional binary input and output 1					2	46
Bidirectional binary input and output 2					3	47
Bidirectional binary input and output 3					4	48
Bidirectional binary input and output 4					5	49
Ground for binary inputs and outputs					6	50
Binary output 1					7	51
Binary output 2					8	52
Binary input 1 (alarm-capable)					9	53
Binary input 2 (alarm-capable)					10	54
Binary input 3 (alarm-capable)					11	55
Binary input 4 (alarm-capable)				X6	1	56
Binary input 5					2	57
Binary input 6					3	58
Binary input 7					4	59
Binary input 8					5	60
Ground for binary inputs and outputs					6	61
Increm. encoder 2:	Track A (HTL)	Increm. encoder 2:	Track A+ (with RS422)		7	62
Increm. encoder 2:	Track B (HTL)	Increm. encoder 2:	Track B+ (with RS422)		8	63
Increm. encoder 2:	Zero pulse (HTL)	Increm. encoder 2:	Zero pulse+ (with RS422)		9	64
Increm. encoder 2:	Coarse pulse				10	65
Ground for increm. encoder 2					11	66
Ser. interface 1:	Rx-RS232			X7	1	67
Ser. interface 1:	Tx-RS232				2	68
Ground for ser. interface					3	69
Ser. interface 1:	Tx/Rx-RS485+				4	70
Ser. interface 1:	Tx/Rx-RS485–				5	71
Ser. interface 2:	Rx/RS485+	Absolute encoder 2:	Data+		6	72
Ser. interface 2:	Rx/RS485–	Absolute encoder 2:	Data–		7	73
Ser. interface 2:	Tx/Rx-RS485+	Absolute endoder 2:	Clock+		8	74
Ser. interface 2:	Tx/Rx-RS485+	Absolute encoder 2:	Clock–		9	75
Absolute encoder 1:	Data+				10	76
Absolute encoder 1:	Data–				11	77
Absolute encoder 1:	Clock+			X8	1	78
Absolute encoder 1:	Clock–				2	79
+15 V encoder supply (max. 100 mA)					3	80
Increm. encoder 1:	Track A				4	81
Increm. encoder 1:	Track B				5	82
Increm. encoder 1:	Zero pulse				6	83
Increm. encoder 1:	Coarse pulse				7	84
Ground for increm. encoder 1					8	85
Increm. encoder 2:	Track A– (with RS422)				9	86
Increm. encoder 2:	Track B– (with RS422)				10	87
Increm. encoder 2:	Zero pulse– (with RS422)				11	88
Ground for analog inputs/outputs				X9	1	89
Analog input 1		Analog input 1+			2	90
		Analog input 1–			3	91
Analog input 2		Analog input 2+			4	92
		Analog input 2–			5	93
Analog input 3					6	94
Analog input 4					7	95
Analog input 5					8	96
Analog output 1					9	97
Analog output 2					10	98
Ground for analog inputs/outputs					11	99

Selection and ordering data

Description	Catalog No.
T400 Technology board	
w/Axial winder software SPW 420	**6DD1-842-0AA0**
Winder software on floppy (no manual)	**6DD1-843-0AA0**
Winder instructions/manual	**6DD1-903-0AA0**
T400 Technology board	
w/Angular synchronous control SPA 440	**6DD1-842-0AB0**
Angular asynchr. software on floppy (no manual)	**6DD1-843-0AB0**
Angular synchr. instructions/manual	**6DD1-903-0BB0**
T400 Technology board, without software	**6DD1-606-0AD0**



Overview

One of the many strong points of the SIMOREG 6RA70 is its serial interface capabilities and its ease at which it can be integrated into the world of automation. The same can be said for Siemens AC drive lines, many of which use the identical communication cards to simplify implementation and limit spare parts in your factory.

Optimal integration of drives into the world of automation

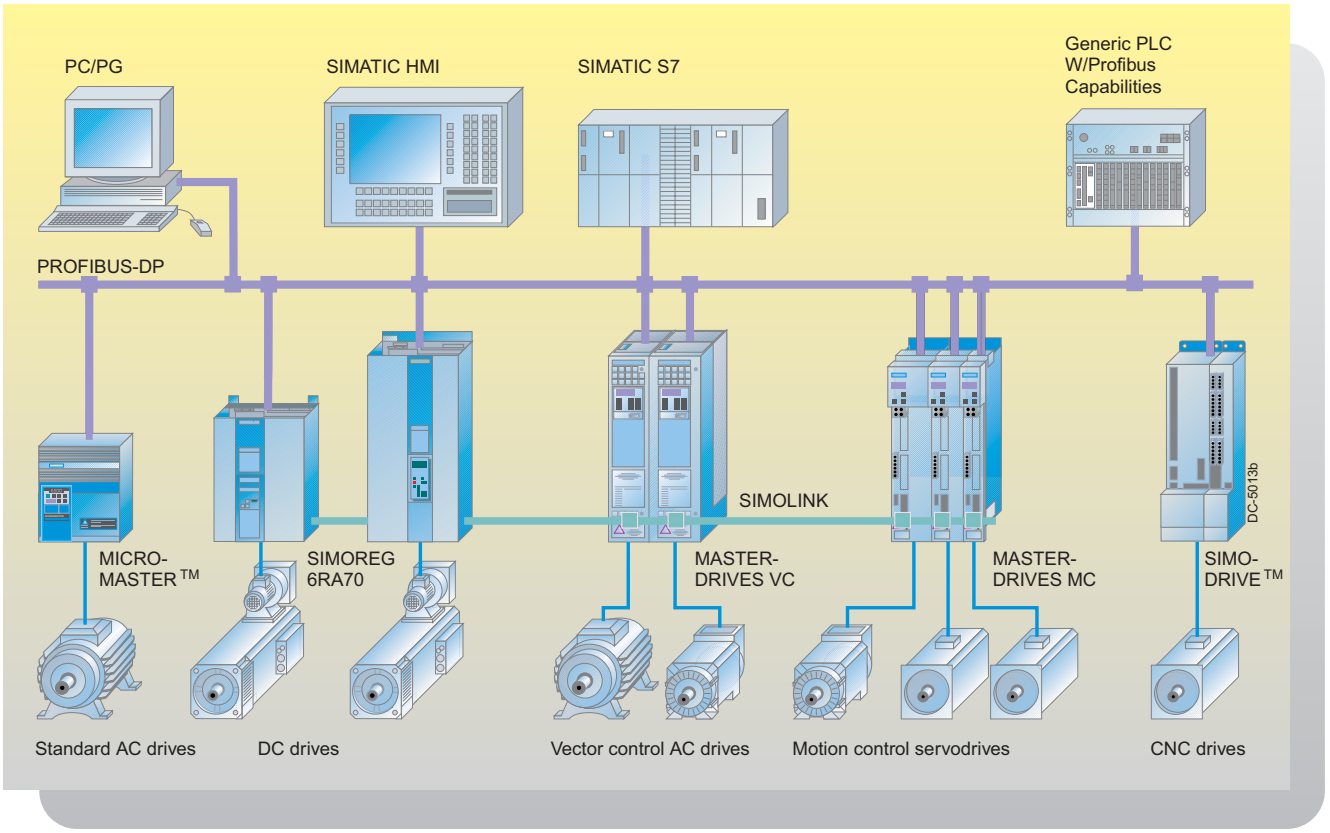


Fig. 4/20

Through the addition of easy to install communication boards a wide spectrum of communication possibilities can be configured to allow communication of the SIMOREG 6RA70 to various protocols.

- SIMOLINK – High speed fiber-optic peer to peer network 11M baud
- PROFIBUS-DP communication
- CAN protocol communication
- DeviceNet communication

Also available are protocol converters that have been tested by Siemens Energy & Automation. Their basic function is to convert the various protocols used in the controls industry to the USS protocol that is standard on the SIMOREG 6RA70.

Standard on all SIMOREG 6RA70 units are two serial interfaces with Siemens USS capabilities including peer to peer functionality up to 187.5 K baud rate. The first serial port is a selectable RS232/RS485 interface located on the front panel for easy connection to the OP1S or connection to a PC via the DriveMonitor and QuickStart software. The second is a dedicated RS485 interface located on the CUD1 terminal block.

An additional RS485 interface is available with the optional CUD2 terminal expansion board.

The USS (Universal Serial Interface) protocol is a Siemens-specific transmission protocol for drive technology. The USS protocol enables bus operation of up to 31 nodes on the basis of RS485 transmission system. Data is exchanged in accordance with the host-slave access procedure. Hosts can be higher-level systems such as the SIMATIC S5, S7 and PC's or non-Siemens automation systems.

SLB SIMOLINK board

The SLB (SIMOLINK) optional board acts as the interface between SIMOREG 6RA70 drives and the SIMOLINK system.

The SLB is mounted on the ADB carrier module. An LBA Local bus adapter is also required.

Every SLB optional board is a node in the SIMOLINK system. The maximum number of nodes is restricted to 201.

The SIMOLINK drive interface is used to exchange data rapidly between different drives. SIMOLINK is a closed circuit into which all nodes are connected.

Data are exchanged between the individual nodes by way of fiber-optic cables. Optical fibers made of glass or plastic can be used as transmission lines.

The SLB optional board has a 24 V voltage input for connecting an external voltage supply, thereby ensuring that data can still be exchanged within the SIMOLINK circuit when the converter is switched off.

The board features three LEDs for displaying the current operational status.

Operating principle

The SLB option board acts as the interface between the SIMOLINK system and converters. It can operate as either a SIMOLINK Dispatcher or a SIMOLINK Transceiver, its status being selected by means of parameter settings.

Voltage supply

The optional board can be supplied with the necessary operating voltage, both internally from the SIMOREG converter and from an external source. In this case, the external power source has priority. Switchover between the sources takes place automatically on the board.

Note

The external voltage supply must not be switched over while the bus is operating since, when the supply is switched over automatically, a reset signal is generated on the board which causes some telegrams to be lost.

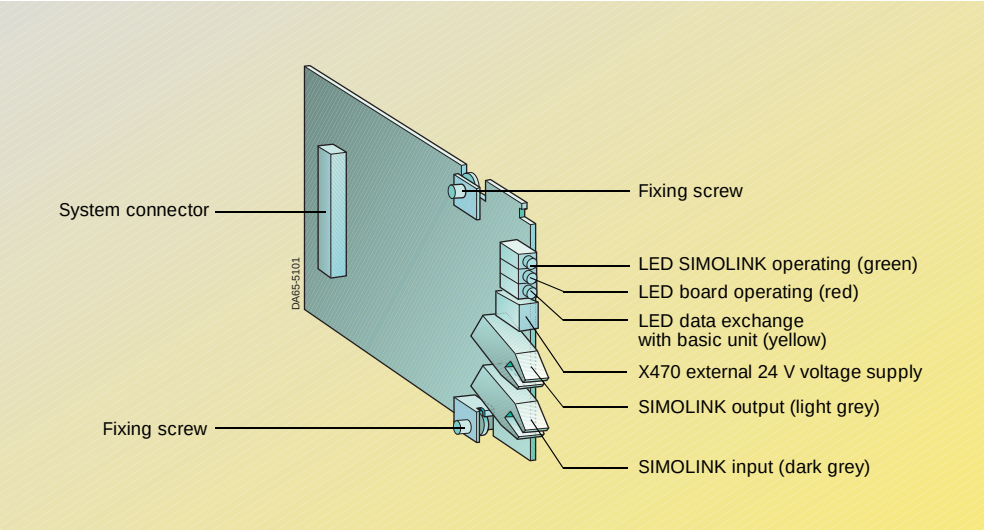


Fig. 4/21
SLB communication board

Designation	Value
Size (length x width)	3.5 in x 3.2 in (90 mm x 83 mm)
External voltage supply	DC 24 V
Power consumption from external voltage supply	max. 200 mA
Voltage supply from basic unit	DC 5 V
Power consumption from basic unit voltage supply	max. 600 mA
Switchover of voltage source	Automatic, external supply has priority
Node address	can be set in the parameter
Baud rate	11 Mbaud
Propagation delay	max. 3 clock cycles
Fiber optic cable	Plastic (preferable; glass fiber)
Cable length	• max. 131 ft (40 m) between 2 nodes (plastic) • 984 ft (300 m) between 2 nodes (glass fiber)
Display	3 LEDs green: SIMOLINK in operation red: operational board yellow: data exchange with basic unit

SLB SIMOLINK board

Characteristics

- The transmission medium is the fiber-optic cable. This can be either glass or plastic.
- The structure of the SIMOLINK is a fiber-optic-cable ring. Each node in the ring acts as a signal amplifier.
- The following distances are possible, depending on the selected transmission medium:
  – a max. of 131 ft (40 m) between each node if plastic cables are used or
  – a max. of 984 ft (300 m) between each node if glass cables are used.
- Theoretically, a maximum of 201 nodes can be connected together using SIMOLINK.
- Very high speed (11 Mbit/s: 100 items of 32-bit data in 0.63 ms)
- Free choice, i.e. each SIMOREG 6RA70 unit can send process data to or receive them from any other SIMOREG 6RA70 unit.

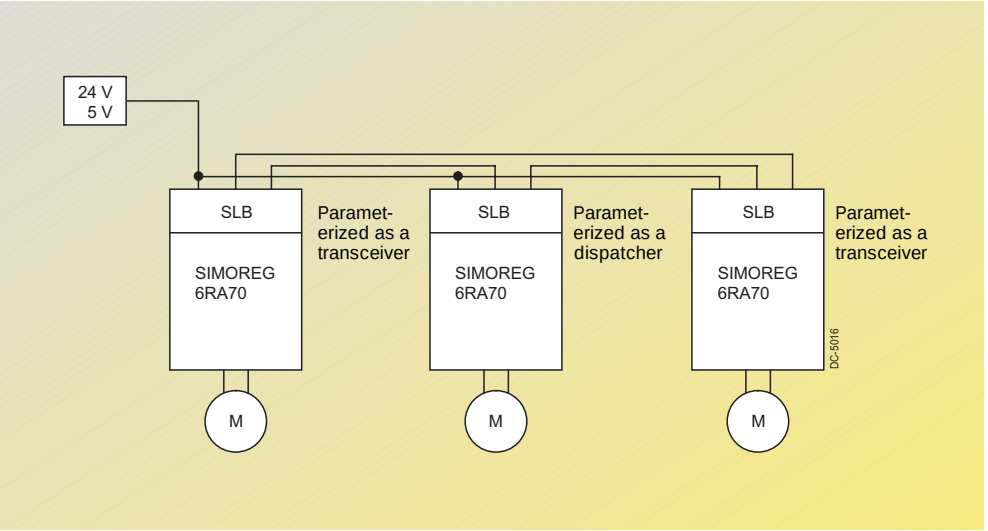


Fig. 4/22
Peer-to-peer functions with SIMOLINK

Selection and ordering data

Description	Catalog No.
SLB SIMOLINK Board (11 MBaud Peer-to-Peer)	**6SX7010-0FJ00** [1])
SIMOLINK fiber optic cable kit 328 ft (100 m), plastic, with 20 connectors	**6SX7010-0FJ50**
SIMOLINK fiber optic cable kit 9.8 ft (3 m), plastic, with 2 connectors	**6SY7000-0AD15**

1) Including 9.8 ft (3 m) plastic fiber-optic cable and two connectors.

CBP2 PROFIBUS-DP board

For Siemens drive technology, the PROFIBUS-DP is now the standard bus system for all field-related applications.

The optional CBP2 (**C**ommunication **B**oard **P**ROFIBUS) board is used to link drives to higher-level automation systems via the PROFIBUS.

In addition to data for process control, the PROFIBUS-DP also transports information for parameterization and diagnosis of the drives.

The CBP2 is mounted on an ADB for installation in the converter. An LBA local bus adapter is also required.

The CBP2 option board features three LEDs (green, yellow and red) as operating status indicators.

The board is supplied with power via the basic unit.

Baud rates from 9.6 Kbits/s to 12 Mbits/s are available.

Data exchange via PROFIBUS

The bus system allows data to be exchanged very rapidly between the drives and higher-level systems (i.e. SIMATIC). The drives are accessed in the bus system according to the master/slave principle. Each slave is uniquely identified by a bus address.

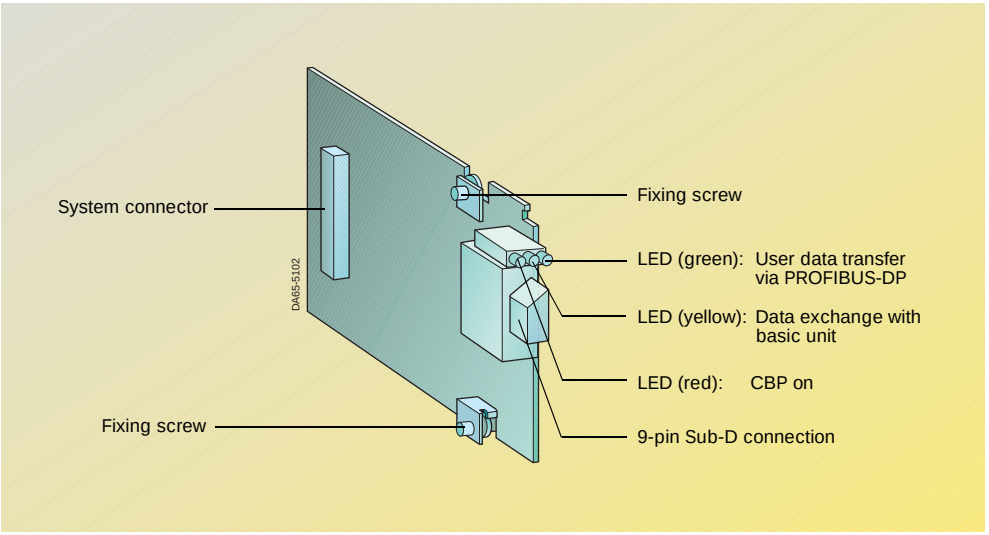


Fig. 4/23
CBP2 Communication board PROFIBUS

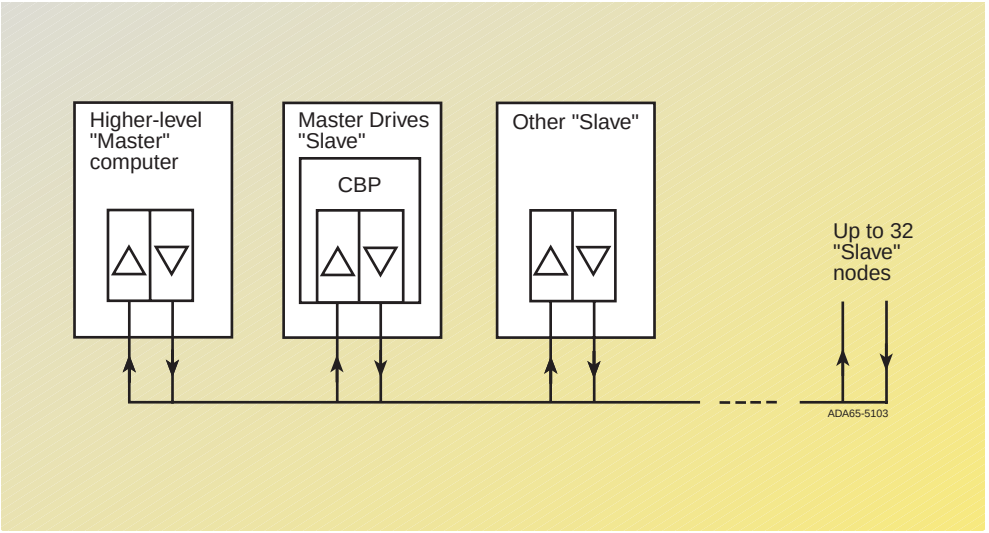
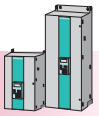


Fig. 4/24
PROFIBUS connections



CBP2 PROFIBUS-DP board

PROFIBUS telegram

Data are exchanged in telegrams. Each telegram contains useful data which are divided into two groups (see also Fig. 4/23):

1. Parameters (parameter ID value, PKW)
2. Process data (PZD)

The PKW area contains all transfer data which are needed to read or write parameter values, or read parameter properties.

The PZD area contains all the information needed to control a variable-speed drive. Control information (control words) and setpoints are passed to the slaves by the PROFIBUS-DP master. Information about the status of slaves (status words) as well as actual values are transferred in the opposite direction.

The length of the PKW and PZD components in the telegram, as well as the baud rate, are determined by the master. Only the bus address and, if necessary, the telegram failure time, are set on the slaves.

Connections

The optional CBP2 board features a 9-pin, subminiature D socket (X448) for the connection to the PROFIBUS system. The connections are short-circuit-proof and floating.

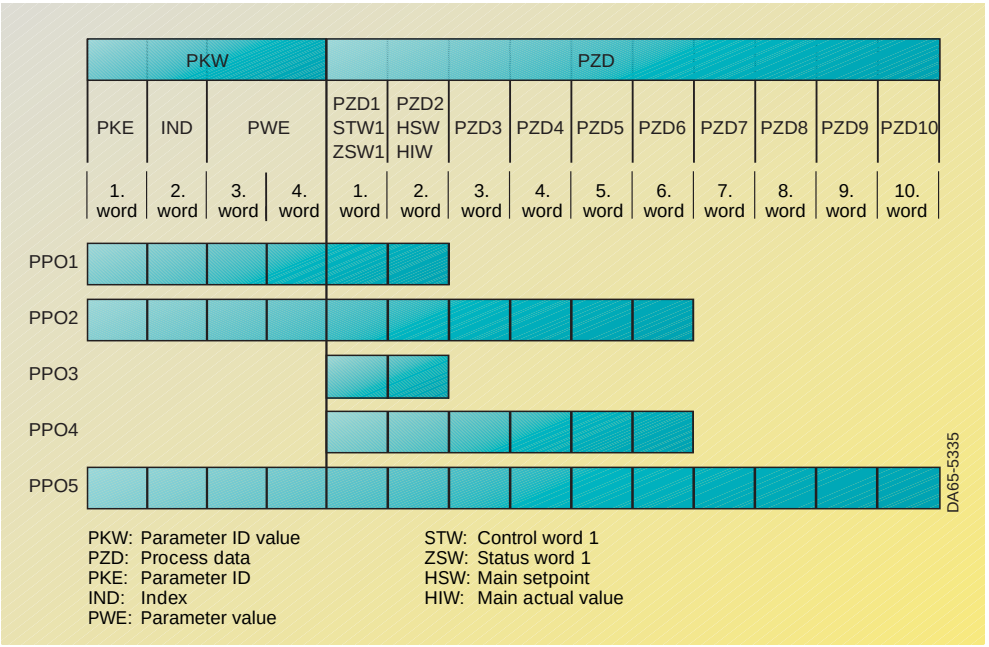


Fig. 4/25
User data structure in the “PROFIBUS Profile for PROFIDRIVE Variable-Speed Drives”

Pin assignments on X448

Pin	Designation	Meaning
1	PE	Earth connection
2	–	Not assigned
3	PBUS_A	Signal cable A
4	PBUS_RTS	Data direction signal
5	M_ISO	PROFIBUS ground, floating
6	P5_ISO	5 V PROFIBUS, floating (100 mA)
7	–	Not assigned
8	PBUS_B	Signal cable B
9	–	Not assigned

Selection and ordering data

Description	Catalog No.
CBP2 Communication board (PROFIBUS-DP/12 m Baud)	**6SX7010-0FF05**
PROFIBUS-DP cable (per meter ... min. 20 m/max. 100 m)	**6XV1830-0AH10**
PROFIBUS-DP interface connector	**6ES7972-0BB20-0XA0**

CAN Communication board CBC

The CAN protocol (**C**ontroller **A**rea **N**etwork) is specified in the proposed international standard ISO DIS 11 898 whereby only the electrical parts of the Physical Layer and the Data Link Layer (Layers 1 and 2 in the ISO/OSI Layer reference model). The CiA (**C**AN **i**n **A**utomation, an international user's and manufacturer's association) has defined implementation as an industrial fieldbus with the DS 102-1 recommendations for bus coupling and the bus medium.

- The CBC board complied with the definitions in ISO-DIS 11 898 and in DS 102-1.
- The CBC board only supports CAN Layers 1 and 2. Higher-level additional communication definitions of the various user organizations, such as CAN open of the CiA are *not* currently supported (CAN open on request).

The CBC (CAN Communication Board) facilitates communication between SIMOREG converters and a higher-level automation system, between SIMOREG converters and between SIMOREG converters and other field devices by means of the CAN protocol. The board is supplied with power via the basic unit.

The CBC board is limited to the main specifications of CAN and is therefore free of the dependent specifications of the user organizations. Data is exchanged with SIMOREG in accordance with the useful data definition for drive technology with PROFIBUS-DP:

The useful data structure is subdivided into two areas

- Process data (control words, setpoints, status words and actual values)
- Parameter area (mechanism for reading and writing parameter values, e.g. setting values, warnings, fault numbers or fault values

The useful data are transferred in the form of communication objects (identifiers).

Individual communication objects are defined for the process data to and from the drive as well as for the “write” and “read” parameter tasks.

Functions		
Process data	Max. 16 words	
Data transfer rate	10, 20, 50 kbit/s	Up to 3280 ft (1000 m) cable length
	100 kbit/s	Up to 2460 ft (750 m) cable length
	125 kbit/s	1738 ft (530 m) cable length
	250 kbit/s	885 ft (270 m) cable length
	500 kbit/s	328 ft (100 m) cable length
	1 Mbit/s	29 ft (9 m) cable length
Max. nodes	≤ 124	

Data exchange via CAN

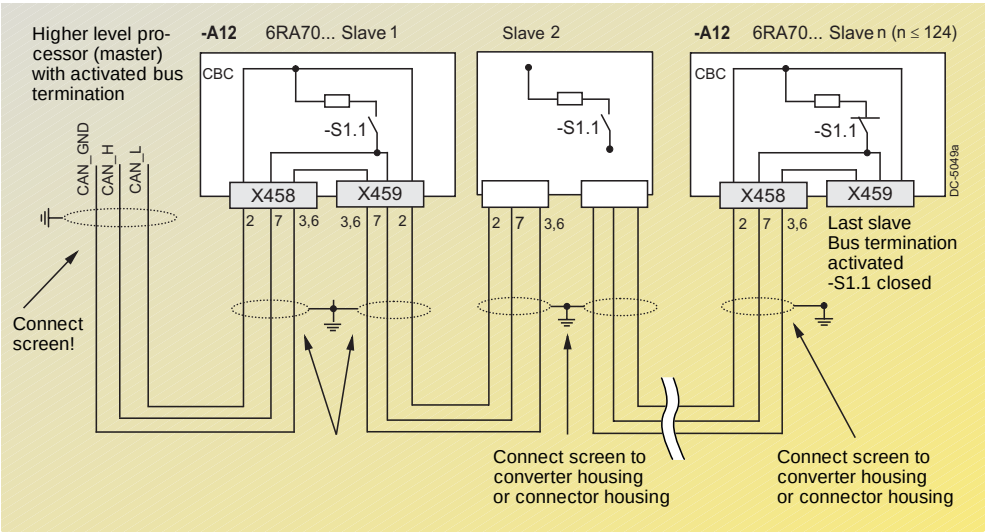


Fig. 4/26
Data exchange between CBC boards, with bus interruption

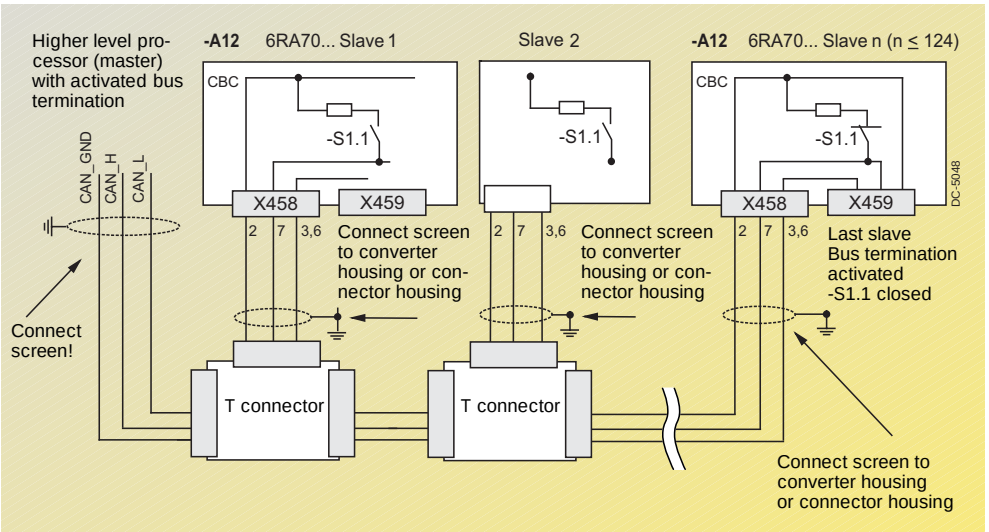


Fig. 4/27
Data exchange between CBC boards, without bus interruption

CAN Communication board CBC

The CAN protocol supports high-speed data transfer between bus stations. In the case of useful data transfer, a distinction is made between the parameter ID value (PKW) and the process data (PZD).

A CAN data message frame comprises the protocol header, the CAN identifier (up to 8 bytes of useful data) and the protocol trailer. The CAN identifier serves to uniquely identify the data message frame. In Standard Message Format, up to 2048 different CAN identifiers are possible; in Extended Message Format, 2^{29} CAN identifiers are possible. Extended Message Format is tolerated by the CBC board but not evaluated. The CAN identifier specifies the priority of the data message frame. The lower the number of the CAN identifier, the higher the priority of the message frame.

Up to 8 bytes of useful data can be transferred in a CAN data message frame. The PKW area always comprises 4 words or 8 bytes i.e. the data can be transferred in a single data message frame. In the case of SIMOREG 6RA70, for example, the process data area comprises 16 words, so 4 data message frames are required in total to transfer all the process data.

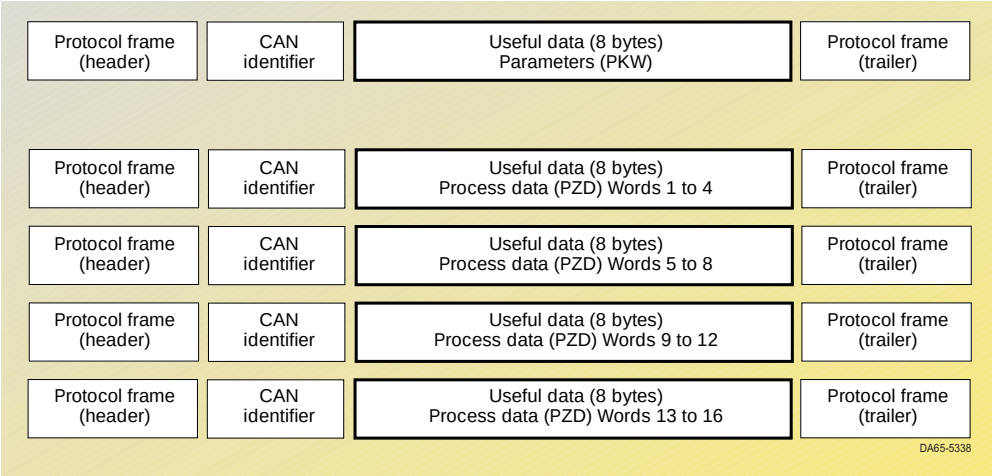


Fig. 4/28
Structure of the useful data in the message frame

X458 and X459 terminals on the CBC board

The CBC communication board has a 9-pole Sub-D connector (X458) and a 9-pole Sub-D socket (X459) for connection to the CAN bus.

Both connectors are assigned identically and are connected internally. The connecting interface is short-circuit-proof and floating.

Pin	Designation	Description
1	–	Not assigned
2	CAN_L	CAN_L bus line
3	CAN_GND	CAN ground (frame M5)
4	–	Not assigned
5	–	Not assigned
6	CAN_GND	CAN ground (frame M5)
7	CAN_H	CAN_H bus line
8	–	Not assigned
9	–	Not assigned

Mounting the CBC board

LBA and ADB are required.

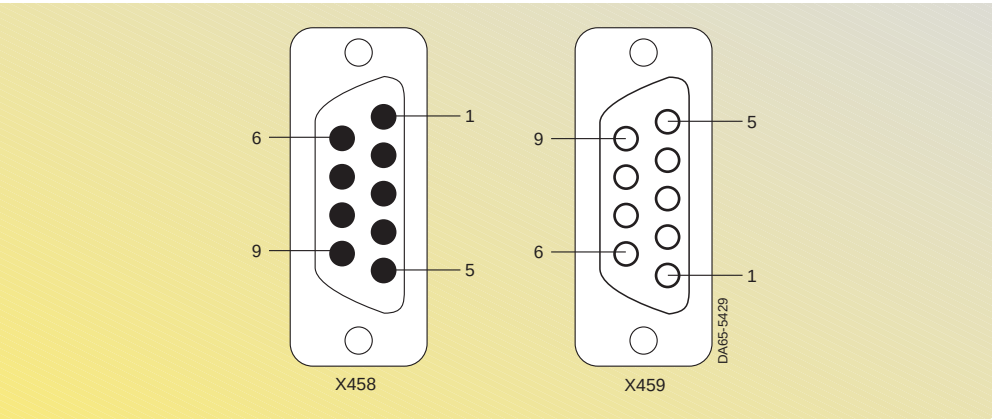


Fig. 4/29
Connectors X458 (plug) and X459 (socket) on the CBC board

Selection and ordering data

Description	Catalog No.
CBC Communication board (CAN Bus)	**6SX7010-0FG00**

CBD Communication board DeviceNet

The CBD (**C**ommunication **B**oard **D**eviceNet) facilitates communication between SIMOREG converters and higher-level programmable controllers or other field devices by means of the DeviceNet protocol. The CBD board is inserted in the electronics box of the SIMOREG 6RA70 unit using the LBA and ADB adapter boards.

The CBD board supports the transfer of process data and parameter data using “DeviceNet Explicit Messages” and “DeviceNet I/O Messages”.

With DeviceNet, Explicit Message Connections provide generic, multi-use communication paths between two units. This allows typical requirements-oriented or response-oriented functions (e.g. board configuration) to be implemented.

In contrast, DeviceNet I/O Message Connections provide communication paths for special purposes between the transmitting and receiving units. Application-specific I/O data are transferred via an I/O connection. The significance of the data within an “I/O message” is determined by the associated “Connection ID”.

The DeviceNet alarms can be subdivided into three main groups:

- DeviceNet configuration data, e.g. channel assignment, timeouts and I/O configurations, whereby “Explicit messages” are used
- Process data, e.g. control words, setpoint/reference values, status information and actual values, whereby “I/O messages” are used
- Parameter data for reading/writing drive parameter data, whereby manufacturer-specific PKW objects and “Explicit messages” are used.

The drive is controlled by process data (e.g. activation/deactivation and setpoint input). The number of process data words (4, 8 or 16) is either determined on switch-on by the value of certain CB parameters or dynamically by DeviceNet. The purpose for which the individual process data words are used is determined in the drive and differs in accordance with the actual function of each individual drive. The process data are processed with the highest priority and shortest time segments.

The master uses the manufacturer-specific PKW object for the purpose of reading drive parameters with DeviceNet or modifying them, whereby the Explicit Messaging Channel is used. The user therefore has access to all parameters in the basic unit (CU) and any existing technology board (TB) via DeviceNet. Examples for this include read-out of detailed diagnostic information, error messages, etc. In this manner, additional information for drive monitoring could be requested from a higher-level system (e.g. a PC) without affecting the transmission of process data.

Control and operation of SIMOREG 6RA70 converters over DeviceNet

In the process data area, all the information is transferred that is necessary for controlling a drive within a specific technical process. The control information (control words) and setpoints are sent to the drive from the DeviceNet master. Information about the status of the drive (status words) as well as actual values are transferred in the opposite direction.

The CBD communication board saves the received process data in the Dual-Port RAM in the order in which they were transferred in the message frame. An address is assigned to each word in the Dual-Port RAM. The content of the Dual-Port RAM in the drive (CU and, if necessary, TB) can be freely assigned by setting parameters. It can, for example, be specified that the second word in the process data area of the message frame should be used as a speed setpoint for the ramp-function generator follow-up. The same mechanism also applies for other setpoints and for each individual control word bit. This mechanism also applies for data exchange in the opposite direction when actual values and status words are transferred to the master. Diagnostic LEDs provide the user with information quickly about the current status of the CBD. More detailed diagnostic information can be read directly out of the diagnostics memory of the CBD with the help of a diagnostic parameter.

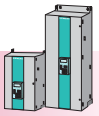
The CBD board operates with the “Predefined master/slave connection set”, that is defined in the DeviceNet specification. Both “Poll” and “Bit strobe” I/O messages are supported.

The CBD complies with the “DeviceNet Device Profile for Communication Adapters” (Device Type 12). This profile was selected to ensure that all features and extended functions of the SIMOREG 6RA70 converter can be used to be the DeviceNet master. For the same reason, the CBD board has not implemented the “DeviceNet DC Drives” profile.

Data rate	Trunk distance	Drop length Maximum drop	Cumulative
125 Kb	1640 ft (500 m)	20 ft (6 m)	512 ft (156 m)
250 Kb	820 ft (250 m)	20 ft (6 m)	256 ft (78 m)
500 Kb	328 ft (100 m)	20 ft (6 m)	128 ft (39 m)

Selection and ordering data

Description	Supplied loose Catalog No.
CBD DeviceNet board	**6SX7010-0FK00**
Instruction manual	**Included in above**



SCB1 interface board

The SCB1 (**S**erial **C**ommunication **B**oard 1) has one fiber-optic connection and can be used to establish:

- A peer-to-peer connection between several devices with a max. transfer rate of 38.4 kbits/s
- A serial I/O system (see Figure 4/30) in conjunction with the serial interface boards SCI1 and SCI2 (see Page 4/15).

This can be implemented to

1. Expand the binary and analog inputs and outputs of the basic units
2. Assign the terminals of the inputs and outputs customer-specifically (e. g. NAMUR).

The following board combinations are possible:

SCB1 with one
SCI1 or SCI2 each

SCB1 with two
SCI1s or SCI2s each

SCB1 with one
SCI1 and SCI2 each

The SCB1 interface board is plugged into location 2 or 3 of the electronics box (see the description on Page 4/6).

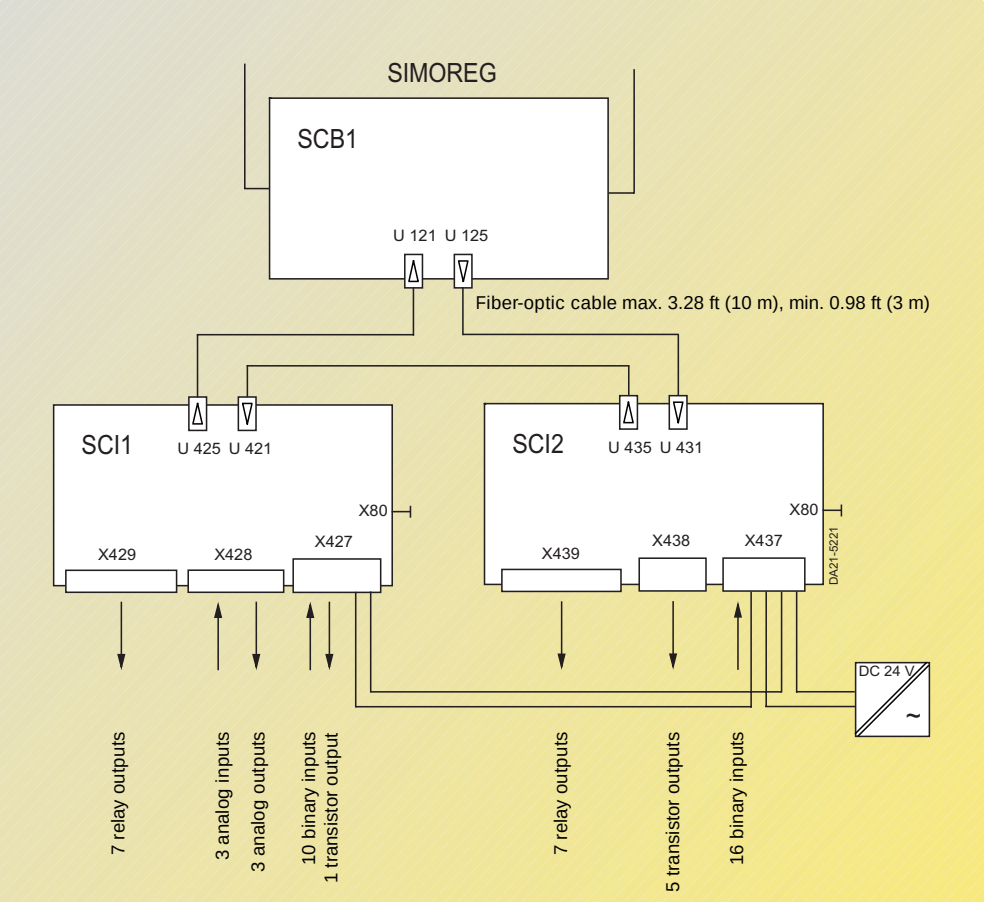


Fig. 4/30
Example to show connection of a serial I/O system comprising an SCB1, SCI1 and SCI2

Selection and ordering data

Description		Order No.:	Weight (approx.) lb kg	Dimensions W x H x D in x in x in mm x mm x mm
SCB1	Interface board with fiber-optic cable connection supplied unassembled incl. 3.28 ft (10 m) FO cable	**6SE7090-0XX84-0BC0**	1.1 (0.5)	0.98 x 9.25 x 4.9 (25 x 235 x 125)

Serial communication converters · Available protocol converters

The following protocol converters have been tested by and are sold by Siemens Energy & Automation. They basically convert the data sent and received by USS protocol into data locations in the host. For example, there will be a separate data word in the host corresponding to the control word for each drive. Changing bit 0 of this data word (usually with ladder logic) will start or stop that individual drive. Another separate data word for each drive would be the speed reference for each drive.

DTU-3006

The DTU-3006 is an intelligent PLC to Siemens Drives Communication Interface Unit. The DTU-3006 supports over 25 PLC Protocols, including Schneider Automation's Modbus, and converts to USS Protocol.

MD-3006

The MD-3006 is an intelligent PLC to Siemens Drive Communication Interface Unit. The MD-3006 converts Schneider Automation's Modbus Plus to USS Protocol.

DN-3006

The DN-3006 is an intelligent PLC to Siemens Drive Communication Interface Unit. The DN-3006 converts DeviceNet to USS Protocol. It has slower communication speeds than CBD.

PD-3006

The PD-3006 is an intelligent PLC to Siemens Drives Communication Interface Unit. The PD-3006 converts PROFIBUS-DP to USS Protocol. It has slower communication speeds than CBP2.

SCI-PU

The 6RA70 SIMOREG drive controller can be interfaced to Allen-Bradley™ and Modicon™ programmable controllers by utilizing the SCI-PU. The SCI-PU performs the complex protocol conversions, transparent to the programmer or operator.

The SCI-PU provides a multi-drop RS485 bus interface to up to 31 6RA70 SIMOREG drive controllers. The serial interface is fully functional for monitoring and control.

Port A (Host) supports:

- Allen-Bradley Data Highway+™
- Modicon Modbus+ (via Modbus)™
- Allen-Bradley Remote I/O Network

Port B (Drive Protocols) supports

- USS Protocol
  RS485
  Variable telegram length
  to 187.5 KBaud
- Simple Protocol
  RS485
  10 word telegram length
  to 38.4 KBaud
- DUST 6B Protocol
  RS485
  Selectable telegram length
  117.6 KBaud

™Data Highway is a trademark of Allen-Bradley Company, Inc.

™Modbus is a trademark of Modicon, Inc.

Selection and ordering data

Serial communication converter	Catalog No.
DTU-3006	**DTU-3006**
MD-3006	**MD-3006**
DN-3006	**DN-3006**
PD-3006	**PD-3006**
SCI-PU	**A1-101-037-811**

4

Drive ES engineering package

With Drive ES (**D**rive **E**ngineering **S**ystem), drives from the SIMOREG range can be totally integrated into the SIMATIC automation world with regard to communication, configuration and data management.

Drive ES comprises four software packages that can be ordered separately: Drive ES Basic, Drive ES Graphic, Drive ES SIMATIC and Drive ES PCS7.

- Drive ES Basic is the basic software that is used to parameterize all drives online and offline as well being the prerequisite for the Drive ES Graphic software.
- Drive ES Graphic is the software that is used for graphical online and offline configuration of the BICO function blocks. The prerequisites are an installed version of Drive ES Basic and an installed version of SIMATIC CFC ≥ V 5.1 (graphical programming tool, see Catalog ST 70, "Industrial Software").
- Drive ES SIMATIC requires an installed version of STEP 7. It contains a SIMATIC function block library and therefore supports easy and reliable programming of the PROFIBUS-DP interface in the SIMATIC CPU for the drives.
- Drive ES PCS7 requires prior installation of SIMATIC PCS7, Version V 5.0 upwards. Drive ES PCS7 provides a function block library complete with function blocks for the drives and the associated faceplates for the operator station. This enables operation of the drives from the PCS7 process control system.

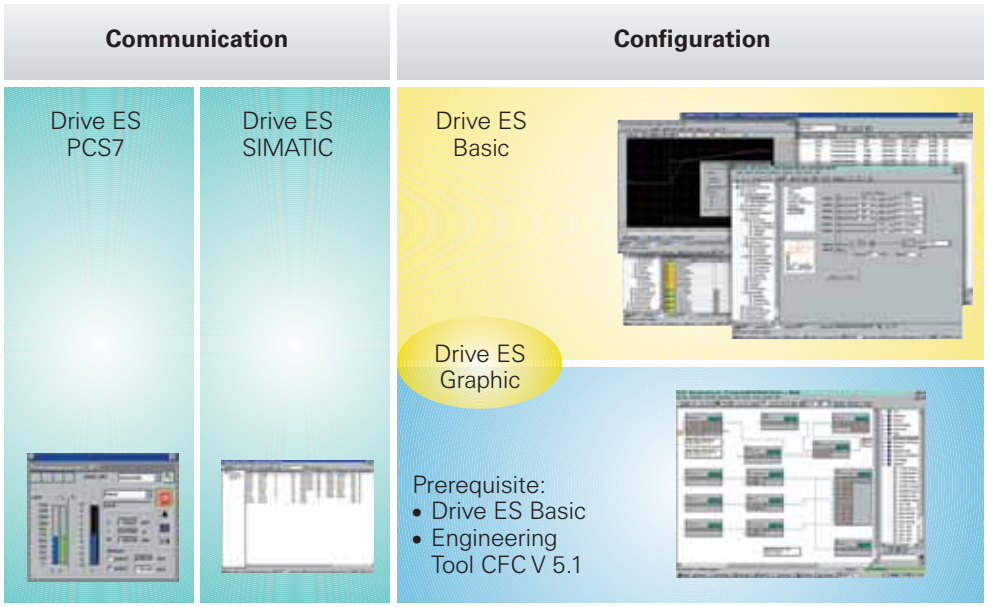


Fig. 4/31
Structure of the Drive ES product

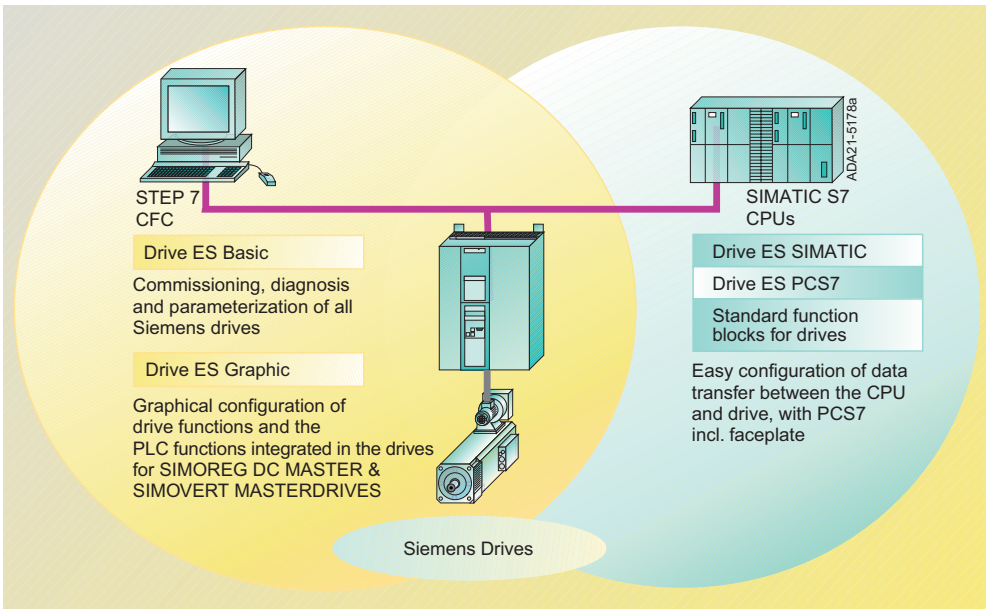


Fig. 4/32
Task distribution for the Drive ES packages

Drive ES Basic

- Drive ES is based on the SIMATIC Manager user interface.
- The parameters and diagrams of drives are available in SIMATIC Manager (integrated data management).
- Drive ES ensures that parameters and diagrams are uniquely assigned to a drive.
- A SIMATIC project complete with drive data can be archived.
- SIMATIC Teleservice (V5) can be used.
- It communicates with the drive over PROFIBUS-DP or USS.

Functions

- Trace evaluation for SIMOREG DC MASTER.
- Read out fault memory for SIMOREG DC MASTER.
- Upread and download of parameter sets (as a complete file or as a delta file compared to the factory settings).
- Parameter sets can be freely combined and processed.
- Script files can be used.
- Guided start-up for SIMOREG DC MASTER.

Installation with STEP 7

Drive ES Basic can be installed as an option for STEP 7 ($V \geq 5.0$) and integrates itself homogeneously in the SIMATIC environment.

Installation without STEP 7

Drive ES Basic can also be installed without STEP 7 and uses its own Drive Manager (similar to the SIMATIC Manager).

Drive ES Graphic

- Function diagrams are stored in SIMATIC CFC format drive-oriented.
- The drive functions are configured in BICO technology with SIMATIC CFC.
- Offline functionality.
- Test mode (online functionality) complete with “Modify connection”, “Modify value” and “Activate function block”.
- Read out and feedback documentation.

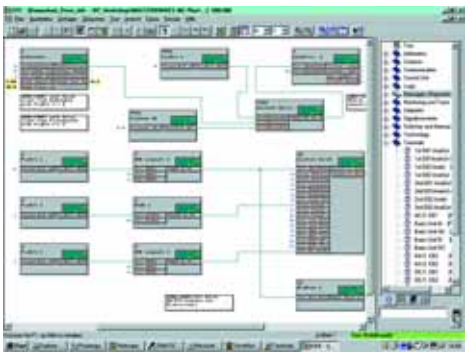


Fig. 4/33
Graphical programming with Drive ES Graphic and CFC

Drive ES SIMATIC

- This provides SIMATIC CPU function blocks and sample projects that process the communication with Siemens drives over PROFIBUS-DP or USS.
- The communication functions are parameterized and not programmed.

Features

- Function blocks in STEP 7 design; symbolic addressing; function blocks with instance data; online help.
- For use in all SIMATIC programming and configuration environments, such as LAD, FDB, STL, SCL and CFC.
- New function block structure: Individual modular functions for runtime-optimized program generation.

Function block types

- Read and write process data of freely configurable length and consistency.
- Exchange parameters cyclically and non-cyclically, monitor communication, read out fault memory from SIMOREG DC MASTER.
- Download parameters into the drive via the CPU.

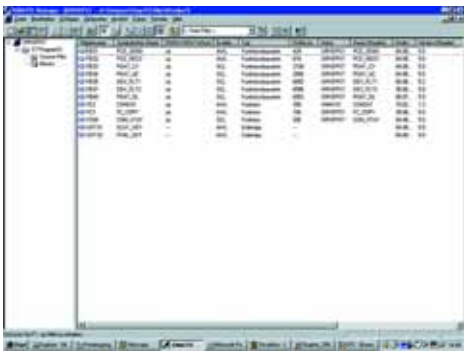


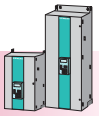
Fig. 4/34
Integrating drives into the STEP 7 Manager

Drive ES PCS7

- Integrates drives with a PROFIBUS-DP interface into PCS7.
- Can be used with STEP 7 or PCS7 V 5 upwards.

Function block types

- Display blocks and control blocks for the integration of drives into PCS7.



Integration of drives into SIMATIC S7 with Drive ES

Drive ES Basic supports the user with commissioning, servicing and diagnosing all Siemens drives. It can be integrated as an option into STEP 7 or it can be installed without STEP 7 as a stand-alone tool on a PC or programming device. In the case of stand-alone installation, the Drive Manager of Drive ES Basic will be installed instead of the SIMATIC Managers with the same Look & Feel. When it is integrated as an option for STEP 7, the Version of STEP 7 must correspond to that listed in the ordering data.

Drive ES Graphic is an option for Drive ES Basic and is used in conjunction with the SIMATIC tool CFC (Continuous Function Chart) for graphical configuration of the functions available with the SIMOREG DC MASTER (basic unit functions, process-specific functions and freely-definable function blocks). Precondition: Drive ES Basic V 5 and CFC V 5.1 upwards must have been installed on the computer beforehand.

Drive ES SIMATIC provides function block libraries complete with SIMATIC function blocks which reduces the configuration of the communication functions between SIMATIC S7 CPUs and Siemens drives (e.g. SIMOREG DC MASTER) to simple parameter settings. Drive ES SIMATIC supersedes the DVA_S7 software package for all versions of STEP 7 ≥ V 5.0 and can also be installed and implemented stand-alone, i.e. without Drive ES Basic.

Drive ES PCS7 provides a function block library complete with display and control function blocks that can be used to integrate Siemens drives (e.g. SIMOREG DC-MASTER) on the basis of a speed interface into the SIMATIC PCS7 process control system. Operation and monitoring of the drive is then possible from the Operator Station (OS). The PCS7 library can be used stand-alone, i.e. even without Drive ES Basic, with PCS7 versions V 5.0 and V 5.1.

Scope of supply	Order No.:	Type of delivery	Documentation
Drive ES software packages · For installation as an integral option of STEP 7 Versions ≥ V 5.3			
Drive ES Basic V 5.3 [1]) single-user license	**6SW1700-5JA00-3AA0**	CD-ROM, 1 unit	5 standard languages
Drive ES Basic Upgrade V 5.2 V → 5.3 single-user license	**6SW1700-5JA00-3AA4**	CD-ROM, 1 unit	5 standard languages
Drive ES Graphic V 6.0 single-user license	**6SW1700-6JB00-0AA0**	CD-ROM, 1 unit	5 standard languages
Drive ES Graphic Upgrade V 5.2 → V 6.0 single-user license	**6SW1700-6JB00-0AA4**	CD-ROM, 1 unit	5 standard languages
Drive ES SIMATIC V 5.3 single-user license	**6SW1700-5JC00-3AA0**	CD-ROM, 1 unit	5 standard languages
Drive ES SIMATIC Upgrade V 5.1 → V 5.3 single-user license	**6SW1700-5JC00-3AA4**	CD-ROM, 1 unit	5 standard languages
Drive ES SIMATIC copy/runtime license	**6SW1700-5JC00-1AC0**	Only product certificate (without software and documentation)	5 standard languages
Drive ES PCS7 V 6.0 single-user license	**6SW1700-6JD00-0AA0**	CD-ROM, 1 unit	5 standard languages
Drive ES PCS7 copy/runtime license	**6SW1700-5JD00-1AC0**	Only product certificate (without software and documentation)	5 standard languages

Contents of the Drive ES SIMATIC package

- **Communication software "PROFIBUS-DP"** for
  S7-300 with CPUs with integrated DP interface (function block libraries DRVDPS7, POSMO)
  S7-400 with CPUs with integrated DP interface or with CP443-5 (function block library DRVDPS7, POSMO)
  S7-300 with CP342-5 (function block library DRVDPS7C)
- **Communication software "USS protocol"** for
  S7-200 with CPU 214/CPU 215/CPU 216 (DRVUSS2 driver program for STEP 7 Micro programming tool)
  S7-300 with CP 340/341 and S7-400 with CP 441 (function block library DRVUSSS7)
- **STEP 7 slave object manager**
  supports easy configuration of drives and non-cyclic PROFIBUS-DP communication with the drives, support for DVA_S7 conversion to Drive ES (only V 5.1 upwards)
- **SETUP program** for installing the software in the STEP 7 environment

Contents of the Drive ES PCS7 package (the PCS7 package can be used with PCS7 versions V 5.0 and V 5.1)

- **Function block library for SIMATIC PCS7**
  Display and control function blocks for SIMOREG DC-MASTER
- **STEP 7 slave object manager**
  supports easy configuration of drives and non-cyclic PROFIBUS-DP communication with the drives
- **SETUP program** for installing the software in the PCS7 environment

Software update service for Drive ES

A software update service can be ordered for the Drive ES software. For one year following the initial order, the customer automatically receives all the latest software, Service Packs and full versions without the need for any action.

Duration of the update service: 1 year

6 weeks before this period elapses, the customer and the relevant Siemens contact partner will be informed about the impending expiry in writing. It is then possible to reorder the update service for another year.

The update service can only be ordered for an existing full version.

Scope of supply	Order No.:
Software update service	
Drive ES Basic	**6SW1700-0JA00-0AB2**
Drive ES Graphic	**6SW1700-0JB00-0AB2**
Drive ES SIMATIC	**6SW1700-0JC00-0AB2**
Drive ES PCS7	**6SW1700-0JD00-0AB2**

1) Drive ES Basic can also be installed stand-alone w/o STEP 7 (for further information, see adjacent text).

DriveMonitor [1])

Features

The current version of the Drive-Monitor is part of the standard scope of supply on CD-ROM.

- All basic unit parameters can be set and monitored by means of tables that can be created as required
- Reading, writing, printing and comparison of parameter sets
- Process data operation (control signals, setpoints)
- Diagnosis (fault, warning, fault memory)
- Offline and online operation.
- Parameterization of technology boards T100, T300 and T400
- Graphical presentation of the trace memory function for analysis
- Guided graphical parameterization during start-up.

System requirements

- Win 95/98/Me/NT/2000/XP
- 64 MB RAM
- Spare hard-disk storage 10 Mbytes
- Screen resolution 800 x 600 or higher.
- Interfacing via USS
- Serial interface RS 232 (for one converter, point-to-point)
- RS 485 serial interface (for several converters and bus operation), e.g. with RS 232/ RS 485 interface converter SU1.

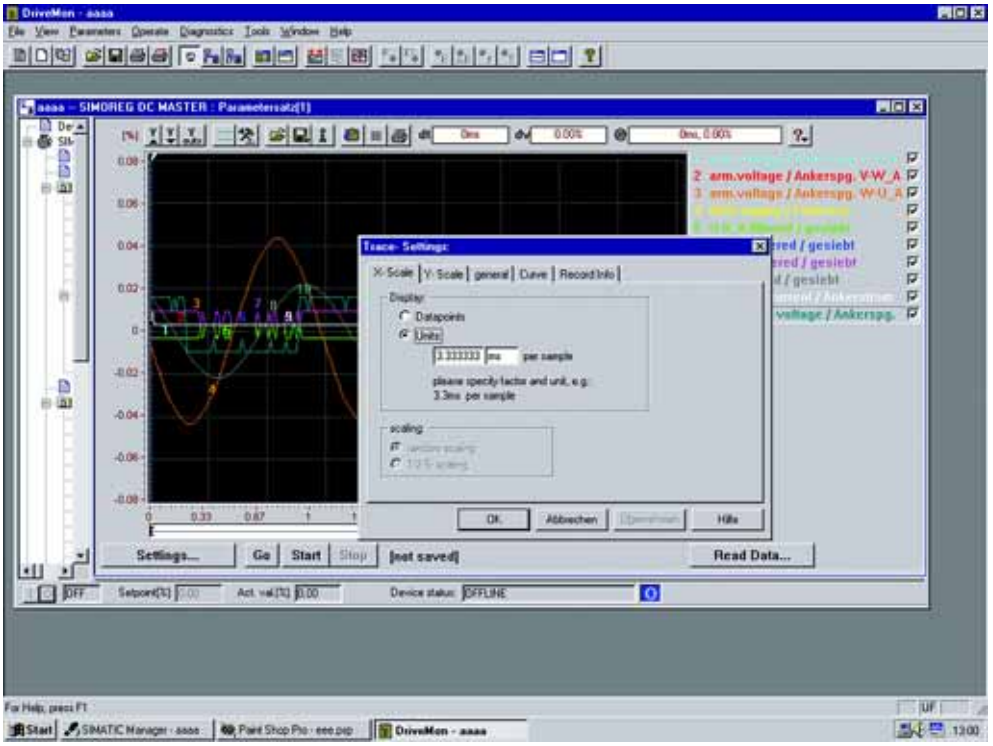


Fig. 4/35
DriveMonitor: Trace function for converter diagnosis

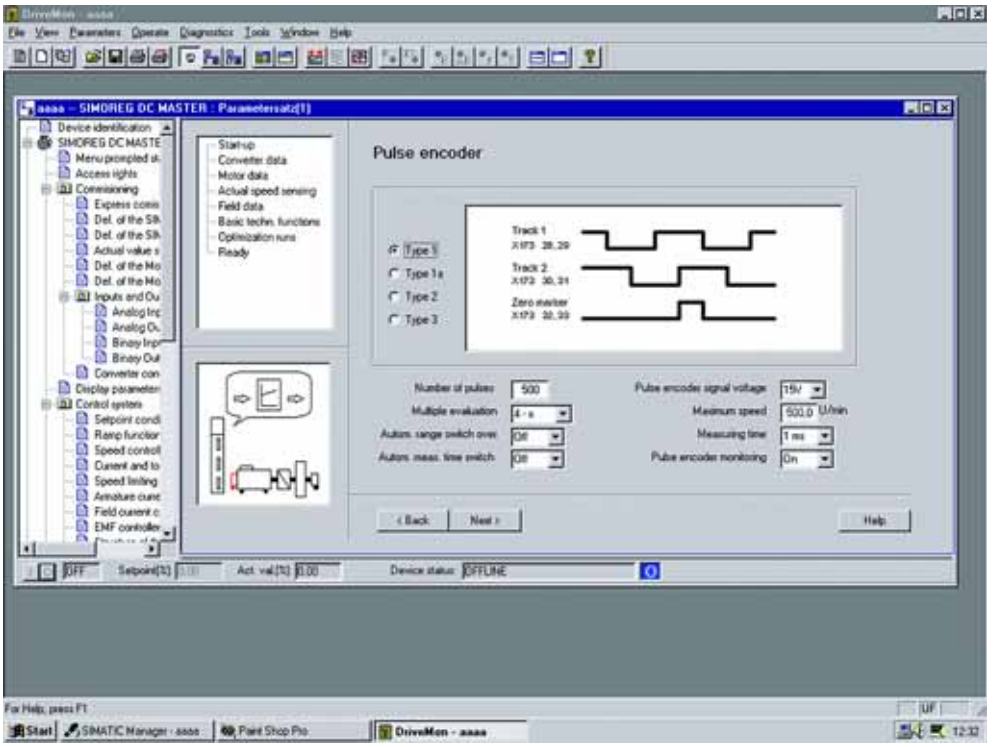


Fig. 4/36
DriveMonitor: Guided start-up

1) The DriveMonitor supersedes SIMOVIS.

QuickStart

The current version of the QuickStart is part of the standard scope of supply on CD-ROM.

- The start-up and parameterization tool
- Automatic drive search and detection over the communications port
- Wizard menu driven step by step start-up procedure for simplified commissioning
- Uploading, downloading, and printing of parameter sets
- Drive control via a software operator panel
- Handling of process data (control commands, setpoints)
- Setting and monitoring of parameters

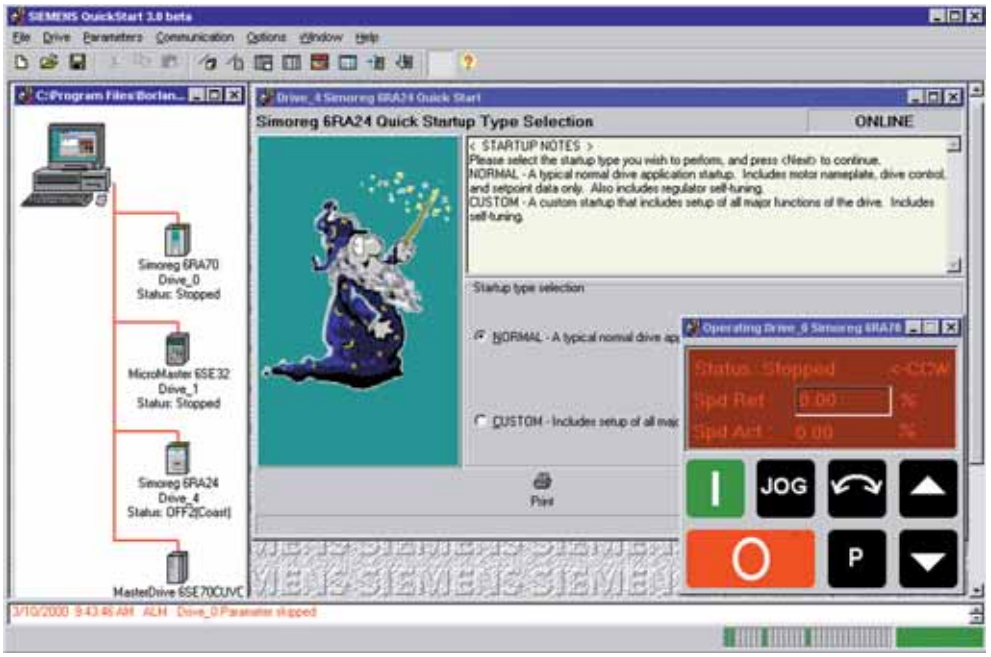


Fig. 4/37
QuickStart function windows

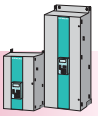
4

SIMOREG 6RA70 DC MASTER

System Components

5

Dynamic braking kits



Technical information

Dynamic braking (DB) is often employed on single quadrant (1Q) drives to provide a means of rapidly stopping a motor. Dynamic braking is also occasionally employed on four quadrant (4Q) drives to provide braking torque in the event of a fault or emergency stop condition which would drop out the main contactor, or in the event of a power failure.

This option is not recommended for continuous regeneration or repetitive operation. It should also be noted that dynamic braking does not replace a holding brake circuit as it will not prevent a motor at standstill from rotating.

DB kits, which can be selected from the tables on page 5/10, are designed for stopping a typical load a maximum of three (3) successive times from base speed. Typical load refers to the motor inertia and a reflected load inertia of less than or equal to that of the motor. A few exceptions are listed in the selection tables. After three (3) successive stops from base speed, a 15 minute waiting period is required.

Dynamic braking contactors employ a normally closed contact which must be opened (by contactor energization) before the main drive contactor can be closed. In a fault condition, both the main contactor and the dynamic braking contactor are immediately dropped out. When the dynamic braking contactor drops out, it connects the motor armature to the dynamic braking resistors.

A typical connection diagram of the dynamic braking kit with the SIMOREG 6RA70 drive controller is shown in Figure 5/4.

Dynamic braking vs. regenerative stop

Often, a comparison of quick stop (regenerative stop at 150 % of rated motor current) and dynamic braking is required for a price/performance comparison. The basic differences in the two stopping modes are described in the following paragraphs.

In the quick stop mode, the motor decelerates faster from top speed down to base speed. This happens because the field strength continually increases until the motor reaches base speed. From base speed down to zero speed, the rate of deceleration is constant since the field flux, as well as the armature current, is constant.

Dynamic braking develops stopping torque by connecting a resistor across the motor armature terminals after the drive controller turns off power to the motor. The motor now acts as a generator as it begins to stop. Stored energy in the rotating motor develops voltage (CEMF) at the armature terminals. When the DB resistor is applied to the motor leads, a closed path is provided for current to flow and the stored energy in the motor is converted to heat. The resistor is sized to allow 150 % current flow initially. At top speed, the deceleration rate matches the same curve as quick stop until base speed is reached. Below base speed, the armature voltage level drops, producing less current through the fixed resistor. This results in an exponential decay of speed. The motor is finally stopped due to frictional torque which depends on the connected load and can vary greatly among different applications.

Typical speed versus time graphs for both quick stop and dynamic braking are shown in Figure 5/5.

DB resistor selection

The dynamic braking resistor is chosen for two parameters:

- Resistance value in ohms (Ω)
- Power rating in Joules or Watt seconds (Ws)

Resistance value calculation

The DB resistance value is typically selected to achieve 150 % of rated full load continuous current when the motor voltage is maximum. The 150 % limit conforms to the overload rating for most DC motors. If the initial dynamic braking current is calibrated higher, for example at 200 %, some motors might experience commutation problems such as sparking at the brushes. If the initial current were calibrated for only 100 %, the motor would take a needlessly long time to come to a stop. The dynamic braking current decreases as the motor decelerates and the effective stopping torque decreases with motor speed.

It should be noted that stopping from above base speed will result in 150 % current (approximately) sustained for the period of time that it takes to decelerate to base speed. This is because the drive will strengthen the field as the motor decelerates until full field is attained. Dynamic braking is especially effective because kinetic energy is being removed from the motor (and load) at the optimal rate until speed falls below base speed. This condition would not hold, of course, in the event of a power failure. With a power failure, the field's time constant establishes the duration of the stopping torque which may be effective for only a fraction of a second. After this time, the motor will coast to a stop unless external braking is applied.

$$R = \frac{V}{15\ I_{FL}}$$

R = the value of resistance in ohms (Ω)
V = the motor voltage at the base speed
I_{FL} = the rated motor current at full load

Technical information

Power rating calculation

To arrive at the power rating of the resistors required, first the inertia energy of the motor and its load – when running at its top speed – needs to be calculated.

The kinetic energy is a function of total inertia and speed. The dynamic braking selection tables contain the kinetic energy of most of the motors covered by the SIMOREG 6RA70 drive controllers. The kinetic energy is calculated based on a typical load for which the load inertia (reflected to the motor through a gear box, if applicable) is no greater than the motor's rotor inertia.

When a gear box is placed between motor and load, the load inertia must be reflected to the motor shaft using the formula:

$$J_{LM} = J_L (n_L + n_m)^2$$

Where J_{LM} = Load inertia reflected to motor shaft in lb ft^2

J_L = Load inertia in lb ft^2
n_L = Load speed in rpm
n_m = Corresponding motor speed in rpm

Once the load inertia (J_{LM}) and the motor inertia are known, then the amount of kinetic energy to be dissipated in resistors can be calculated using the formula:

$$E_M = \frac{2.309 \times 10^{-4} \times n_m^2}{(J_M + J_{LM}) \times S_N}$$

Where E_M = Kinetic energy in Joules
J_M = Motor inertia in lb ft^2
S_N = No. of consecutive stops desired (typically 3)

Once the kinetic energy value is calculated, then it needs to be compared with the energy absorbing capacity of the DB resistors.

The resistors are not usually rated for their energy absorbing capacity but are rated in terms of their continuous dissipation capacity in watts. However, by judiciously considering resistor short time ratings, the energy absorbing capacity of DB resistors, in Joules, can be calculated as described below.

Energy (watt seconds or Joules) absorbed by a resistor varies with time. Energy, absorbed over an unlimited time, approaches infinity since the resistor is continually dissipating heat. However, in a short period of time, such as five or ten seconds, there is insufficient time for the resistor to dissipate much heat. In such a short period of time, the heat is essentially converted to temperature rise of the resistor itself. The energy absorbing capacity of the DB resistor can be arrived at from its short time current rating, by the formula:

$$E_R = I_{ST}^2 \times R \times T$$

Where E_R = Energy in watt seconds (Ws) or Joules

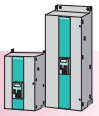
R = Resistance of resistor in ohms (Ω)
I_{ST} = Current rating when limited to time T
T = Time in seconds (s)

The DB kit selection tables list the heat absorption capacity of the DB resistors for each horsepower rating.

The energy to be absorbed (E_M) should be compared with the resistor's capacity (E_R).

If the energy calculated for the motor and load (E_M) exceeds (E_R), the standard DB kit must not be used. In a case where (E_R) is greater than (E_M), but the number of consecutive stops (S_N) is greater than three (3), the temperature rise may overheat the resistors. A custom DB kit will then be required. In case of such a requirement, please contact Siemens for details.

Dynamic braking kits



Selection and ordering data

Catalog No.		Motor rating		Kinetic energy of motor & load		Resistor bank		
		Base/max. speed	Motor inertia $	At base speed %	At top speed %			
	HP	rpm	lb ft^2	Joules	Joules	Ω	% FLA	Joules
DB kit for 500 V DC motors								
D57002L (	**3**	1750/2300	0.45	636	1099	62	144	5500
D57003L (	**5**	1750/2300	0.67	948	1637	36	138	7800
D57004L (	**7.5**	1750/2300	1.35	1909	3298	27	125	9300
D57005L (	**10**	1750/2300	1.49	2107	3640	20	125	1100
D57006L (	**15**	1750/2300	2.91	4116	7109	12.5	141	28000
D57007L (	**20**	1750/2300	3.31	4681	8086	10	135	22000
D57008L (	**25**	1750/2300	3.2	4526	7817	8	136	33000
D57009L (	**30**	1750/2300	3.6	5091	8795	6.7	141	31000
D57010L)	**40**	1750/2100	5.6	7920	11405	4.8	148	60000
D57011L)	**50**	1750/2100	6.7	9476	13645	4	147	60000
D57012L &)	**60**	1750/2100	15.61	22077	31790	3.4	141	62000
D57013L &)	**75**	1750/2100	18.27	25839	37208	2.6	151	50000
D57014L &*	**100**	1750/2000	22.21	31411	41026	2	152	80000
D57015L *	**125**	1750/2000	22.21	31411	41026	1.87	132	420000
D57016L *	**150**	1750/2000	35.47	50164	65520	1.4	147	275000
D57017L *	**200**	1750/2000	43.88	62058	81055	1.01	152	690000
D57018L *	**250**	1750/2000	79.1	111868	131867	0.78	156	690000
D57019L *	**300**	1750/1900	98.76	139673	164643	0.66	155	550000
D57020L *	**400**	1750/1900	121.87	172356	203169	0.52	146	1050000
D57021L *	**500**	1750/1900	157.28	222435	262201	0.416	146	840000
	600 – 1000	Consult factory						
DB kit for 240 V DC motors								
D27004L (	**3**	1750/2300	0.45	636	1099	12	160	14600
D27005L (	**5**	1750/2300	0.67	948	1637	8.6	131	10400
D27006L (	**7.5**	1750/2300	0.77	1089	1881	5.5	134	15800
D27007L (	**10**	1750/2300	1.49	2107	3640	4.5	127	17600
D27008L (	**15**	1750/2300	2.91	4116	7109	2.8	140	30000
D27009L (	**20**	1750/2300	3.31	4681	8086	2.2	137	15000
D27010L)	**25**	1750/2300	3.2	4526	7817	1.7	143	31000
D27011L)	**30**	1750/2300	3.6	5091	8795	1.4	148	32000
D27012L *	**40**	1750/2100	5.6	7920	11405	1	165	60000
D27013L *	**50**	1750/2100	6.7	9476	13645	0.85	159	61000
D27014L *	**60**	1750/2100	18.27	25839	37208	0.7	161	64000
D27015L *	**75**	1750/2100	18.27	25839	37208	0.6	152	72000
D27016L *	**100**	1750/2000	22.21	31411	41026	0.47	145	420000
D27017L *	**125**	1750/2000	35.54	50263	65649	0.37	149	345000
D27018L *	**150**	1750/2000	35.54	50263	65649	0.31	150	275000
D27019L *	**200**	1750/2000	43.88	62058	81055	0.253	141	525000
D27020L *	**250**	1750/1900	79.15	111939	131951	0.187	152	1050000

$ Values are for typical DPFG motors and may vary according to motor style selected. Please calculate values based on specified motor data. Reflected load inertia is assumed to be equal to or less than the motor inertia.

% Multiply these values by three (3) to calculate energy requirements for three (3) successive stops and then compare with resistor bank capacity.

& These kits are designed for two successive stops from base speed with resistors at ambient temperature.

(These kits are panel mounted and require 15"H x 11"W x 10"D panel space.

) These kits are panel mounted and require 15"H x 11"W x 13"D panel space.

* These kits have roof mounted resistors and require 16"H x 24"W x 18"D space mounting cage on roof and, in addition, also require 13"H x 8"W x 13"D panel space.

Connection diagram · Speed vs. time graph

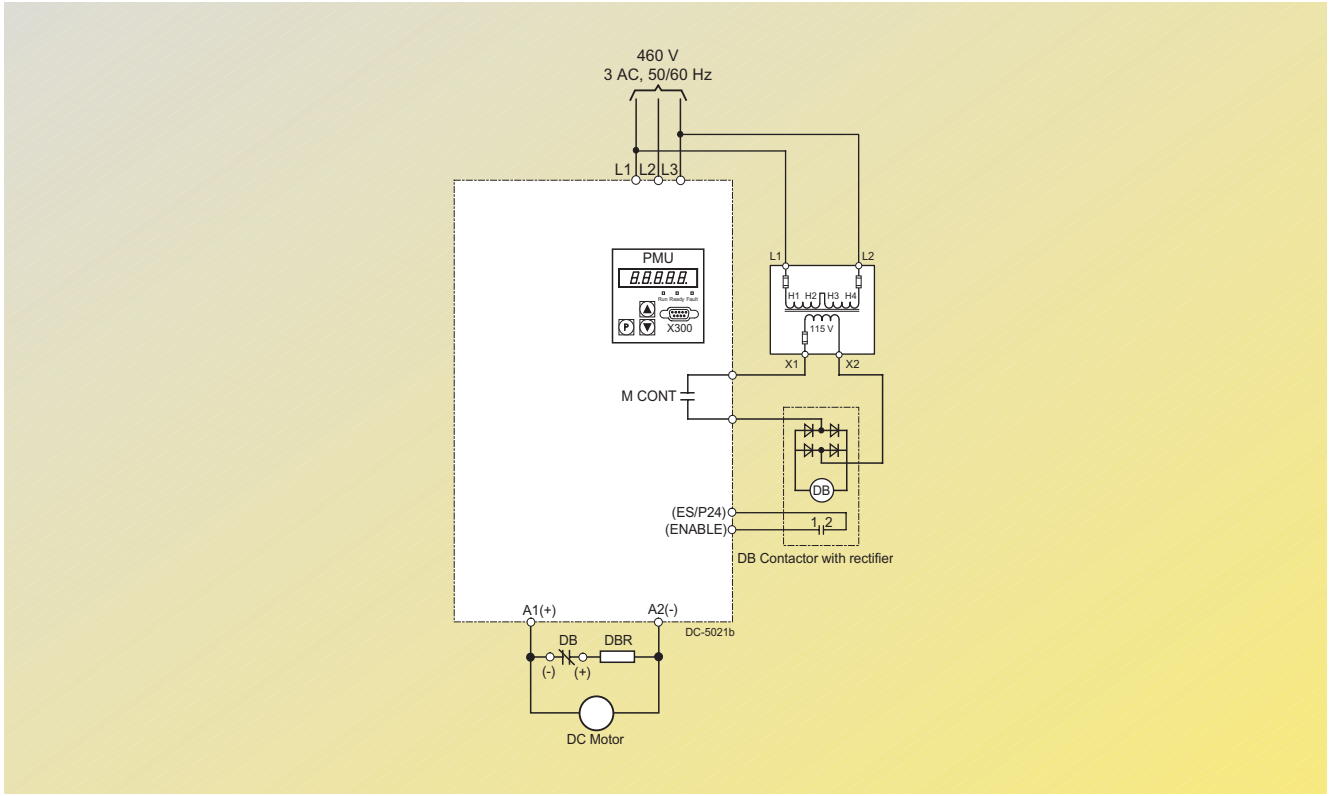


Fig. 5/4
Typical connection diagram for dynamic braking

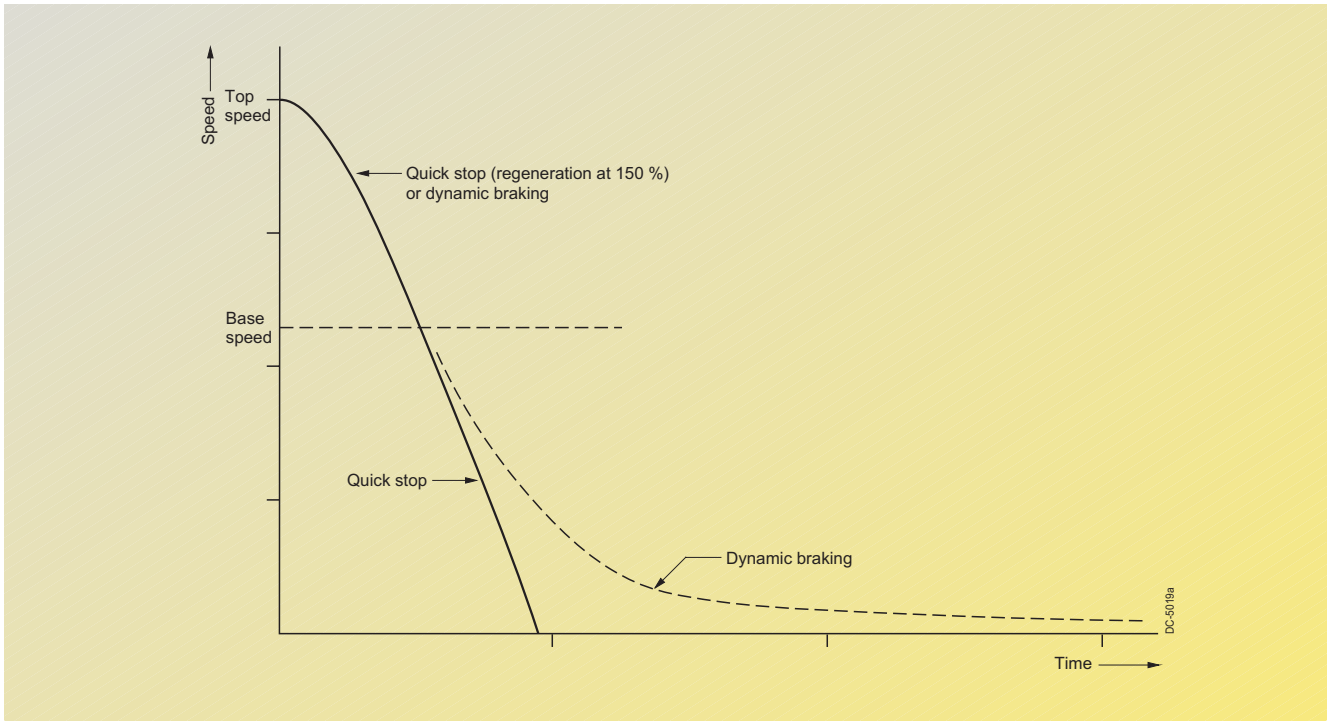
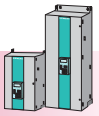


Fig. 5/5
Speed vs. time graph for DB and quick stop



Technical information

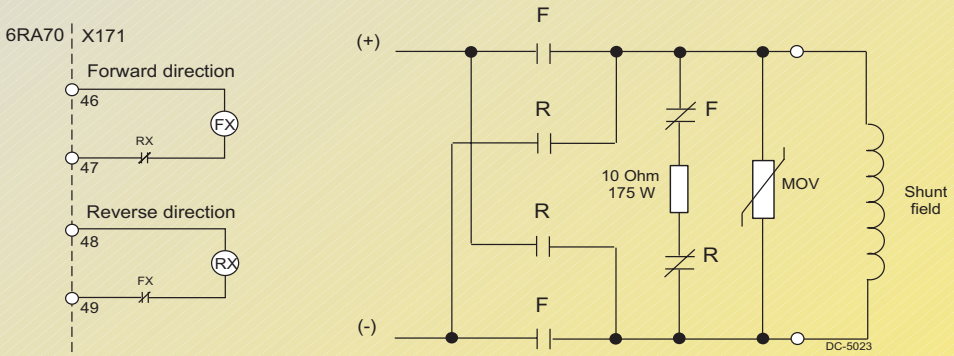
Field contactor reverse kits can be used to provide bidirectional rotation from a single quadrant (1Q) drive. Field reversal can reduce the system cost for bidirectional operation if:

1. The drive is large enough that cost difference between a single quadrant and a four quadrant drive controller is greater than the cost of the field contactor reverse kit.
2. Quick reversal is not required.

As an example, on some mill drives it may be required to jog in the reverse direction. Field reversal can be used to accomplish the reverse direction for jogging.

The control signals for the field contactor reverse kits, sequencing and logic are standard in single quadrant SIMOREG 6RA70 drive controllers.

This option includes field reversing contactors and relays, control transformer, MOV, resistor and mounting hardware.



Note:
Can be utilized with straight shunt wound DC motors only.

Fig. 5/6
Typical field reversal connection diagram

Selection and ordering data

Continuous field rating ADC	Panel space requirement H" x W" x D"	Heat dissipation W	Catalog No.
40	25" x 20" x 10"	35	**FC7001L**

5

Technical information

Siemens starter (blower motor) kits are designed to provide adjustable overload and short circuit protection to 3-phase squirrel cage induction motors used for ventilation of DC motors.

Included in a kit are the following parts:

- A “Manual Starter Protector”, (MSP). These versatile Siemens devices provide a 3-phase manual motor disconnect function, and contain both adjustable bimetal thermal and fixed magnetic trip protection. These devices are designed to snap on standard 35-millimeter DIN rails, (DIN rail is not included in the kit). Also included is a side mount auxiliary contact block with 1-normally open and 1-normally closed contact. For further information on MSP‘s, refer to the Siemens Control Products catalog, (Order No. SFPC-06000).
- Fuses and fuse blocks for the short circuit protection on the line side of the MSP. Fuses are class CC, time delay type, with 200 kA interrupting capacity at 600 V AC. Fuses are selected to have a maximum rating of 400 % of the highest current setting on the MSP, in accordance with the NEC. Three single fuse blocks are provided, and they also snap on standard 35-millimeter DIN rail, (DIN rail is not included in the kit). Three of these fuse blocks mounted on DIN rail will be approximately 2.1" wide by 3.2" high.
- Three additional fuses are included in the kit for spares.

The proper kit is selected from the table on page 5/14. Select the kit that has an MSP FLA adjustment range that matches the AC blower motor‘s full load amperes.

Fig. 5/7
Manual starter protector

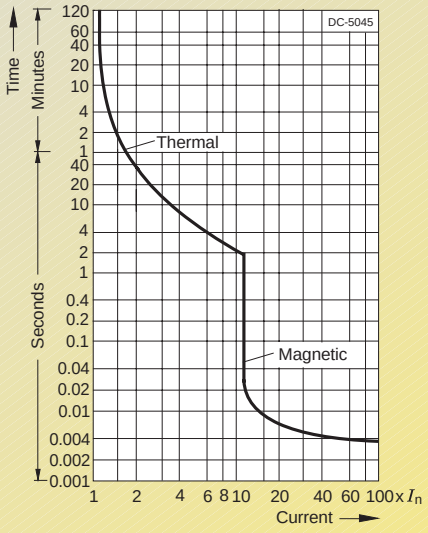


Fig. 5/8
Overload and magnetic trip characteristics

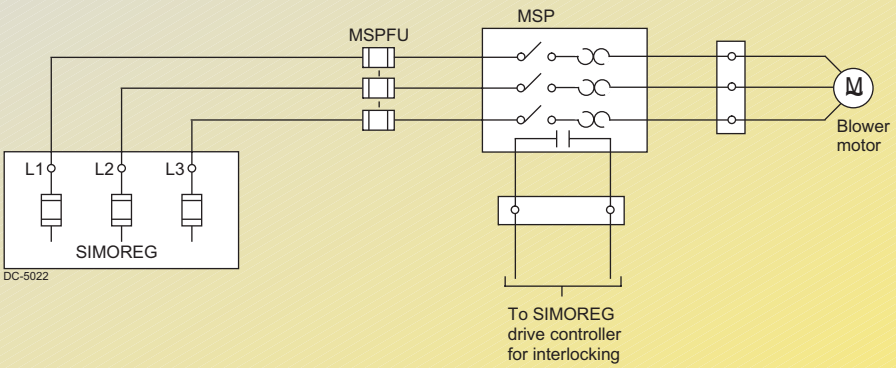
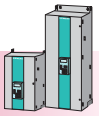


Fig. 5/9
Typical connection diagram for the starter (blower motor)

Starter (blower motor) kits



Selection and ordering data

MSP FLA ADJ. Range	Typical HP rating 230 V AC	460 V AC	MSP Type	MSPFU Fuse rating	Kit Catalog No.
0.45 – 0.63	–	–	3RV1011-0GA10	2.0 A, 600 V, CLASS CC	**SB7003L**
0.55 – 0.8	–	1/4	3RV1011-0HA10	2.0 A, 600 V, CLASS CC	**SB7004L**
0.70 – 1.0	–	1/2	3RV1011-0JA10	2.0 A, 600 V, CLASS CC	**SB7005L**
0.90 – 1.25	1/4	3/4	3RV1011-0KA10	2.0 A, 600 V, CLASS CC	**SB7006L**
1.1 –1.6	1/3	3/4	3RV1011-1AA10	5.0 A, 600 V, CLASS CC	**SB7007L**
1.4 – 2.0	1/2	1	3RV1011-1BA10	5.0 A, 600 V, CLASS CC	**SB7008L**
1.8 – 2.5	1/2	1.5	3RV1011-1CA10	5.0 A, 600 V, CLASS CC	**SB7009L**
2.2 – 3.2	3/4	1.5	3RV1011-1DA10	5.0 A, 600 V, CLASS CC	**SB7010L**
2.8 – 4.0	1	2	3RV1011-1EA10	12 A, 600 V, CLASS CC	**SB7011L**
3.5 – 5.0	1	3	3RV1011-1FA10	12 A, 600 V, CLASS CC	**SB7012L**
4.5 – 6.3	1.5	5	3RV1011-1GA10	12 A, 600 V, CLASS CC	**SB7013L**
5.5 – 8.0	2	5	3RV1011-1HA10	12 A, 600 V, CLASS CC	**SB7014L**
7.0 – 10.0	3	7.5	3RV1021-1JA10	20 A, 600 V, CLASS CC	**SB7015L**
9.0 – 12.5	3	7.5	3RV1021-1KA10	20 A, 600 V, CLASS CC	**SB7016L**
11.0 – 16.0	5	10	3RV1021-4AA10	30 A, 600 V, CLASS CC	**SB7017L**
14.0 – 20.0	7.5	15	3RV1021-4BA10	30 A, 600 V, CLASS CC	**SB7018L**
17.0 – 22.0	7.5	15	3RV1021-4CA10	30 A, 600 V, CLASS CC	**SB7019L**

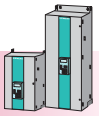
Technical information

Circuit breakers

The National Electrical Code, (NEC), requires that short circuit protection be provided on all motor branch circuits. Molded case circuit breakers, when properly sized, are ideally suited for this task. The NEC permits the breaker to be sized at between 115 % and 300 % of the full load amperes (FLA).

Siemens series of SENTRON™ molded case circuit breakers are ideally suited for this application and offer an abundance of models, covering a wide range of current ratings, and with a large variety of available options, (e.g. operating and mounting mechanisms, auxiliary switches, undervoltage and shunt trips, etc.). For information on selection, ordering, dimensions, options and technical data on Siemens molded case circuit breakers, refer to the Siemens Control Products catalog (Order No. SFPC-06000). For additional information, please contact your local Siemens sales office.

Fig. 5/10
Series of SENTRON



Technical information

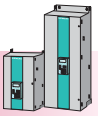
The table on the right lists the recommended Siemens breaker as a function of the motor horsepower. Values for both 230 V AC and 460 V AC, 3-phase input voltages are provided. The motor FLA values given in the table are from the NEC. In most cases, the actual motor FLA for a given horsepower will be somewhat lower. When selecting molded case breakers for incoming protection, be sure to be aware of the breakers interrupting capacity compared to the available fault current that the feeder circuit is capable of delivering.

HP Rating 230 V AC	HP Rating 460 V AC	DC Motor FLA	CB Rating AC A	CB Type
–	3	5.5	15	ED, 125 A FRAME
2	–	8.5	15	ED, 125 A FRAME
–	5	9.1	15	ED, 125 A FRAME
3	–	12.2	25	ED, 125 A FRAME
–	7.5	14	25	ED, 125 A FRAME
–	10	18	25	ED, 125 A FRAME
5	–	20	35	ED, 125 A FRAME
–	15	27	35	ED, 125 A FRAME
7.5	–	29	35	ED, 125 A FRAME
–	20	34	60	ED, 125 A FRAME
10	–	38	60	ED, 125 A FRAME
–	25	43	60	ED, 125 A FRAME
–	30	51	90	ED, 125 A FRAME
15	–	55	90	ED, 125 A FRAME
–	40	67	90	ED, 125 A FRAME
20	–	72	90	ED, 125 A FRAME
–	50	83	125	ED, 125 A FRAME
25	–	89	125	ED, 125 A FRAME
–	60	99	125	ED, 125 A FRAME
30	–	106	150	FD, 250 A FRAME
–	75	123	175	FD, 250 A FRAME
40	–	140	175	FD, 250 A FRAME
–	100	164	200	FD, 250 A FRAME
50	–	173	200	FD, 250 A FRAME
–	125	205	250	FD, 250 A FRAME
60	–	206	250	FD, 250 A FRAME
–	150	246	300	JD, 400 A FRAME
75	–	255	300	JD, 400 A FRAME
–	200	330	400	JD, 400 A FRAME
100	–	341	400	JD, 400 A FRAME
–	250	412	500	LD, 600 A FRAME
125	–	425	500	LD, 600 A FRAME
–	300	495	600	LD, 600 A FRAME
150	–	506	600	LD, 600 A FRAME
–	400	660	800	MD, 800 A FRAME
200	–	675	800	MD, 800 A FRAME
–	500	825	1000	ND, 1200 A FRAME
250	–	843	1000	ND, 1200 A FRAME
–	600	990	1200	ND, 1200 A FRAME
300	–	1012	1200	ND, 1200 A FRAME
–	750	1237	1600	PD, 1600 A FRAME
–	1000	1650	2000	RD, 2000 A FRAME

SIMOREG 6RA70 DC MASTER

Technical Information

6



Drive controller performance and specifications

This section describes the specifications and conditions of use for the standard SIMOREG 6RA70 drive controllers. Variations outside of these specifications are possible. Please contact Siemens when specific questions arise.

Drive controller location

SIMOREG 6RA70 drive controllers supplied as open chassis mounted units will normally require an enclosure for installation that meets the applicable safety codes. The type of enclosure, NEMA 1, NEMA 4, NEMA 12 etc., will depend on the environmental conditions at the installation site.

The purchaser of open chassis base drive units is responsible for assuring proper installation that meets the requirements listed in this section, as well as any applicable safety codes.

In choosing a location for the drive controller, be sure to consider the need for adequate clearance to allow cooling air circulation. Ample room must also be provided to permit the door to swing open for maintenance and service. Consult the dimensional drawings supplied in this chapter for further details.

Performance characteristics

Speed regulation methods	Armature voltage regulation with IR compensation (240 V DC or 500 V DC motors only). Speed regulation with analog or pulse tachometer (standard).
Speed regulation accuracy	Depends on feedback method used. See Table below for details.
Controlled speed range	Depends on feedback method and motor capability. See Note and Table below.
Field weakened operation	Standard on all SIMOREG 6RA70 drive controllers are CEMF field crossover regulators to permit operation above base speed. Up to 4:1 speed range is possible. See Note for further details.

Typical efficiency

Drive controller only	99 %
Drive controller and motor	87 %
Displacement power factor Typical at. max. speed and load	86.6 %

Typical speed regulation accuracy [1]) and ranges

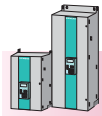
Speed feedback device	Speed regulation with 95 % load change, as a % of rated max. speed	Regulation from other variables [2])	Controlled speed range
Armature voltage	2	5	25:1
5 PY DC Tachometer	1	2	50:1
BC 42 DC Tachometer	0.5	1	100:1
BC 46 DC Tachometer	0.1	0.25	250:1
Digital at 1024 PPR	<0.1	<0.25	1000:1

Note:

DC motors may require derating or supplemental ventilation when operating at constant torque below 60 % of base speed. Motors to be used for field weakened operation above base speed must be specified accordingly and be equipped with tachometers.

1) Regulation accuracy of 0.01 % is possible under certain conditions with a digital tach and digital reference. For such applications, contact Siemens.

2) Regulation from other variables includes +10 %, –5 % change in line voltage and ±10°C change in ambient temperature.



Installation conditions

Unless designed for any special requirements specified in the original sales order, the drive unit should be installed in accordance with the drive performance specifications. In addition, the following conditions should be considered.

1. Atmosphere should be reasonably free of dirt, dust, combustible vapors, and electrically conductive or corrosive materials.
2. Mounting surfaces must be level and sufficiently rigid to support the weight of the equipment without settling or damage to cable duct and conduit enclosed connections.

DO NOT MOUNT TO SURFACES THAT ARE SUBJECT TO SHOCK OR VIBRATION.

3. The area must be free of electromagnetic interference or noise, caused for example, by:

- Radio frequency signals, such as those generated by portable transmitters used near drive or its wiring.
- Stray high voltage or high frequency signals, such as those generated by arc welders or unsuppressed inductive loads (e.g., relay, contactor, or brake coils), which are connected to circuits used within or in the vicinity of the drive controller or its wiring.

Note:

When the drive controller is supplied without a circuit breaker or fused disconnect on the incoming AC line, the user is responsible for installing such a device in order to meet the branch protection requirements of the National Electrical Code. Be sure that the protective device is capable of interrupting the available fault current from the power supply feeding the drive controller.

Application limitations

In order to assure proper operation of the SIMOREG 6RA70 drive controller, the following application limitations should always be observed. Failure to observe the following limitations could result in faults, instability, or improper operation of the automatic parameter adjustment features and thyristor diagnostic features.

Drive controller vs. motor current rating

The motor current rating should not be less than 10 % of the drive controller's continuous rating.

Field current rating

The drive controller should not be connected to a motor with a field current rating greater than the field supply rating. Also, it is recommended that the field current be set at 10 % or greater of the field current rating of the drive controller.

Motor armature voltage vs. incoming AC line voltage:

The motor armature voltage rating is most critical when applied with 4 Quadrant (regenerative) control units.

When the SIMOREG 6RA70 drive controller is in the regenerating mode of operation (power flow is back into the line), the line voltage must commutate the thyristors. If the DC motor voltage is too high, or the line voltage is too low, commutation failures can occur which will damage components and blow fuses. Armature voltage should never be set higher than 1.09 times the RMS incoming line voltage (250 V DC for 230 V AC supplies, 500 V DC for 460 V AC supplies).

If the armature voltage is reduced below the values listed above, then the margin for proper commutation in the event of a line “dip” is substantially improved.

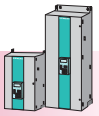
Converter overload

All SIMOREG 6RA70 drive controllers are capable of handling 150 % overload of the US rating for 60 s after reaching steady-state operating temperatures at the US rated current and ambient temperature. Following the overload, the unit must be returned to the US current rating for at least two (2) hours before another rated overload is allowed. Other overload cycles are permitted, provided the RMS current does not exceed the US rating of the drive controller. This may require derating of the drive controller. Please refer questions regarding special overload ratings to Siemens.

230 V AC Base drive panel connection

The standard 3-phase input power to SIMOREG 6RA70 Base drive panel controllers is 460 V AC. Base drive panel controllers are shipped configured for 460 V AC and UL listed in this configuration. For 230 V AC connection refer to the 6RA70 Application Note “Base Drive Panel Voltage Modification” for jumper settings on 1CTR control transformer.

Pulse tachometer evaluation specifications



Characteristic data

Level of input pulses

The evaluation electronics are capable of processing encoder signals (both symmetrical and asymmetrical) up to a maximum of 27 V differential voltage. The evaluation electronics are electronically adapted (in parameter P140) to the encoder signal voltage. The parameter setting selects one of two possible rated input voltages (see Table 6/1).

If the pulse encoder does not supply symmetrical encoder signals, then its grounding lead must be routed with each signal cable as a twisted pair and connected to the negative terminals of track 1, track 2 and the zero marker.

	Rated input voltage range	
	5 V P140=0x	**15 V P140=1x**
Low level	Differential voltage <0.8 V	Differential voltage <5 V
High level	Differential voltage >2 V	Differential voltage <8 V [1])
Hysteresis	>0.2 V	>1 V
Common mode	±10 V	±10 V

Table 6/1
Effect of plug-in jumper setting

	Rated input voltage range				
	5 V		**15 V**		
Differential voltage [2])	2 V	>2.5 V	8 V	10 V	>14 V
T_{min} [3])	630 nS	380 ns	630 ns	430 ns	380 ns

Table 6/2
Minimum distance between edges

	f_{max}				
	50 kHz	**100 kHz**	**150 kHz**	**200 kHz**	**300 kHz**
Differential voltage [4])	to 27 V	to 22 V	to 18 V	to 16 V	to 14 V

Table 6/3
Maximum input frequency as a function of supply voltage

Switching frequency

The maximum frequency of the encoder pulses is 300 kHz. To ensure correct evaluation of the encoder pulses, the minimum distance T_{min} between two encoder signal edges (tracks 1 and 2) specified in the table must be observed (see Table 6/2).

If the pulse encoder is incorrectly matched to the encoder cable, disturbing cable reflections will be produced at the receive end. These reflections must be damped so that the encoder pulses can be correctly evaluated. The limit values specified in Table 6/3 must be maintained to ensure that the resultant power loss in the adapting element of the evaluation electronics is not exceeded.

Cable, cable length, shield connection

The encoder cable capacitance must be recharged at each encoder edge change. The RMS value of this current is proportional to the cable length and pulse frequency and must not exceed the current specified by the encoder manufacturer.
A suitable cable as recommended by the encoder manufacturer must be used.

The maximum cable length must not be exceeded. Generally, a twisted cable pair with common pair shield is sufficient for each track. Crosstalk between the cables is thus reduced. The shielding of all pairs protects against noise pulses.

The shield must be connected to the shield bar of the SIMOREG converter over the largest possible surface area.

1) Restriction: See switching frequency

2) Differential voltage at evaluation electronics terminals

3) The phase error L_G (deviation from 90°), which may occur as the result of encoder and cable, can be calculated from T_{min}:
L_G = + (90° – f_p x T_{min} x 360° x 10^{-6})
L_G[°] = phase error
f_p[kHz] = pulse frequency
T_{min}[ns] = minimum distance between edges

4) Differential voltage of encoder pulses without load (approximate encoder current supply voltage)

15 A to 100 A Power modules, 3 AC 460 V, single- and four-quadrant

Model No.		6RA70@@-6F...-0			
		18	25	28	31
Rated supply voltage armature [1]	V	3-phase 230 or 460 (+15 %/–5 %)			
Rated input current armature [2]	A	13	25	50	82
Rated supply voltage Electronics power supply	V	2 AC 380 (–25 %) to 460 (+15 %); I_n = 1 A or 1 AC 190 (–25 %) to 230 (+15 %); I_n = 2 A			
Fan type		N/A			
Rated supply voltage field	V	2 AC 230 or 460 (+10 %)			
Rated frequency	Hz	45 to 65 Hz self-adapting (armature and field are independent)			
Rated DC voltage [3]	V	240 or 500			
DC armature current US rating [8]	A	**15**	**30**	**60**	**100**
Overload capability 60 s [7]		150 % of rated DC current			
Rated output at 500 V DC	HP	7.5	15	30	60
Rated output at 240 V DC	HP	3	7.5	15	25
Power loss at rated DC current (approximately)	W	125	170	250	355
Rated DC voltage field	V	150 or 300			
Rated DC current field	A	**5**	**10**		
Operational ambient temperature	°C	0 to 45 at I_{rated} self-cooled [4]			
Storage and transport temperature	°C	–25 to +70			
Installation altitude above sea level		≤ 1000 m at rated DC current [5]			
Control stability		Δ_n = 0.006 % of the rated motor speed, valid for pulse encoder operation and digital setpoint Δ_n = 0.1 % of the rated motor speed, valid for analog tachometer or analog setpoint [6]			
Degree of protection		Open chassis (IP 00)			
Dimensions		See dimension drawings page 6/11			
Weights (approx.)	lb	25	35	35	40

1) Power module armature and field converters can operate with incoming AC voltages down to 85 V AC. In these cases a separate 230 or 460-volt supply is required for the fans and control power supply. Operation with reduced input voltage will result in reduced output voltage accordingly.

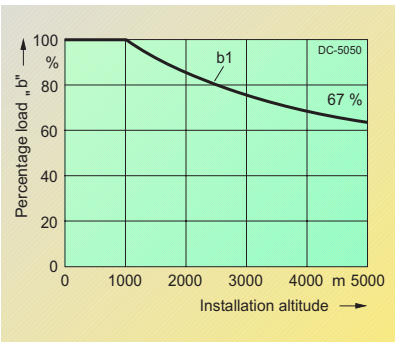
2) Values apply for rated DC output current on the armature.

3) The specified output DC voltage can be guaranteed up to an undervoltage of 5 % of rated line voltage.

4) Load values (DC current) as a function of coolant temperature (refer to P077 Operating Instructions, Section 11).

Ambient temperature or coolant temperature	Change in load values (percentage reduction "a")	
	in converters with self-cooling	in converters with forced air cooling
+40 °C	0 %	–0 %
+45 °C	0 %	0 %
+50 °C	– 6 %	(–5 %)
+55 °C	–11 %	
+60 °C	–18 %	

5) Load values as a function of installation altitude (refer to P077 Operating Instructions, Section 11).



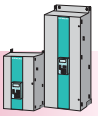
Curve b1: Reduction factor of load values (DC current) at installation altitudes above 1000 m.
The supply voltages of all circuits are available up to an installation altitude of 5000 m for basic insulation.
Safe electrical separation is restricted at site altitudes of 2000 m and above.

6) Requirements:
The control stability (closed-loop PI control) is referred to the rated motor speed and applies when the SIMOREG converter is warm.
The following conditions are applicable:
– Temperature changes of ±10 °C
– Line voltage changes corresponding to +10 %/–5 % of the rated input voltage
– Temperature coefficient of temperature-compensated tachometer 0.15 ‰ per 10 °K (applies only to analog tachometer)
– Constant setpoint (14-bit resolution)
– Motor, load, and encoder are correctly aligned and the load is balanced.

7) Overload:
Following operation at rated load, base drives are capable of carrying 150 % of rated load for 1 minute, followed by a period of light load operation of such duration that the rms load does not exceed rated continuous current. Power Modules are designed for operation with heatsink air inlet temperatures up to 45 °C.

8) DC Current ratings:
This catalog covers the applicable data for the power modules based on the US ratings. IEC ratings and data for these power modules can be found in the power module manual.
Applicable standards
UL508C
CE

Power modules technical data



6RA70
DC MASTER

140 A to 850 A Power modules, 3 AC 460 V, single- and four-quadrant

Model No.		6RA70@@-6F...-0					
		75	78	82	85	87	91
Rated supply voltage armature [1]	V	3-phase 230 or 460 (+15 %/–5 %)					
Rated input current armature [2]	A	115	173	210	353	419	697
Rated supply voltage Electronics power supply	V	2 AC 380 (–25 %) to 460 (+15 %); I_n = 1 A or 1 AC 190 (–25 %) to 230 (+15 %); I_n = 2 A					
Fan type	V	Internal 24 V DC		2 AC 230 V (±10 %)			
	A			0.55			3.3
Air flow rate	ft³/min	100		570			1300
Fan noise level	dBA	40		76			85
Rated supply voltage field	V	2 AC 230 or 460 V (+10 %)					
Rated frequency	Hz	45 to 65 Hz self-adapting (armature and field are independent)					
Rated DC voltage [3]	V	240 or 500					
DC armature current US rating [8]	A	**140**	**210**	**255**	**430**	**510**	**850**
Overload capability 60 s [7]		150 % of rated DC current					
Rated output at 500 V DC	HP	75	125	150	250	300	500
Rated output at 240 V DC	HP	40	60	75	125	150	250
Power loss at rated DC current (approximately)	W	470	696	820	1348	1838	2440
Rated DC voltage field	V	150 or 300					
Rated DC current field	A	**15**		**25**			**30**
Operational ambient temperature	°C	0 to 45 at I_{rated} forced-cooled [4]					
Storage and transport temperature	°C	–25 to +70					
Installation altitude above sea level		≤ 1000 m at rated DC current [5]					
Control stability		Δ_n = 0.006 % of the rated motor speed, valid for pulse encoder operation and digital setpoint Δ_n = 0.1 % of the rated motor speed, valid for analog tachometer or analog setpoint [6]					
Degree of protection		Open chassis (IP 00)					
Dimensions		See dimension drawings pages 6/11 to 6/13					
Weights (approx.)	lb	40	40	70	70	105	190

6

1) Power module armature and field converters can operate with incoming AC voltages down to 85 V AC. In these cases a separate 230 or 460-volt supply is required for the fans and control power supply. Operation with reduced input voltage will result in reduced output voltage accordingly.

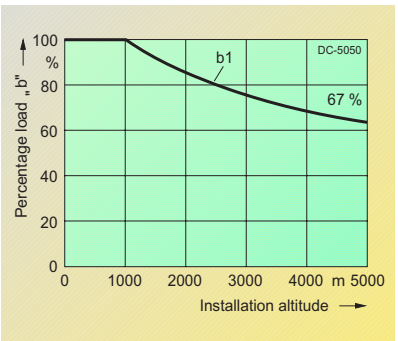
2) Values apply for rated DC output current on the armature.

3) The specified output DC voltage can be guaranteed up to an undervoltage of 5 % of rated line voltage.

4) Load values (DC current) as a function of coolant temperature (refer to P077 Operating Instructions, Section 11).

Ambient temperature or coolant temperature	Change in load values (percentage reduction "a")	
	in converters with self-cooling	in converters with forced air cooling
+40 °C	0 %	–0 %
+45 °C	0 %	0 %
+50 °C	– 6 %	(–5 %)
+55 °C	–11 %	
+60 °C	–18 %	

5) Load values as a function of installation altitude (refer to P077 Operating Instructions, Section 11).



Curve b1: Reduction factor of load values (DC current) at installation altitudes above 1000 m.
The supply voltages of all circuits are available up to an installation altitude of 5000 m for basic insulation.
Safe electrical separation is restricted at site altitudes of 2000 m and above.

6) Requirements:
The control stability (closed-loop PI control) is referred to the rated motor speed and applies when the SIMOREG converter is warm.
The following conditions are applicable:
– Temperature changes of ±10 °C
– Line voltage changes corresponding to +10 %/–5 % of the rated input voltage
– Temperature coefficient of temperature-compensated tachometer 0.15 ‰ per 10 °K (applies only to analog tachometer)
– Constant setpoint (14-bit resolution)
– Motor, load, and encoder are correctly aligned and the load is balanced.

7) Overload:
Following operation at rated load, base drives are capable of carrying 150 % of rated load for 1 minute, followed by a period of light load operation of such duration that the rms load does not exceed rated continuous current. Power modules are designed for operation with heatsink air inlet temperatures up to 45 °C.

8) DC Current ratings:
This catalog covers the applicable data for the power modules based on the US ratings. IEC ratings and data for these power modules can be found in the power module manual.
Applicable standards
UL508C
CE

1180 A, 1660 A and 1680 A Power modules, 3 AC 575 V, single- and four-quadrant

Model No.		6RA70@@-4G...-0		
		93	95	96
Rated supply voltage armature [1]	V	3-phase 575 (+10 %/–20 %) or 460 (+15 %/–5 %)		
Rated input current armature [2]	A	967	1361	1378
Rated supply voltage Electronics power supply	V	2 AC 380 (–25 %) to 460 (+15 %); I_n = 1 A or 1 AC 190 (–25 %) to 230 (+15 %); I_n = 2 A		
Fan type	V A	3 AC 460 V (±10 %) 1.25		
Air flow rate	ft³/min	824		
Fan noise level	dBA	88		
Rated supply voltage field	V	2 AC 400 (+15 %/–20 %) or 2 AC 460 (+10 %)		
Rated frequency	Hz	45 to 65 Hz self-adapting (armature and field are independent)		
Rated DC voltage [3]	V	500		
DC armature current US rating [8]	A	**1180**	**1660**	**1680**
Overload capability 60 s [7]		150 % of rated DC current		
Rated output at 500 V DC	HP	700	1000	1000
Power loss at rated DC current (approximately)	W	5900	7300	7400
Rated DC voltage field	V	150 or 300		
Rated DC current field	A	**40**		**85**
Operational ambient temperature	°C	0 to 45 at I_{rated} forced-cooled [4]		
Storage and transport temperature	°C	–25 to +70		
Installation altitude above sea level		≤ 1000 m at rated DC current [5]		
Control stability		Δ_n = 0.006 % of the rated motor speed, valid for pulse encoder operation and digital setpoint Δ_n = 0.1 % of the rated motor speed, valid for analog tachometer or analog setpoint [6]		
Degree of protection		Open chassis (IP 00)		
Dimensions		See dimension drawings page 6/13		
Weights (approx.)	lb	320		

1) Power module armature and field converters can operate with incoming AC voltages down to 85 V AC. In these cases a separate 230 or 460-volt supply is required for the fans and control power supply. Operation with reduced input voltage will result in reduced output voltage accordingly.

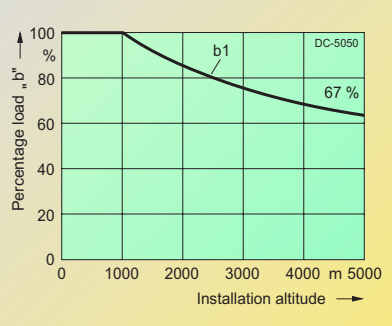
2) Values apply for rated DC output current on the armature.

3) The specified output DC voltage can be guaranteed up to an undervoltage of 5 % of rated line voltage.

4) Load values (DC current) as a function of coolant temperature (refer to P077 Operating Instructions, Section 11).

Ambient temperature or coolant temperature	Change in load values (percentage reduction "a")	
	in converters with self-cooling	in converters with forced air cooling
+40 °C	0 %	–0 %
+45 °C	0 %	0 %
+50 °C	– 6 %	(–5 %)
+55 °C	–11 %	
+60 °C	–18 %	

5) Load values as a function of installation altitude (refer to P077 Operating Instructions, Section 11).



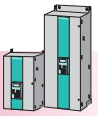
Curve b1: Reduction factor of load values (DC current) at installation altitudes above 1000 m.
The supply voltages of all circuits are available up to an installation altitude of 5000 m for basic insulation.
Safe electrical separation is restricted at site altitudes of 2000 m and above.

6) Requirements:
The control stability (closed-loop PI control) is referred to the rated motor speed and applies when the SIMOREG converter is warm.
The following conditions are applicable:
– Temperature changes of ±10 °C
– Line voltage changes corresponding to +10 %/–5 % of the rated input voltage
– Temperature coefficient of temperature-compensated tachometer 0.15 ‰ per 10 °K (applies only to analog tachometer)
– Constant setpoint (14-bit resolution)
– Motor, load, and encoder are correctly aligned and the load is balanced.

7) Overload:
Following operation at rated load, base drives are capable of carrying 150 % of rated load for 1 minute, followed by a period of light load operation of such duration that the rms load does not exceed rated continuous current. Power modules are designed for operation with heatsink air inlet temperatures up to 45 °C.

8) DC Current ratings:
This catalog covers the applicable data for the power modules based on the US ratings. IEC ratings and data for these power modules can be found in the power module manual.
Applicable standards
UL508C
CE

Base drive panel technical data



15 A to 100 A Base drive panel, 3 AC 460 V, single- and four-quadrant

Model No.		6RA70@@-2F...-0			
		13	18	25	30
Rated supply voltage armature [1]	V	3-phase 460 (+10 %/–5 %)			
Rated input current armature and field [2]	A	17.3	34.6	59.2	92
Rated supply voltage field	V	1-phase 460 (+10 %)			
Rated frequency	Hz	45 to 65 Hz self-adapting (armature and field are independent)			
Rated DC voltage [3]	V	500			
Rated DC armature current	A	**15**	**30**	**60**	**100**
Overload capability 60 s [7]		150 % of rated DC current			
Rated output at 500 V DC	HP	7.5	15	30	60
Rated output at 240 V DC	HP	3	7.5	15	25
Power loss at rated DC current (approximate)	W	150	200	350	500
Rated DC voltage field	V	300			
Rated DC current field	A	**5**	**10**		
Operational ambient temperature	°C	0 to 45 at I_{rated} self-cooled [4]			
Storage and transport temperature	°C	–25 to +70			
Installation altitude above sea level		≤ 1000 m at rated DC current [5]			
Control stability		Δ_n = 0.006 % of the rated motor speed, valid for pulse encoder operation and digital setpoint Δ_n = 0.1 % of the rated motor speed, valid for analog tachometer or analog setpoint [6]			
Degree of protection		Open chassis (IP 00)			
Dimensions		See dimension drawings page 6/14			
Weights (approx.)	lb	35	55	60	70

1) Operation with reduced input voltage will result in reduced maximum output voltage accordingly.

2) Values apply for rated DC output current on both the armature and field circuits.

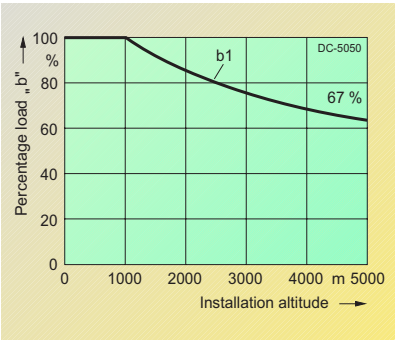
3) The specified output DC voltage can be guaranteed up to an undervoltage of 5 % of rated line voltage.

4) The table below gives load values, (DC current), as a function of ambient temperature surrounding the base drive panel, (refer to P077 Operating Instructions, Section 11).
Note, Important: When base drive panels are installed into enclosures, make sure the temperature inside does not exceed 45 °C, otherwise derate the DC current rating per the table below.

Ambient temperature	% reduction in base drive DC ampere rating	
	Self-cooled converters (15, 30, 60, 100 A DC)	Fan-cooled converters (140 – 1660 A DC)
+40 °C	– 0 %	–0 %
+45 °C	– 0 %	–0 %
+50 °C	– 6 %	–5 %[a]
+55 °C	–11 %	–5 %[a]
+60 °C	–18 %	–5 %[a]

a) Operation of fan cooled units at ambients above 50 °C is not permitted because of limitations on the allowable fan operating temperature.

5) Load values, (DC current), as a function of installation altitude (refer to P077 Operating Instructions, Section 11).



Curve b1: Reduction factor of load values (DC current) at installation altitudes above 1000 m.
No derating of the supply voltages to any circuits is required up to an installation altitude of 5000 m for basic insulation.

6) Requirements to achieve control stability:
The control stability (closed-loop PI control) is referred to the rated motor speed and applies when the SIMOREG converter is warm.
The following conditions are applicable:
- Temperature changes of ±10 °C
- Line voltage changes corresponding to +10 %/–5 % of the rated input voltage
- Temperature coefficient of temperature-compensated tachometer 0.15 ‰ per 10 °K (applies only to analog tachometer)
- Constant setpoint (14-bit resolution)
- Motor, load, and encoder are correctly aligned and the load is balanced.

7) Overload:
Following operation at rated load, base drive panels are capable of carrying 150 % of rated load for 1 minute, followed by a period of light load operation of such duration that the rms load does not exceed rated continuous current. Base drive panels are designed for operation with heatsink air inlet temperatures up to 45 °C.
Applicable standards
UL508A
National Electrical Code 1999

140 A to 850 A Base drive panel, 3 AC 460 V, single- and four-quadrant

Model No.		6RA70@@-2F...-0					
		72	75	77	82	83	87
Rated supply voltage armature [1]	V	3-phase 460 (+10 %/–5 %)					
Rated input current armature and field [2]	A	129.8	187.2	234.1	377.6	448.2	727
Fan type	V	Internal 24 V DC		1-phase 230 V			
Air flow rate	ft^3/min	100		570			1300
Fan noise level	dBA	40		76			85
Rated supply voltage field	V	1-phase 460 (+10 %)					
Rated frequency	Hz	45 to 65 Hz self-adapting (armature and field are independent)					
Rated DC voltage [3]	V	500					
Rated DC armature current	A	**140**	**210**	**255**	**430**	**510**	**850**
Overload capability 60 s [7]		150 % of rated DC current					
Rated output at 500 V DC	HP	75	125	150	250	300	500
Rated output at 240 V DC	HP	40	60	75	125	150	250
Power loss at rated DC current (approximately)	W	725	1000	1290	1825	2125	3750
Rated DC voltage field	V	300					
Rated DC current field	A	**15**		**25**		**30**	
Operational ambient temperature	°C	0 to 45 at I_{rated} forced-cooled [4]					
Storage and transport temperature	°C	–25 to +70					
Installation altitude above sea level		≤ 1000 m at rated DC current [5]					
Control stability		Δ_n = 0.006 % of the rated motor speed, valid for pulse encoder operation and digital setpoint Δ_n = 0.1 % of the rated motor speed, valid for analog tachometer or analog setpoint [6]					
Degree of protection		Open chassis (IP 00)					
Dimensions		See dimension drawings pages 6/14 to 6/17					
Weights (approx.)	lb	90	95	145	160	210	400

1) Operation with reduced input voltage will result in reduced maximum output voltage accordingly.

2) Values apply for rated DC output current on both the armature and field circuits.

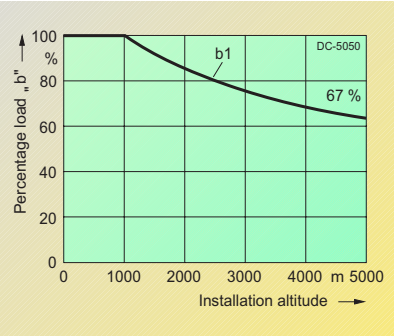
3) The specified output DC voltage can be guaranteed up to an undervoltage of 5 % of rated line voltage.

4) The table below gives load values, (DC current), as a function of ambient temperature surrounding the base drive panel, (refer to P077 Operating Instructions, Section 11).
Note, Important: When base drive panels are installed into enclosures, make sure the temperature inside does not exceed 45 °C, otherwise derate the DC current rating per the table below.

Ambient temperature	% reduction in base drive DC ampere rating	
	Self-cooled converters (15, 30, 60, 100 A DC)	Fan-cooled converters (140 – 1660 A DC)
+40 °C	– 0 %	–0 %
+45 °C	– 0 %	–0 %
+50 °C	– 6 %	–5 %[a]
+55 °C	–11 %	–5 %[a]
+60 °C	–18 %	–5 %[a]

a) Operation of fan cooled units at ambients above 50 °C is not permitted because of limitations on the allowable fan operating temperature.

5) Load values, (DC current), as a function of installation altitude (refer to P077 Operating Instructions, Section 11).

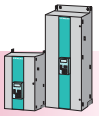


Curve b1: Reduction factor of load values (DC current) at installation altitudes above 1000 m.
No derating of the supply voltages to any circuits is required up to an installation altitude of 5000 m for basic insulation.

6) Requirements to achieve control stability:
The control stability (closed-loop PI control) is referred to the rated motor speed and applies when the SIMOREG converter is warm.
The following conditions are applicable:
- Temperature changes of ±10 °C
- Line voltage changes corresponding to +10 %/–5 % of the rated input voltage
- Temperature coefficient of temperature-compensated tachometer 0.15 ‰ per 10 °K (applies only to analog tachometer)
- Constant setpoint (14-bit resolution)
- Motor, load, and encoder are correctly aligned and the load is balanced.

7) Overload:
Following operation at rated load, base drive panels are capable of carrying 150 % of rated load for 1 minute, followed by a period of light load operation of such duration that the rms load does not exceed rated continuous current.
Base drive panels are designed for operation with heatsink air inlet temperatures up to 45 °C.
Applicable standards
UL508A
National Electrical Code 1999

Base drive panel technical data



1180 A and 1660 A Base drive panel, 3 AC 460 V, single- and four-quadrant

Model No.		6RA70@@-2F...-0	
		91	94
Rated supply voltage armature [1]	V	3-phase 460 (+10 %/–5 %)	
Rated input current armature [2]	A	1000	1401
Fan type	V	3-phase 460	
Air flow rate	ft^3/min	824	
Fan noise level	dBA	88	
Rated supply voltage field	V	1-phase 460 (+10 %)	
Rated frequency	Hz	45 to 65 Hz self-adapting (armature and field are independent)	
Rated DC voltage [3]	V	500	
Rated DC armature current	A	**1180**	**1660**
Overload capability 60 s [7]		150 % of rated DC current	
Rated output at 500 V DC	HP	700	1000
Rated output at 240 V DC	HP	350	500
Power loss at rated DC current (approximately)	W	6115	7930
Rated DC voltage field	V	300	
Rated DC current field	A	**40**	
Operational ambient temperature	°C	0 to 45 at I_{rated} forced-cooled [4]	
Storage and transport temperature	°C	–25 to +70	
Installation altitude above sea level		≤ 1000 m at rated DC current [5]	
Control stability		Δ_n = 0.006 % of the rated motor speed, valid for pulse encoder operation and digital setpoint Δ_n = 0.1 % of the rated motor speed, valid for analog tachometer or analog setpoint [6]	
Degree of protection		Open chassis (IP 00)	
Dimensions		See dimension drawings page 6/18 and 6/19	
Weights (approx.)	lb	725	755

Note

These armature converters are capable of operating at 575 V AC however a separate 3-phase supply rated at either 230 or 460 V AC is required for the field supply, cooling fan, and control power supply.

1) Operation with reduced input voltage will result in reduced maximum output voltage accordingly.

2) Values apply for rated DC output current on both the armature and field circuits.

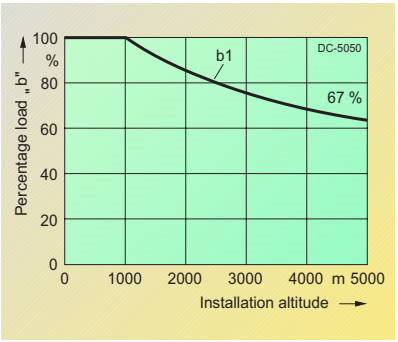
3) The specified output DC voltage can be guaranteed up to an undervoltage of 5 % of rated line voltage.

4) The table below gives load values, (DC current), as a function of ambient temperature surrounding the base drive panel, (refer to P077 Operating Instructions, Section 11).
Note, Important: When base drive panels are installed into enclosures, make sure the temperature inside does not exceed 45 °C, otherwise derate the DC current rating per the table below.

Ambient temperature	% reduction in base drive DC ampere rating	
	Self-cooled converters (15, 30, 60, 100 A DC)	Fan-cooled converters (140 – 1660 A DC)
+40 °C	– 0 %	–0 %
+45 °C	– 0 %	–0 %
+50 °C	– 6 %	–5 %[a]
+55 °C	–11 %	–5 %[a]
+60 °C	–18 %	–5 %[a]

a) Operation of fan cooled units at ambients above 50 °C is not permitted because of limitations on the allowable fan operating temperature.

5) Load values, (DC current), as a function of installation altitude (refer to P077 Operating Instructions, Section 11).



Curve b1: Reduction factor of load values (DC current) at installation altitudes above 1000 m.
No derating of the supply voltages to any circuits is required up to an installation altitude of 5000 m for basic insulation.

6) Requirements to achieve control stability:
The control stability (closed-loop PI control) is referred to the rated motor speed and applies when the SIMOREG converter is warm.
The following conditions are applicable:
- Temperature changes of ±10 °C
- Line voltage changes corresponding to +10 %/–5 % of the rated input voltage
- Temperature coefficient of temperature-compensated tachometer 0.15 ‰ per 10 °K (applies only to analog tachometer)
- Constant setpoint (14-bit resolution)
- Motor, load, and encoder are correctly aligned and the load is balanced.

7) Overload:
Following operation at rated load, base drive panels are capable of carrying 150 % of rated load for 1 minute, followed by a period of light load operation of such duration that the rms load does not exceed rated continuous current.
Base drive panels are designed for operation with heatsink air inlet temperatures up to 45 °C.
Applicable standards
UL508A
National Electrical Code 1999

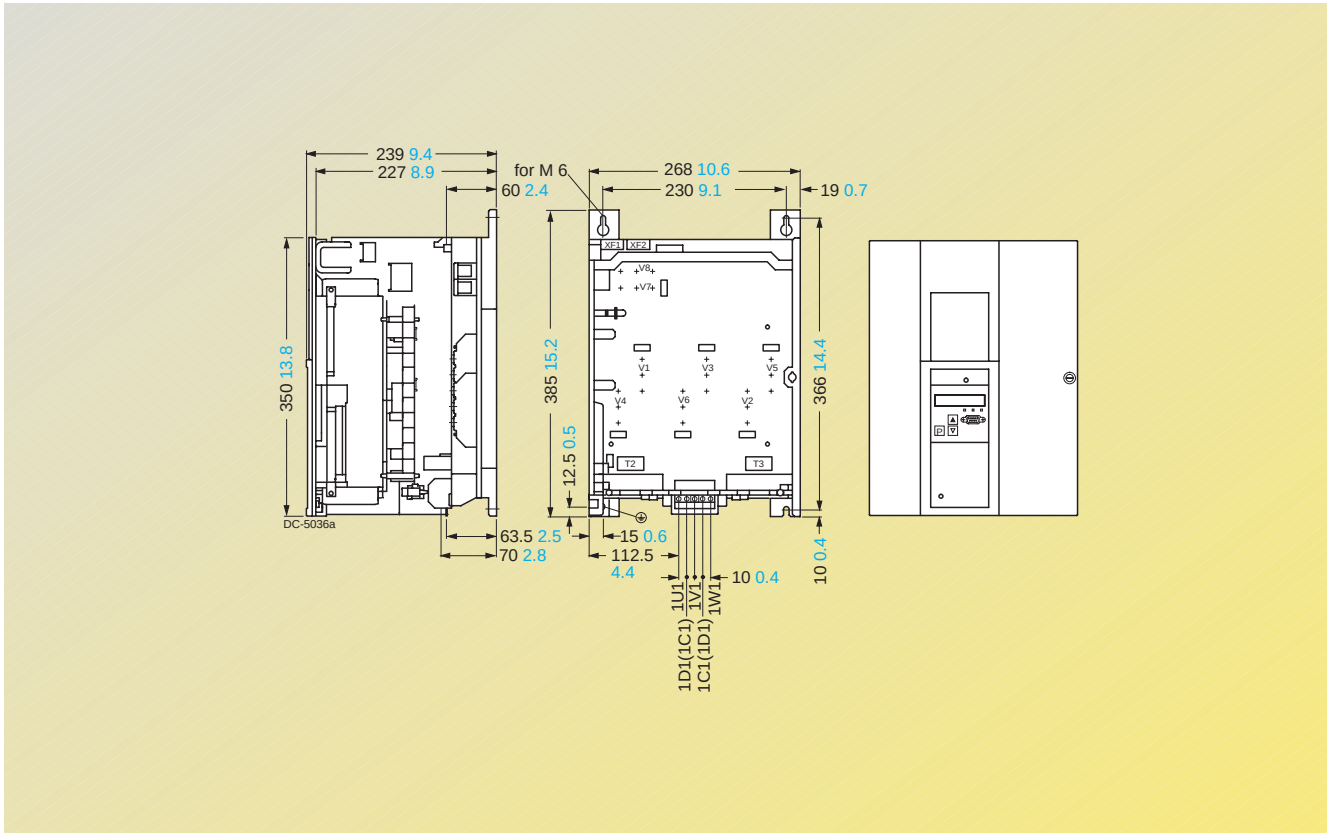


Fig. 6/1 Dimension drawings for US rated
15 A Power modules

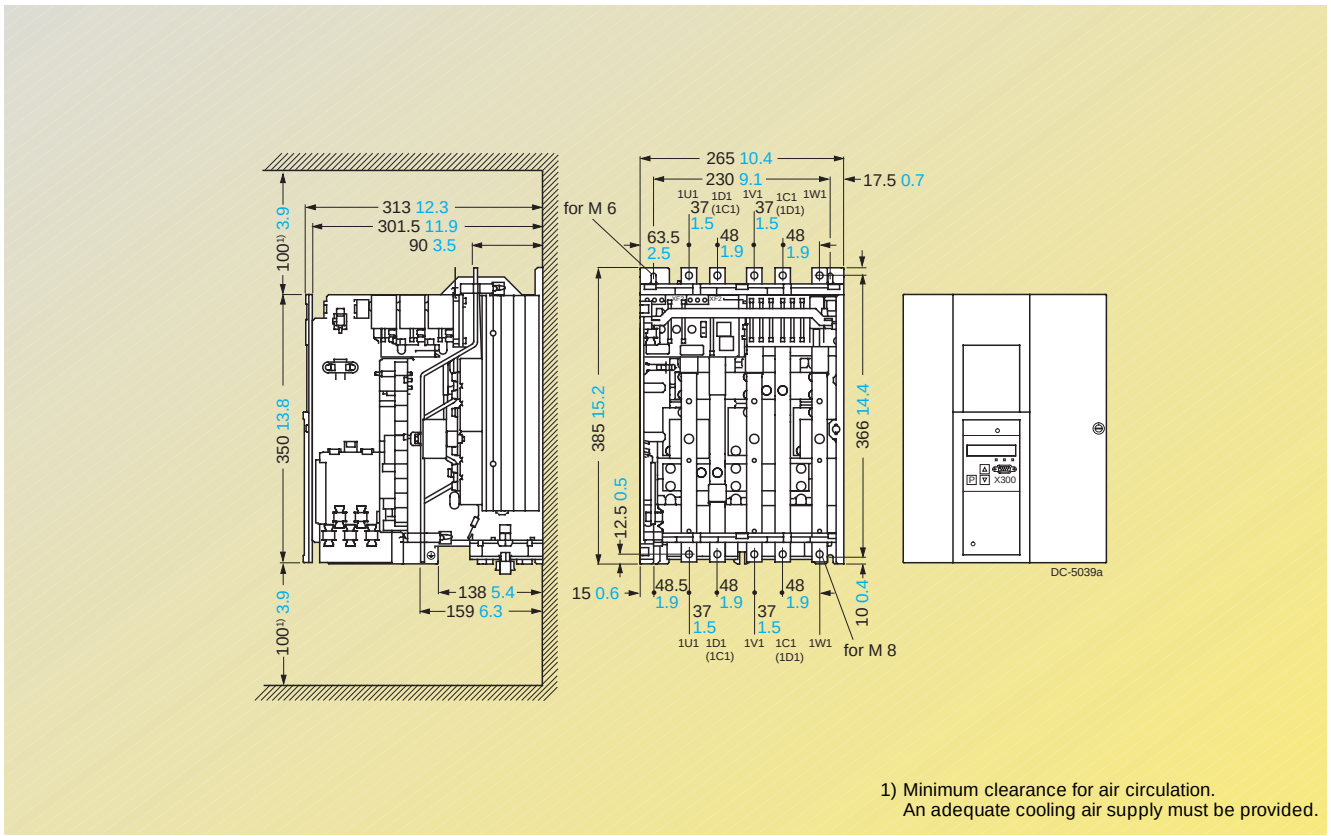


Fig. 6/2 Dimension drawings for US rated
30 to 210 A Power modules

Dimension in inches
Dimension in mm

Power modules dimension drawings

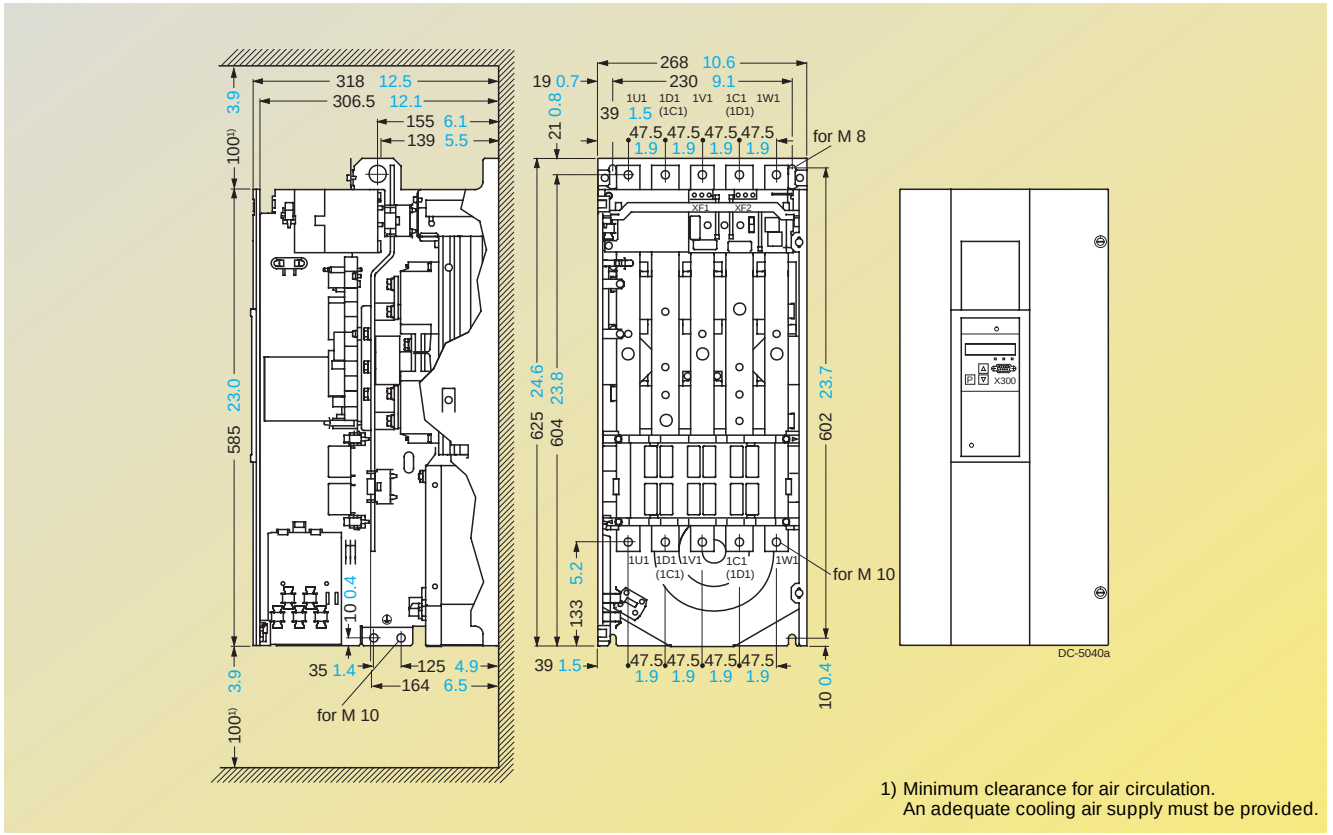


Fig. 6/3 Dimension drawings for US rated
255 and 430 A Power modules

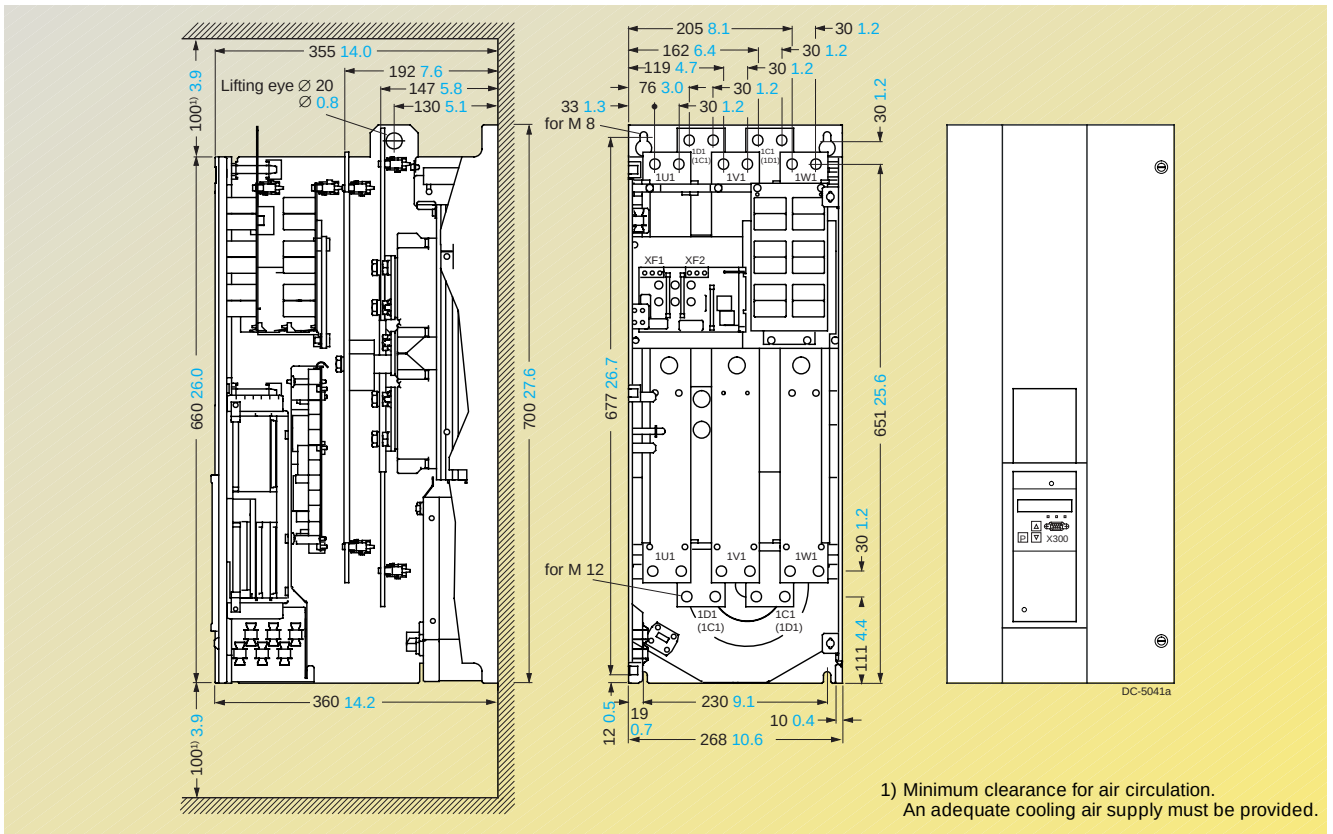


Fig. 6/4 Dimension drawings for US rated
510 A Power modules

Dimension in inches
Dimension in mm

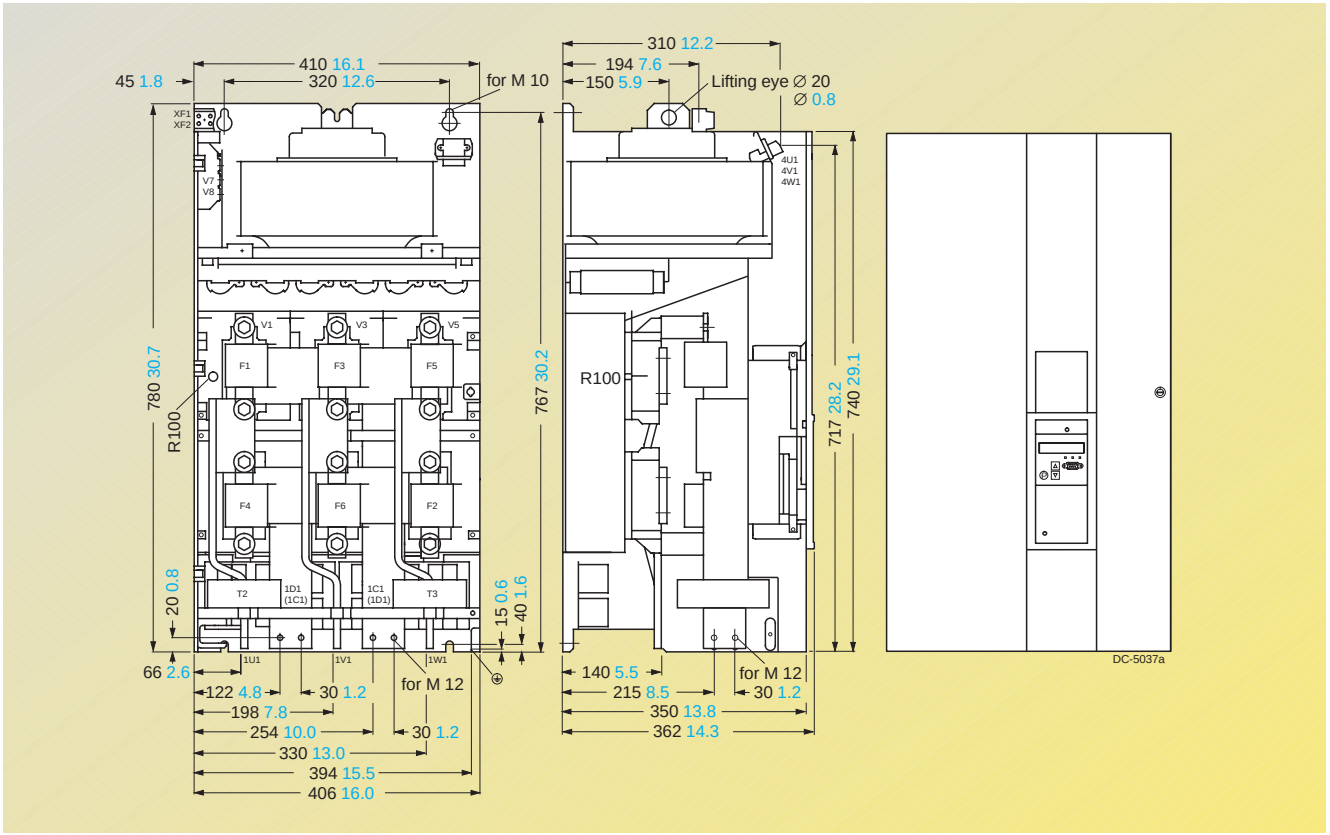


Fig. 6/5 Dimension drawings for US rated
850 A Power modules

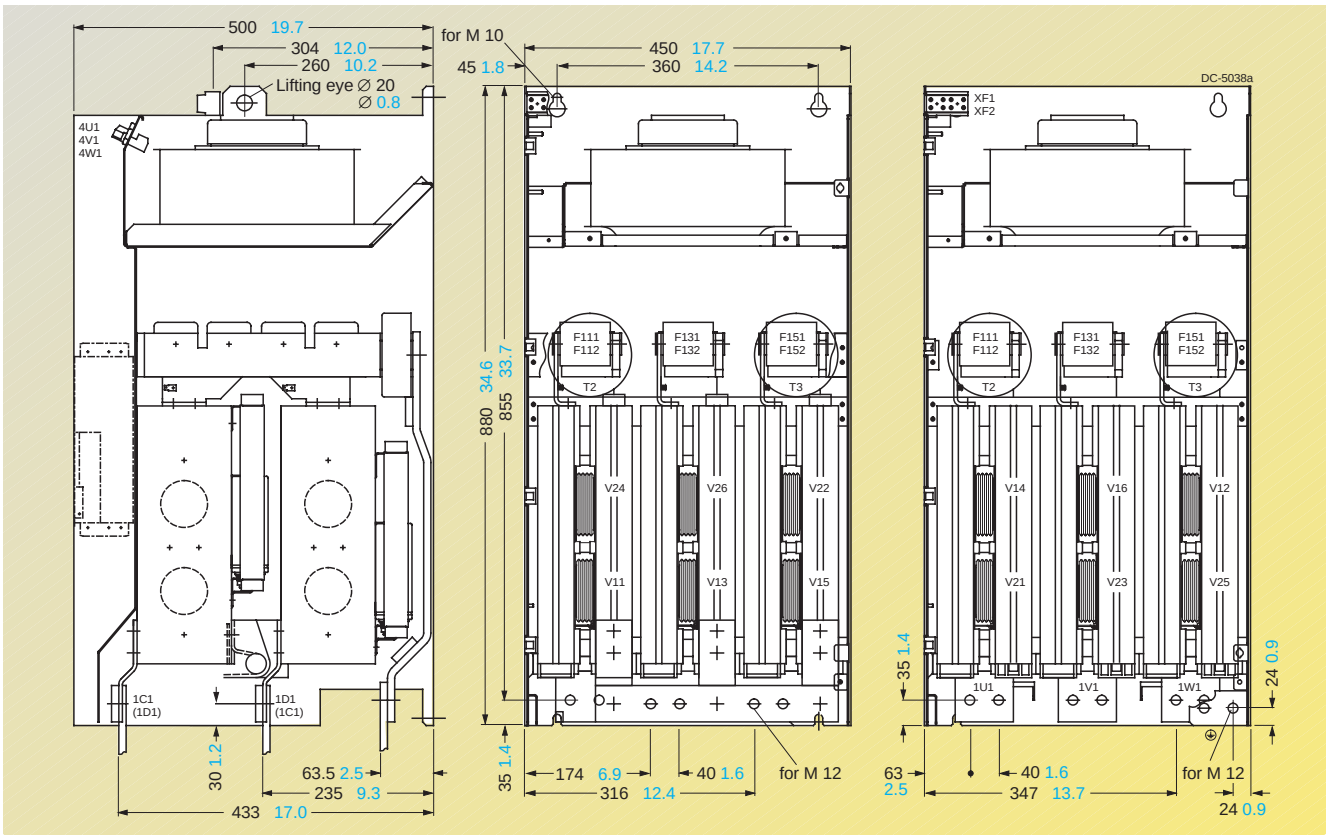


Fig. 6/6 Dimension drawings for US rated
1180 A, 1660 A and 1680 A Power modules

Dimension in inches
Dimension in mm

Base drive panel dimension drawings

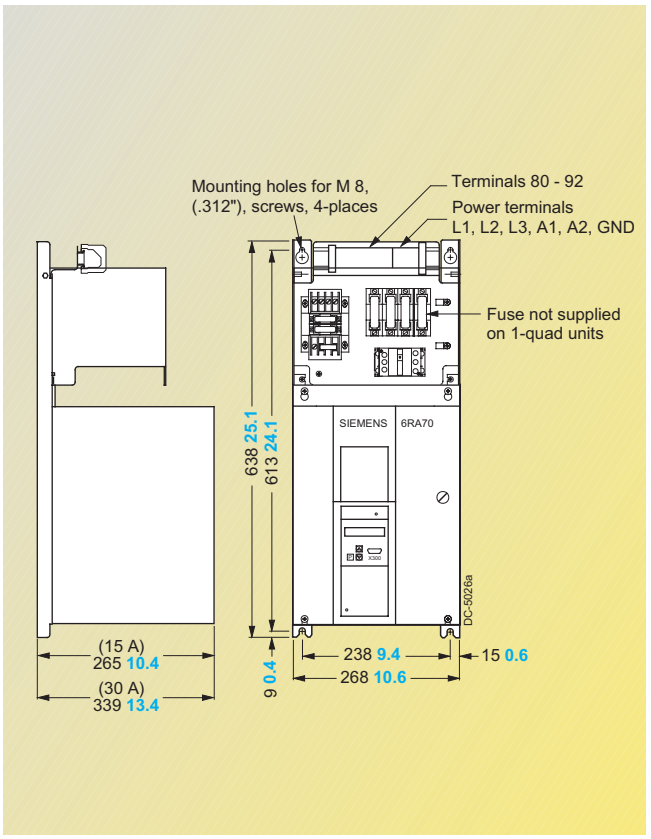


Fig. 6/7
15 – 30 A Base drive panel

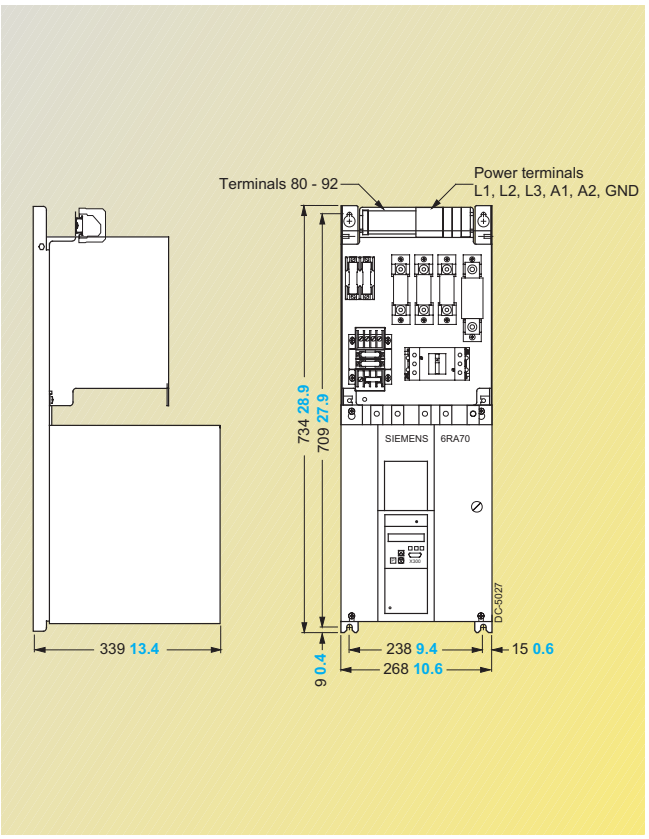


Fig. 6/8
60 A Base drive panel

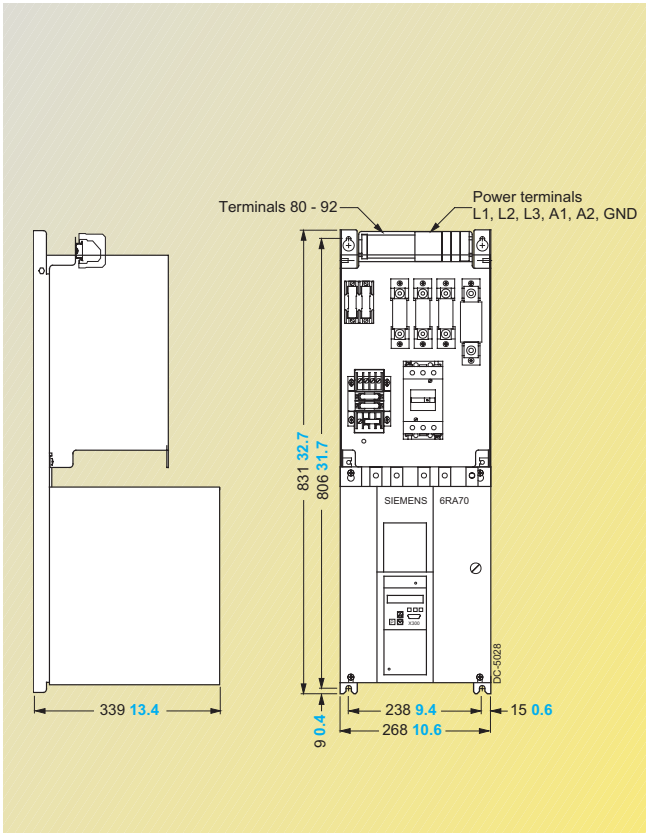


Fig. 6/9
100 A Base drive panel

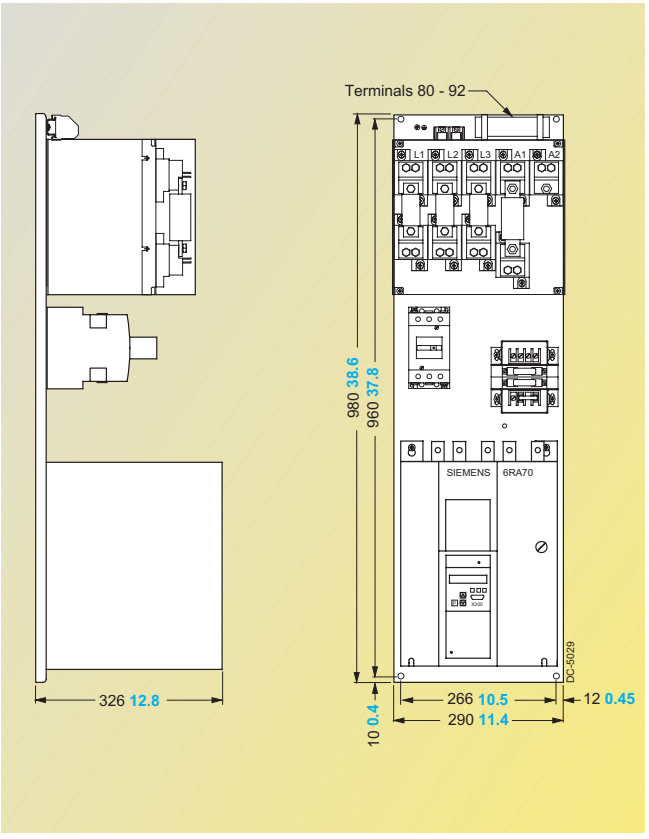


Fig. 6/10
140 A Base drive panel

Dimension in inches
Dimension in mm

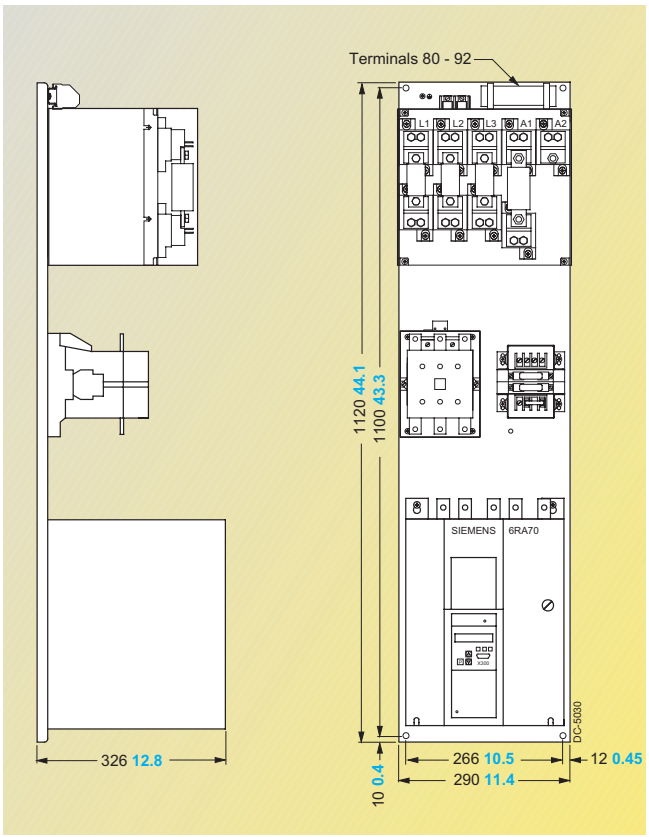


Fig. 6/11
210 A Base drive panel

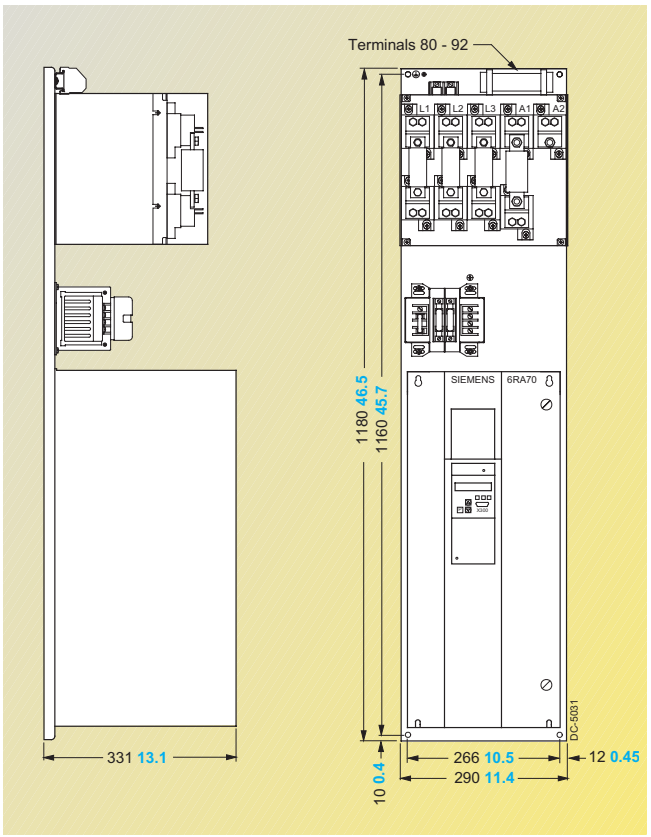


Fig. 6/12
255 A Base drive panel

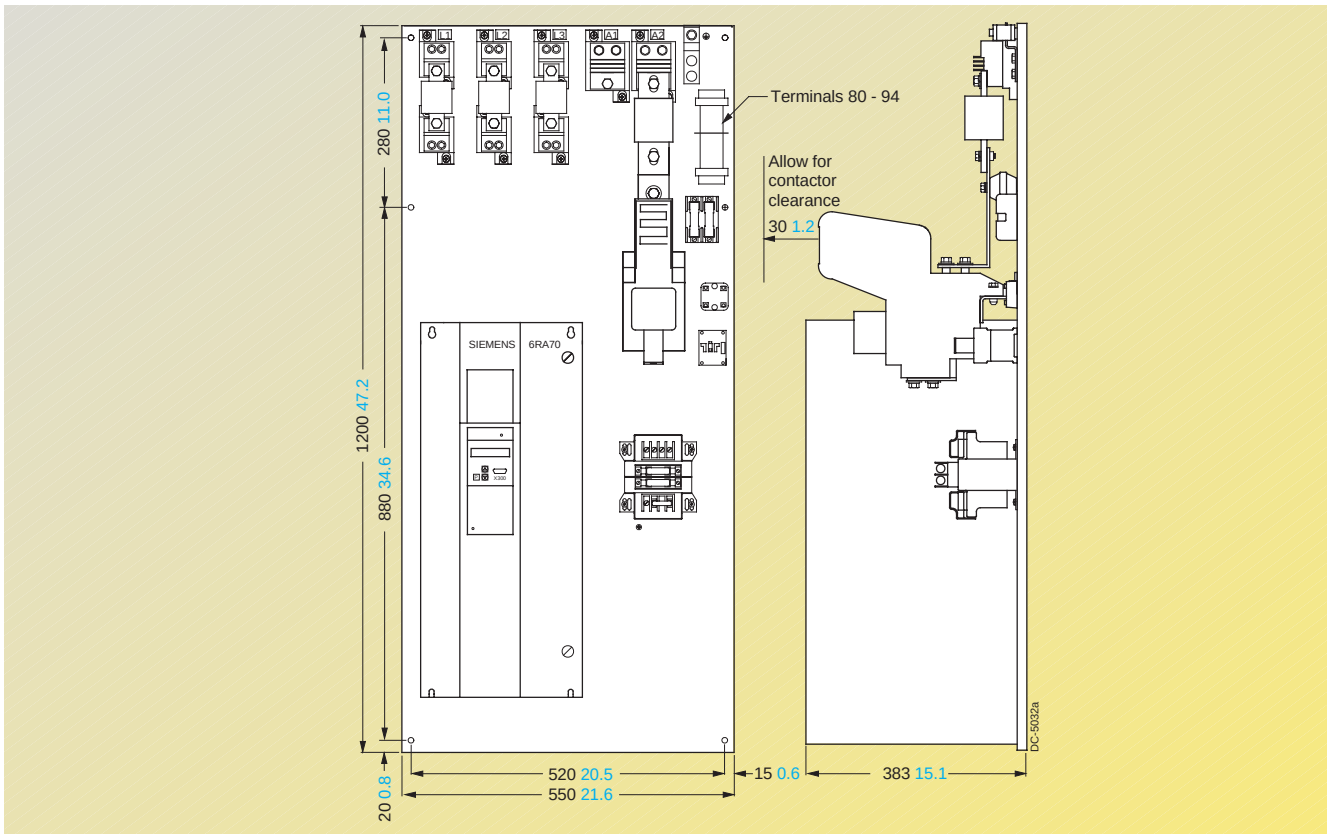


Fig. 6/13
430 A Base drive panel

Dimension in inches
Dimension in mm

6

Base drive panel dimension drawings

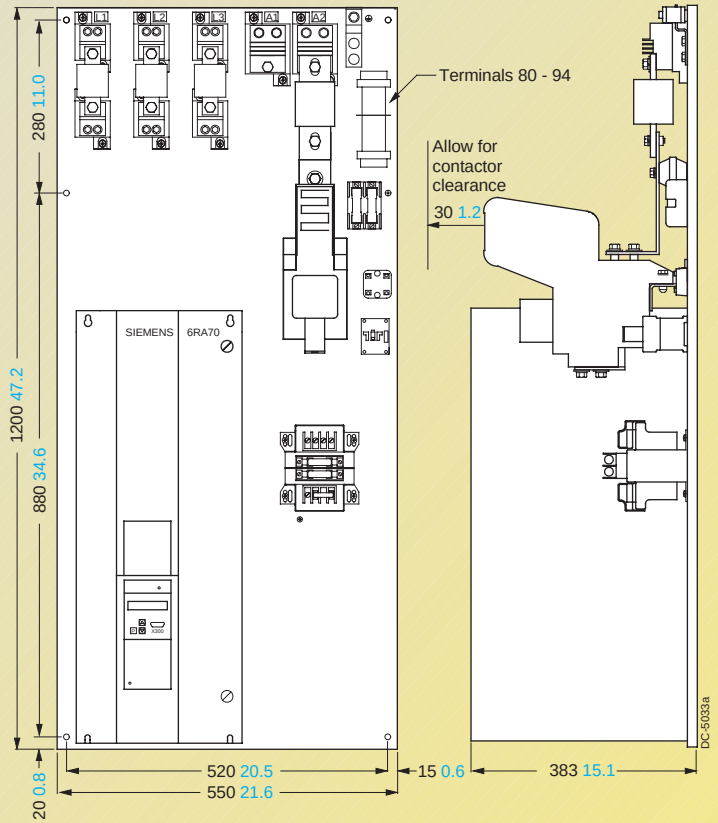


Fig. 6/14
510 A Base drive panel

Dimension in inches
Dimension in mm

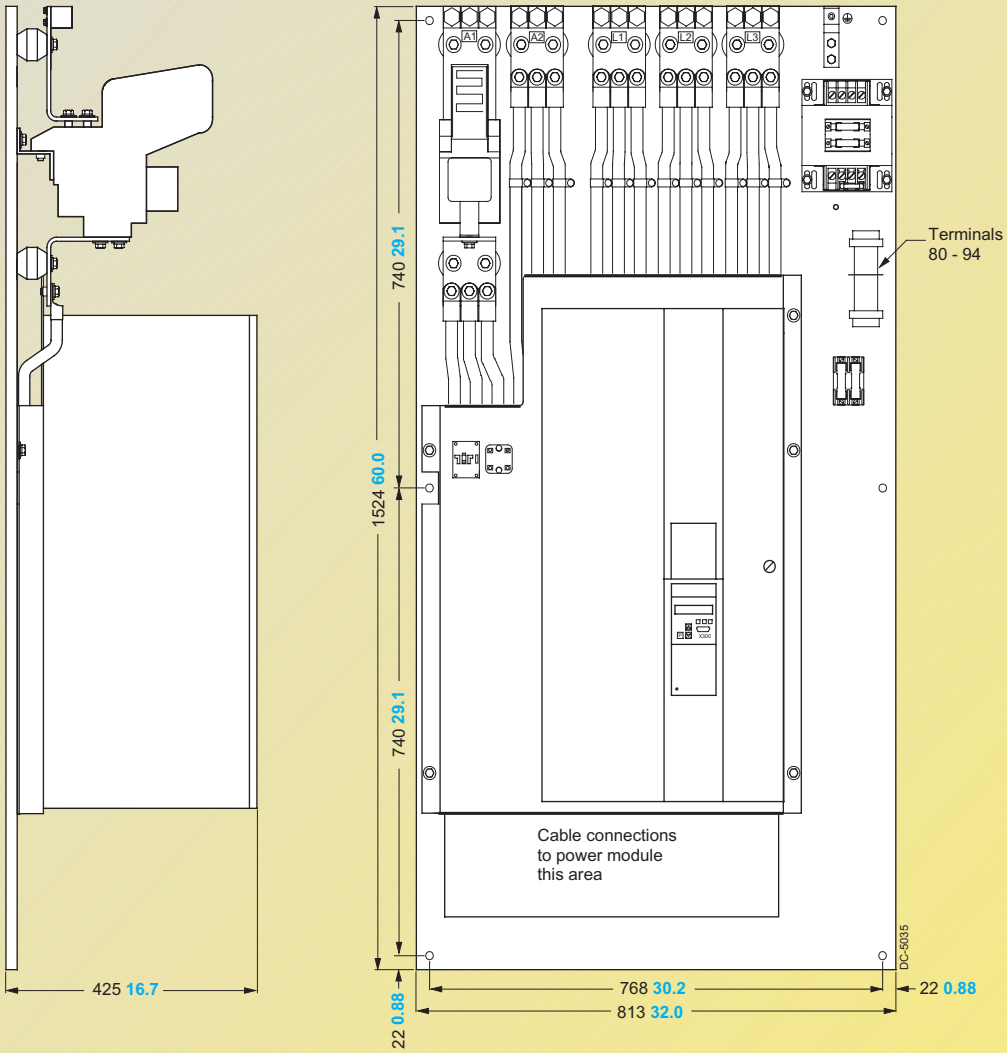


Fig. 6/15
850 A Base drive panel

Dimension in inches
Dimension in mm

6

Base drive panel dimension drawings

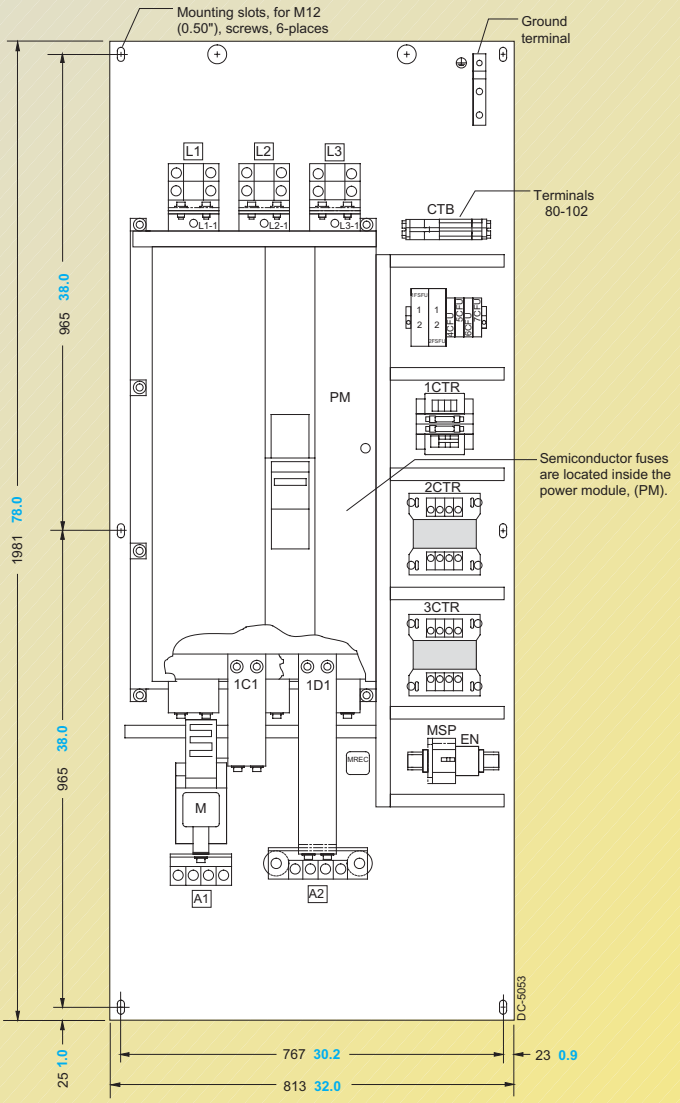


Fig. 6/16
1180 A Base drive panel

Dimension in inches
Dimension in mm

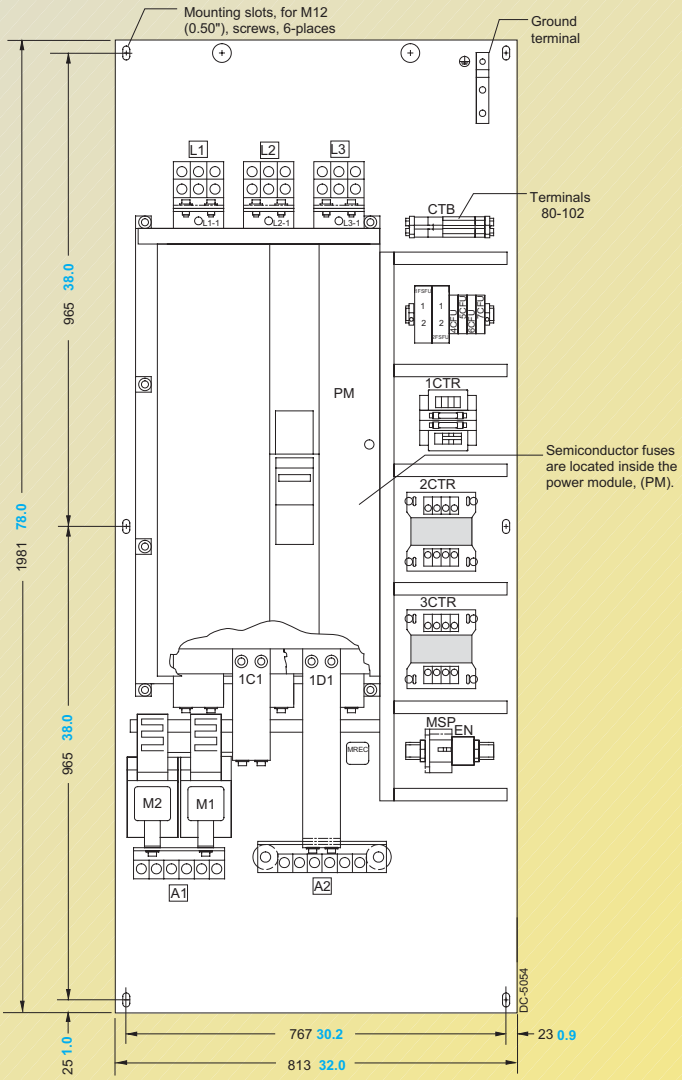
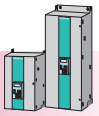


Fig. 6/17
1660 A Base drive panel

Dimension in inches
Dimension in mm

6

Power connections



6RA70
DC MASTER

Power connections must be made using cable with the proper ratings as defined by the National Electric Code and other state or local codes. SIMOREG 6RA70 units can accommodate various cable sizes as indicated below.

Power modules at the US rating of 15 A include compression type terminal blocks for power connections. Power modules at US ratings from 30 A to 1660 A use bolted connections and require that a compression ring tongue terminal be connected to the cable end.

On base drive panel ratings 100 A and lower power connections are made on the supplied terminal blocks at the top of the panel. On base drive panel units above 100 A cable compression points are supplied at the top of the panel assembly for ease of connection.

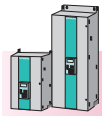
Power modules

Rating	Cable range	Recommended torque
15 A	#14 to #6 AWG (AC & DC)	11 lb-in

Rating	Terminals	Bolt size
30 – 210 A	1U, 1V, 1W, 1C1, 1D1	M8 (metric), $^{5}/_{16}$" (English)
255 – 430 A	1U, 1V, 1W, 1C1, 1D1	M10 (metric), $^{3}/_{8}$" (English)
510 – 850 A	1U, 1V, 1W, 1C1, 1D1	M12 (metric), $^{3}/_{8}$" (English)
1180 – 1660 A	1U, 1V, 1W, 1C1, 1D1	M12 (metric), $^{3}/_{8}$" (English)

Base drive panel

Rating	Terminals	Recommended torque
15 A	#14 to #6 AWG (AC & DC)	12 lb-in
30 A	#14 to #6 AWG (AC & DC)	12 lb-in
60 A	#10 to #2 AWG (AC & DC)	26 lb-in
100 A	#10 to #2 AWG (AC & DC)	26 lb-in
140 A	2 cables per connection #6 AWG to 250 MCM (AC & DC)	275 lb-in
210 A	2 cables per connection #6 AWG to 250 MCM (AC & DC)	275 lb-in
255 A	2 cables per connection #6 AWG to 250 MCM (AC & DC)	275 lb-in
430 A	2 cables per connection #6 AWG to 250 MCM (AC) #6 AWG to 500 MCM (DC)	275 lb-in 375 lb-in
510 A	2 cables per connection #6 AWG to 500 MCM (AC & DC)	375 lb-in
850 A	3 cables per connection #6 AWG to 500 MCM (AC & DC)	375 lb-in
1180 A	6 cables per connection #6 AWG to 500 MCM (AC & DC)	375 lb-in
1660 A	6 cables per connection #6 AWG to 500 MCM (AC & DC)	375 lb-in



Parallel connection of power modules

SIMOREG 6RA70 power modules can be connected in parallel as part of a design to increase the output power or achieve redundancy. The optional CUD2 terminal expansion board is required for each converter in a parallel connection. The CUD2 features 2 connectors for the parallel interface via which the firing pulses for the other parallel-connected converters are transferred.

The following guidelines must be adhered to with parallel converter designs.

The same phase sequence is required between 1U1/1V1/1W1.

The same phase sequence is required between 1C1/1D1.

The converters are connected by means of an (8-pin) shielded Patch cable of type UTP CAT5 according to ANSI/EIA/TIA 568, such as those used in PC networking.
A standard 5 m cable can be ordered directly from Siemens (Order No.: 6RY1707-0AA08). (n-1) cables are needed to connect n converters in parallel. The bus terminator must be activated (U805 = 1) on the converter at each end of the bus.

Base drive panel units are not recommended for paralleling due to their individual contactor design. Operation in this configuration may void warranty.

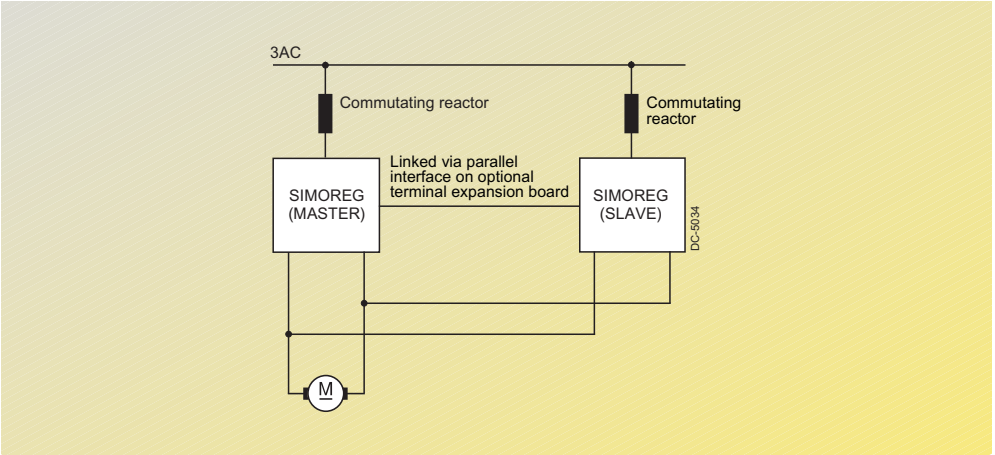


Fig. 6/18
Parallel connection of SIMOREG converters

The motor field must only be connected to the master convertor.

The terminal expansion option (CUD2) is required for each converter in a parallel connection.

A maximum of 6 converters can be connected in parallel.
When several converters are connected in parallel, the master unit should be positioned in the center to allow for signal transit times. Maximum length of paralleling interface cable between master and slave converters at each end of bus: 15 m.

For the purpose of current distribution, separate commutating reactors of the same type are required for each SIMOREG converter. Current distribution is determined by the differential reactor tolerance. A tolerance of 5 % or higher is recommended for operation without derating (reduced current).

Caution!

Parallel connections may only be made between converters with the same DC current rating!

SIMOREG for supplying high inductances

For supplying high inductances such as the fields of large DC or synchronous motors or solenoids, the gating unit is switched to long pulses via a parameter setting. Long pulses ensure reliable triggering of thyristors for high-inductance equipment. In such cases, the converter armature circuit (terminals 1C1/1D1) is not used to supply DC motors, but large-scale field windings.

Note

An external snubber circuit (e.g. resistor or block varistor) must be provided at the DC voltage output of the converter.

Typical base drive panel connection diagrams

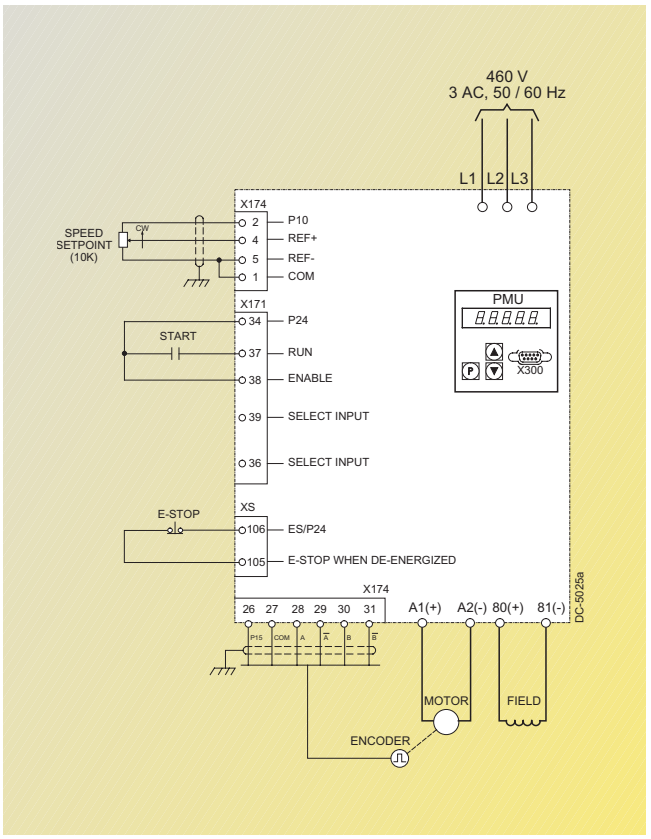


Fig. 6/19
6RA70 Base drive panel typical connection diagram
(analog setpoint with on/off switch)

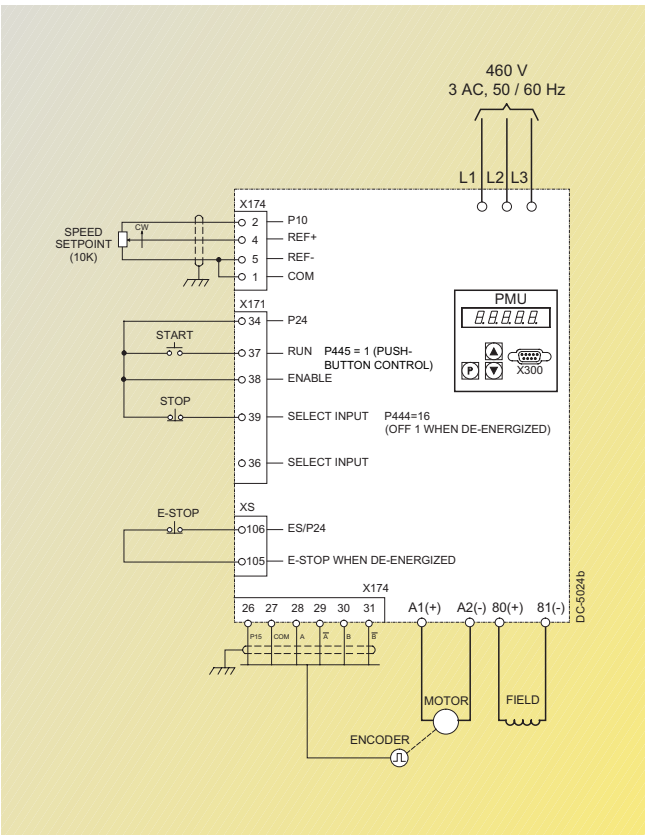


Fig. 6/20
6RA70 Base drive panel typical connection diagram
(analog setpoint with push-button control)

SIMOREG 6RA70 DC MASTER SIMOREG CM

7

SIMOREG CM

Application

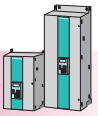
Fig. 7/1
SIMOREG CM

An important application for the SIMOREG CM converter is in the retrofitting and modernization of DC drives in existing systems.

In the field of DC drives, many systems exist that are older than 5 or 10 years and that still use analog technology.

On retrofitting or updating these systems, the motor, mechanical components and power section are retained and only the closed-loop control section is replaced by a 6RA70 Control Module. This is an extremely economical way to obtain a modern DC drive with the complete functional scope of the well-proven, fully digital converters of the SIMOREG DC MASTER series.

6RA70
DC MASTER



It is easily adapted to the configuration of the existing components by setting parameters.

The 6RA70 Control Module contains a power section for supplying the field with a rated current of up to 40 A.

Note:

6RA70 CM is only available through qualified Siemens Solution Providers.

Design

The 6RA70 Control Module is characterized by its compact, space-saving design. The compact construction makes it especially easy to service since individual components are easily accessible. The electronics box contains the basic electronics as well as any supplementary boards.

To support optimum utilization of the installation possibilities in the system, the 6RA70 Control Module can be separated in its depth. Furthermore, the PCBs for firing pulse generation and distribution as well as for fuse monitoring and voltage measurement are designed to be removed and mounted either partially or completely outside the unit directly on the power section and connected to the basic unit via cables.

All 6RA70 Control Modules are equipped with a PMU simple operator panel in the door of the unit. The PMU consists of a five-digit, seven-segment display, three LEDs as status indicators and three parameterization keys. The PMU also features connector X300 with a USS interface in compliance with the RS232 or RS485 standard.

The panel provides all the facilities required during start-up for making adjustments or settings and displaying measured values.

The optional OP1S converter operator panel can be mounted either in the converter door or externally, e.g. in the cubicle door. For this purpose, it can be connected up by means of a 5 m long cable. Cables of up to 200 m in length can be used if a separate 5 V supply is available. The OP1S is connected to the SIMOREG CM unit via connector X300.

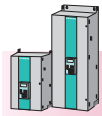
The OP1S can be installed as an economic alternative to control cubicle measuring instruments which display physical measured quantities.

The OP1S features an LCD with 4 x 16 characters for displaying parameter names in plain text. English, German, French, Spanish and Italian can be selected as the display languages.

The OP1S can store parameter sets for easy downloading to other devices.

The converter can also be parameterized via the serial interface of the basic unit by means of a generally available PC and appropriate software. This PC interface is used for start-up, for maintenance during shutdown and for diagnosis during operation and is, therefore, a service interface. Upgrades of the converter software that is stored in Flash memory can also be loaded via this interface.

The field is supplied by a single-phase, semi-controlled dual pulse bridge connection B2HZ. The power section for the field is constructed with galvanically isolated thyristor modules; the heat sink is therefore at floating potential.



6RA70
DC MASTER

Technical data

Type 6RA7000-0MV62-0Z+X01

Measurable rated supply voltage armature	**V**	85/250/575/1000
Rated supply voltage electronics supply	**V**	2-ph. AC 380 (–25 %) to 460 (+15 %); I_n = 1 A or 1-ph. AC 190 (–25 %) to 230 (+15 %); I_n = 2 A (–35 % for 1 min)
Rated supply voltage field [1]	**V**	2-ph. AC 400 (+15 %/–20 %) 2-ph. AC 460 (+10 %)
Rated frequency	**Hz**	The converters automatically adjust to the connected line frequency within a frequency range of 45 to 65 Hz [2]
Rated DC voltage field [1]	**V**	Max. 325/373
Rated DC current field	**A**	**40**
Operational ambient temperature	**°C**	0 to +60
Storage and transport temperature	**°C**	–25 to +70
Control stability		Δ_n = 0.006 % of the rated motor speed, valid for pulse encoder operation and digital setpoint Δ_n = 0.1 % of the rated motor speed, valid for analog tacho and analog setpoint [3]
Environmental class	**EN 60721-3-3**	3K3
Degree of protection	**EN 60529**	IP 00
See dimension drawing on Page		7/6
Weight approx.	**kg**	15

Standards

DIN VDE 0106 Part 100	Protection against electric shock; location of actuators near live parts.
DIN VDE 0110 Part 1	Insulation coordination for electrical equipment in low-voltage installations. Pollution Severity 2 for boards and power section. Only non-conductive pollution is permissible. Temporary conductivity must however be accepted due to condensation. "Dewing is not permitted because the components are only approved for Humidity Class F"
EN 60146 T1-1/DIN VDE 0558 T11	Semiconductor converters General requirements and line-commutated converters
DIN EN 50178/DIN VDE 0160	Regulations for the equipment of electrical power installations with electronic equipment.
EN 61800-3	Variable-speed drives, Part 3, EMC product standard including special test procedures
DIN IEC 60 068-2-6 acc. to degree of severity 12 (SN29010 Part 1)	Mechanical stress

Selection and Ordering Data

Rated data						**SIMOREG CM**	**Fuses**
Armature circuit				Field circuit			Excitation circuit
Rated supply voltage [1]	Rated DC voltage	Rated DC current	Rated output	Rated supply voltage [1]	Rated DC current		Each unit
V	V	A	kW	V	A	Order No.:	Order No.:
3 AC 85/250/575/1000	–	–	–	2-ph. AC 460	40	**6RA7000-0MV62-0Z+X01**	3NE1802-0 (UL-recognized)

Options see page 7/6.

1) The field supply voltage can be less than the rated supply voltage field (set with Parameter P078.002; input voltages of up to 85 V are permissible). The output voltage is reduced accordingly. The specified output DC voltage can be guaranteed up to undervoltages 5 % below the supply voltage (rated supply voltage field).

2) Adaptation to the line frequency within a frequency range of 23 Hz to 110 Hz via separate parameterization is available on request.

3) Conditions:

The control stability (PI control) is referred to the rated motor speed and applies when the SIMOREG converter is warm. The following conditions are applicable:

- Temperature changes of ±10 °C
- Line voltage changes corresponding to +10 %/ 5 % of the rated input voltage
- Temperature coefficient of temperature-compensated tacho-generators 0.15 ‰ per 10 °C (applies only to analog tacho-generator)
- Constant setpoint (14-bit resolution)

SIMOREG CM

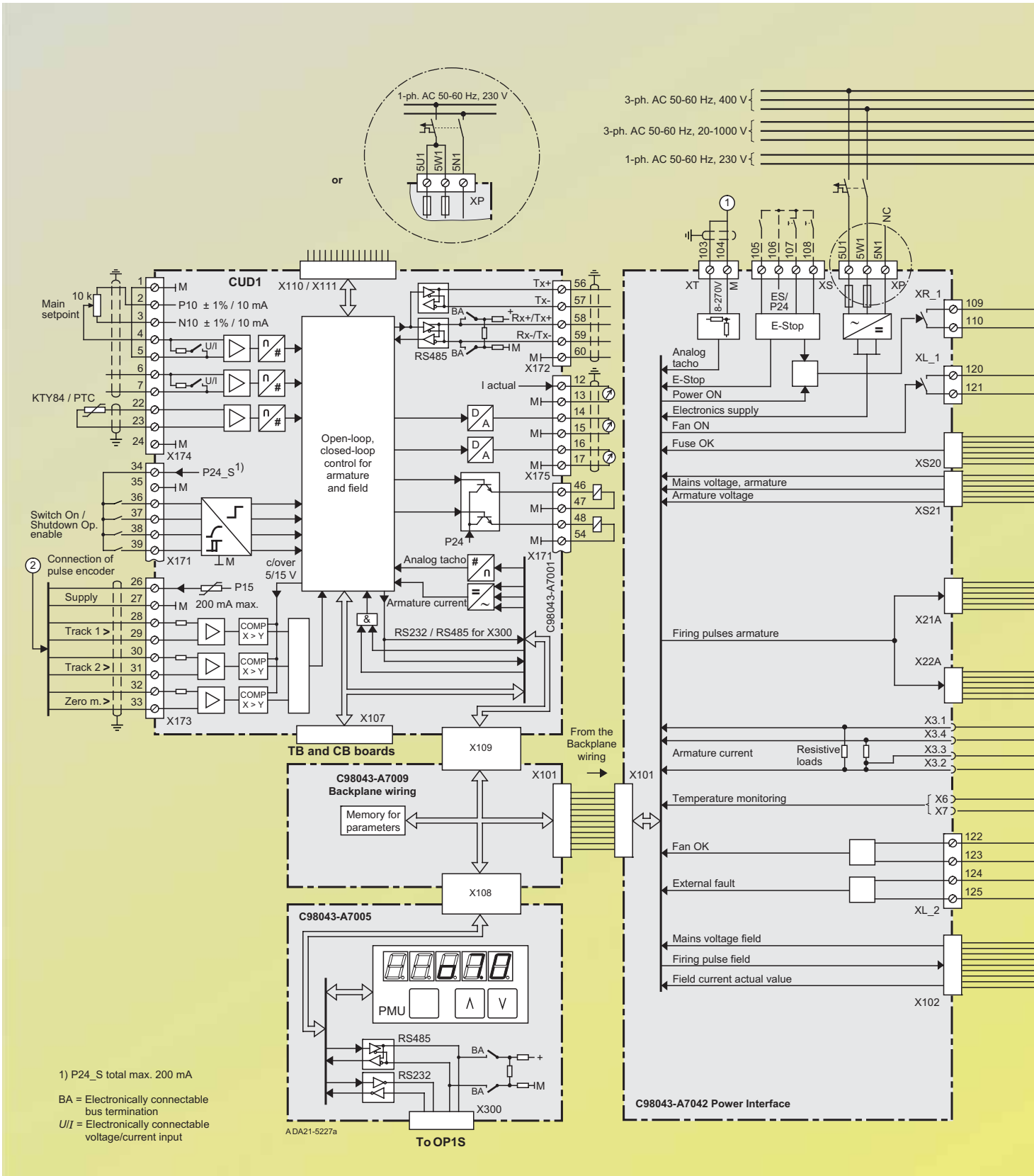
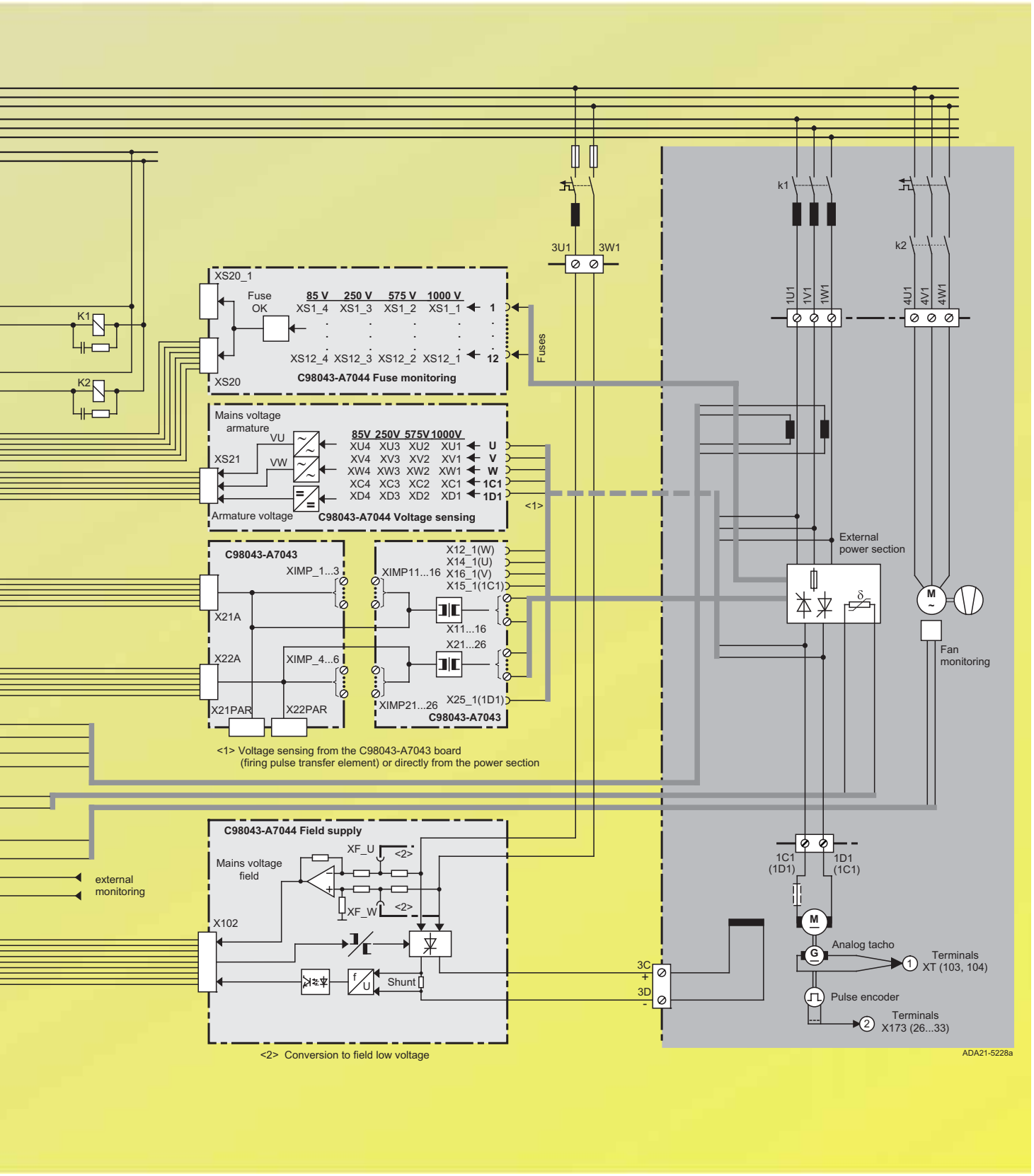
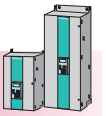


Fig. 7/2


K1
K2
3U1
3W1
k1
k2
1U1
1V1
1W1
4U1
4V1
4W1
XS20_1
Fuse OK
85 V 250 V 575 V 1000 V
XS1_4 XS1_3 XS1_2 XS1_1
1
XS12_4 XS12_3 XS12_2 XS12_1
12
XS20
C98043-A7044 Fuse monitoring
Fuses
Mains voltage armature
VU
VW
XS21
85V 250V 575V 1000V
XU4 XU3 XU2 XU1 U
XV4 XV3 XV2 XV1 V
XW4 XW3 XW2 XW1 W
XC4 XC3 XC2 XC1 1C1
XD4 XD3 XD2 XD1 1D1
Armature voltage
C98043-A7044 Voltage sensing
<1>
External power section
C98043-A7043
XIMP_1...3
X21A
X22A
XIMP_4...6
X21PAR
X22PAR
XIMP11...16
X12_1(W)
X14_1(U)
X16_1(V)
X15_1(1C1)
X11...16
X21...26
XIMP21...26
X25_1(1D1)
C98043-A7043
Fan monitoring
<1> Voltage sensing from the C98043-A7043 board
(firing pulse transfer element) or directly from the power section
C98043-A7044 Field supply
Mains voltage field
XF_U
XF_W
<2>
X102
external monitoring
Shunt
3C
3D
1C1 (1D1)
1D1 (1C1)
Analog tacho
Terminals XT (103, 104)
Pulse encoder
Terminals X173 (26...33)
<2> Conversion to field low voltage
ADA21-5228a

Options



The SIMOREG CM can be subdivided into several modules. These modules can be mounted separately

Sets of preassembled cables are available as options for interconnecting the separate modules of the CM unit.

This allows fast, flexible adaptation to system requirements.

Description	Connection	Cable length ft (m)	Order No.:
Preassembled ribbon cable set 2 off 26-core ribbon cable, shielded 2 off 10-core ribbon cable, shielded 1 off 20-core ribbon cable, shielded	From X21A, X22A on FBG -A7042- to X21A, X22A on FBG -A7043- From XS20, XS21 on FBG -A7042- to XS20, XS21 on FBG -A7044- From X102 on FBG -A7042- to X102 on FBG -A7044-	9.84 (3) 32.8 (10)	**6RY1707-0CM01** **6RY1707-0CM02**
Preassembled cable set for current transformer 2 off 2-core twisted-pair cable	From X3 on FBG -A7042- to the current transformers	6.56 (2) 32.8 (10	**6RY1707-0CM03** **6RY1707-0CM04**
Preassembled cable set for heat sink temperature sensing 1 off 2-core shielded cable	From X6 and X7 on FBG -A7042- to temperature sensor on KK	32.8 (10)	**6RY1707-0CM05**
Preassembled cable set for firing pulse cables Bridging set for 12 off 2-core twisted-pair cable	From XIMP11 through XIMP16 and XIMP21 through XIMP26 to the thyristors	9.84 (3)	**6RY1707-0CM06**
Preassembled cable set for the fuse monitoring system 6 off 2-core twisted-pair cable	From XS1_. through XS12_. (according to the voltage: 85 V, 250 V, 575 V or 1000 V) to the fuses	32.8 (10)	**6RY1707-0CM07**
Preassembled cable set for voltage measurement 1 off 3-core twisted-pair cable U-V-W 1 off 2-core twisted-pair cable C-D	From XU., XV., XW. (according to the voltage: 85 V, 250 V, 575 V or 1000 V) to the supply voltage terminals From XC., XD. (according to the voltage: 85 V, 250 V, 575 V or 1000 V) to the armature voltage terminals	9.84 (3)	**6RY1707-0CM08**
Preassembled cable set for activation of the firing pulse transver devices 12 off 2-core twisted-pair cable 2 off 12-core shielded cable	From XIMP1, XIMP4 or XIMP2, XIMP5 or XIMP3, XIMP6 on FBG through A7043- (side panels) on the firing pulse transfer modules (single boards) with Terminals X11 through X16 and X21 through X26 From XIMP1, XIMP4 and/or XIMP2, XIMP5 and/or XIMP3, XIMP6 on FBG -A7043- to external firing pulse transfer devices	3.28 (1) 32.8 (10)	**6RY1707-0CM09** **6RY1707-0CM10**
Preassembled cable set for cradle in-line mounting 2 off 26-core ribbon cable 2 off 10-core ribbon cable 1 off 20-core ribbon cable	From X21A, X22A on FBG -A7042- to X21A, X22A on FBG -A7043- From XS20, XS21 on FBG -A7042- to XS20, XS21 on FBG -A7044- From X102 on FBG -A7042- to X102 on FBG -A7044-	–	**6RY1707-0CM11**

Dimension drawings

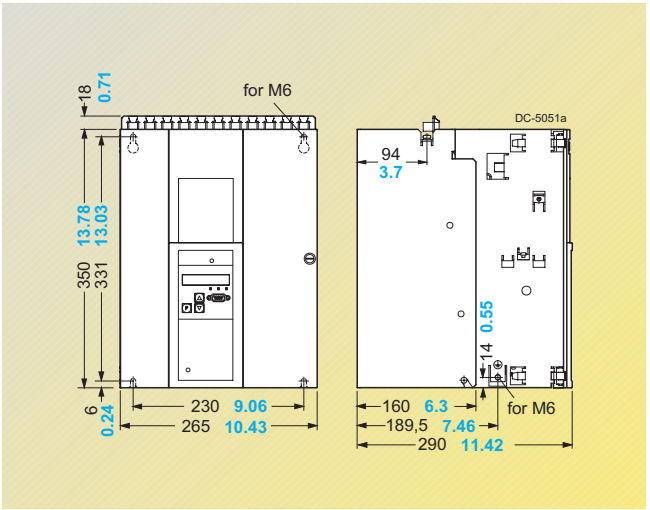


Fig. 7/3
Device components assembled (as-supplied state)

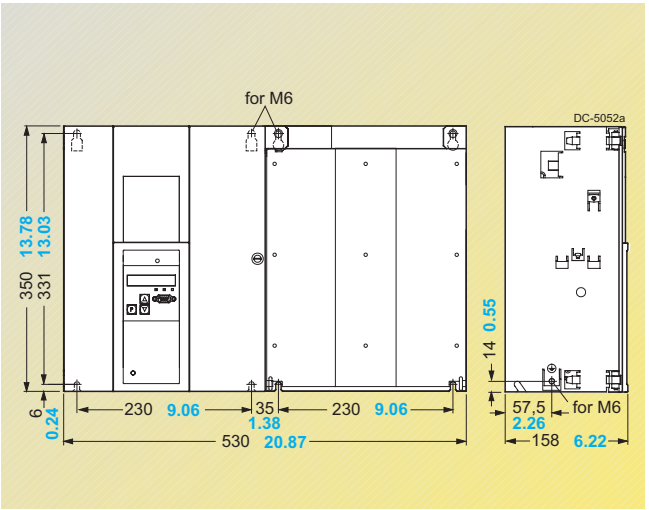


Fig. 7/4
Device components alongside each other

Dimension in inches
Dimension in mm

SIMOREG 6RA70 DC MASTER

Appendix

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Appendix

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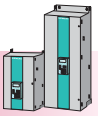

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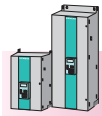
A



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DC MASTER

Order number index

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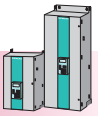
Appendix

Universal single quadrant power modules



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Rated supply voltage [1]	Type	IEC Rated DC current [2]	US Rated DC current [3]	Rated DC voltage	Rated DC current field [4]
V		A	A	V	A
AC 400	6RA7018-6DS22-0 Z+X01	30	25	DC 485	5
	6RA7025-6DS22-0 Z+X01	60	51		10
	6RA7028-6DS22-0 Z+X01	90	74		10
	6RA7031-6DS22-0 Z+X01	125	106		10
	6RA7075-6DS22-0 Z+X01	210	158		15
	6RA7078-6DS22-0 Z+X01	280	216		15
	6RA7081-6DS22-0 Z+X01	400	278		25
	6RA7085-6DS22-0 Z+X01	600	443		25
	6RA7087-6DS22-0 Z+X01	850	620		30
	6RA7091-6DS22-0 Z+X01	1200	843		30
	6RA7093-4DS22-0 Z+X01	1600	1190		40
	6RA7095-4DS22-0 Z+X01	2000	1439		40
	6RA7098-4DS22-0 Z+X01	3000	2179		85
AC 460	6RA7018-6FS22-0 Z+X01	30	15	DC 550	5
	6RA7025-6FS22-0 Z+X01	60	30		10
	6RA7028-6FS22-0 Z+X01	90	60		10
	6RA7031-6FS22-0 Z+X01	125	100		10
	6RA7075-6FS22-0 Z+X01	210	140		15
	6RA7078-6FS22-0 Z+X01	280	210		15
	6RA7082-6FS22-0 Z+X01	450	255		25
	6RA7085-6FS22-0 Z+X01	600	430		25
	6RA7087-6FS22-0 Z+X01	850	510		30
	6RA7091-6FS22-0 Z+X01	1200	850		30
AC 575	6RA7025-6GS22-0 Z+X01	60	51	DC 690	10
	6RA7031-6GS22-0 Z+X01	125	106		10
	6RA7075-6GS22-0 Z+X01	210	158		15
	6RA7081-6GS22-0 Z+X01	400	278		25
	6RA7085-6GS22-0 Z+X01	600	443		25
	6RA7087-6GS22-0 Z+X01	800	578		30
	6RA7090-6GS22-0 Z+X01	1000	700		30
	6RA7093-4GS22-0 Z+X01	1600	1190		40
	6RA7095-4GS22-0 Z+X01	2000	1660		40
	6RA7096-4GS22-0 Z+X01	2200	1680		85
	6RA7097-4GS22-0 Z+X01	2800	2024		85
AC 690	6RA7086-6KS22-0 Z+X01	720	526	DC 830	30
	6RA7088-6KS22-0 Z+X01	950	668		30
	6RA7093-4KS22-0 Z+X01	1500	1102		40
	6RA7095-4KS22-0 Z+X01	2000	1504		40
	6RA7097-4KS22-0 Z+X01	2600	1877		85
AC 830	6RA7088-6LS22-0 Z+X01	900	634	DC 1000	30
	6RA7093-4LS22-0 Z+X01	1500	1102		40
	6RA7095-4LS22-0 Z+X01	1900	1414		40
AC 950	6RA7096-4MS22-0 Z+X01	2200	1588	DC 1140	85

A

Note:

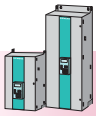
All units are 3-phase self-adapting to 50/60 Hz supplies. Z+X01 extension includes English manual and S00 technology functions.

1) 50/60 Hz.

2) IEC armature rating is a continuous current rating. Operating continuously at this rating with 40 °C ambient there is no overload capacity.

3) US armature rating allows a 150 % overload for 60 seconds with a 45 °C ambient.

4) All units contain an internal single-phase field supply. Consult manual for field voltage ratings.



6RA70 DC MASTER

Universal four quadrant power modules

Rated supply voltage [1] V	Type	IEC Rated DC current [2] A	US Rated DC current [3] A	Rated DC voltage V	Rated DC current field [4] A
AC 400	6RA7013-6DV62-0 Z+X01	15	14	DC 420	3
	6RA7018-6DV62-0 Z+X01	30	25		5
	6RA7025-6DV62-0 Z+X01	60	53		10
	6RA7028-6DV62-0 Z+X01	90	78		10
	6RA7031-6DV62-0 Z+X01	125	106		10
	6RA7075-6DV62-0 Z+X01	210	158		15
	6RA7078-6DV62-0 Z+X01	280	216		15
	6RA7081-6DV62-0 Z+X01	400	286		25
	6RA7085-6DV62-0 Z+X01	600	450		25
	6RA7087-6DV62-0 Z+X01	850	626		30
	6RA7091-6DV62-0 Z+X01	1200	842		30
	6RA7093-4DV62-0 Z+X01	1600	1190		40
	6RA7095-4DV62-0 Z+X01	2000	1405		40
	6RA7098-4DV62-0 Z+X01	3000	2179		85
AC 460	6RA7018-6FV62-0 Z+X01	30	15	DC 500	5
	6RA7025-6FV62-0 Z+X01	60	30		10
	6RA7028-6FV62-0 Z+X01	90	60		10
	6RA7031-6FV62-0 Z+X01	125	100		10
	6RA7075-6FV62-0 Z+X01	210	140		15
	6RA7078-6FV62-0 Z+X01	280	210		15
	6RA7082-6FV62-0 Z+X01	450	255		25
	6RA7085-6FV62-0 Z+X01	600	430		25
	6RA7087-6FV62-0 Z+X01	850	510		30
	6RA7091-6FV62-0 Z+X01	1200	850		30
AC 575	6RA7025-6GV62-0 Z+X01	60	53	DC 600	10
	6RA7031-6GV62-0 Z+X01	125	106		10
	6RA7075-6GV62-0 Z+X01	210	158		15
	6RA7081-6GV62-0 Z+X01	400	286		25
	6RA7085-6GV62-0 Z+X01	600	450		25
	6RA7087-6GV62-0 Z+X01	850	626		30
	6RA7090-6GV62-0 Z+X01	1100	767		30
	6RA7093-4GV62-0 Z+X01	1600	1190		40
	6RA7095-4GV62-0 Z+X01	2000	1660		40
	6RA7096-4GV62-0 Z+X01	2200	1680		85
	6RA7097-4GV62-0 Z+X01	2800	2024		85
AC 690	6RA7086-6KV62-0 Z+X01	760	569	DC 725	30
	6RA7090-6KV62-0 Z+X01	1000	702		30
	6RA7093-4KV62-0 Z+X01	1500	1116		40
	6RA7095-4KV62-0 Z+X01	2000	1405		40
	6RA7097-4KV62-0 Z+X01	2600	1877		85
AC 830	6RA7088-6LV62-0 Z+X01	950	668	DC 875	30
	6RA7093-4LV62-0 Z+X01	1500	1116		40
	6RA7095-4LV62-0 Z+X01	1900	1414		40
AC 950	6RA7096-4MV62-0 Z+X01	2200	1588	DC 1000	85

Note:

All units are 3-phase self-adapting to 50/60 Hz supplies. Z+X01 extension includes English manual and S00 technology functions.

1) 50/60 Hz.

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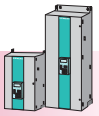
Conversion Tables



Rotary inertia (to convert from A to B, multiply by entry in table)

A \ B	lb-in^2	lb-ft^2	lb-in-s^2	lb-ft-s^2 slug-ft^2	Kg-cm^2	Kg-cm-s^2	gm-cm^2	gm-cm-s^2	oz-in^2	oz-in-s^2
lb-in^2	1	6.94×10^{-3}	2.59×10^{-3}	2.15×10^{-4}	2.926	2.98×10^{-3}	2.92×10^{3}	2.984	16	4.14×10^{-2}
lb-ft^2	144	1	0.3729	3.10×10^{-2}	421.40	0.4297	4.21×10^{5}	429.71	2304	5.967
lb-in-s^2	386.08	2.681	1	8.33×10^{-2}	1.129×10^{3}	1.152	1.129×10^{6}	1.152×10^{3}	6.177×10^{3}	16
lb-ft-s^2 slug-ft^2	4.63×10^{3}	32.17	12	1	1.35×10^{4}	13.825	1.355×10^{7}	1.38×10^{4}	7.41×10^{4}	192
Kg-cm^2	0.3417	2.37×10^{-3}	8.85×10^{-4}	7.37×10^{-5}	1	1.019×10^{-3}	1000	1.019	5.46	1.41×10^{-2}
Kg-cm-s^2	335.1	2.327	0.8679	7.23×10^{-2}	980.66	1	9.8×10^{5}	1000	5.36×10^{3}	13.887
gm-cm^2	3.417×10^{-4}	2.37×10^{-6}	8.85×10^{-7}	7.37×10^{-8}	1×10^{-3}	1.01×10^{-6}	1	1.01×10^{-3}	5.46×10^{-3}	1.41×10^{-5}
gm-cm-s^2	0.335	2.32×10^{-3}	8.67×10^{-4}	7.23×10^{-5}	0.9806	1×10^{-3}	980.6	1	5.36	1.38×10^{-2}
oz-in^2	0.0625	4.34×10^{-4}	1.61×10^{-4}	1.34×10^{-5}	0.182	1.86×10^{-4}	182.9	.186	1	2.59×10^{-3}
oz-in-s^2	24.13	.1675	6.25×10^{-2}	5.20×10^{-3}	70.615	7.20×10^{-2}	7.06×10^{4}	72.0	386.08	1

Torque (to convert from A to B, multiply by entry in table)

A \ B	lb-in	lb-ft	oz-in	N-m	Kg-cm	Kg-m	gm-cm	dyne-cm
lb-in	1	8.333×10^{-2}	16	0.113	1.152	1.152×10^{-2}	1.152×10^{3}	1.129×10^{6}
lb-ft	12	1	192	1.355	13.825	0.138	1.382×10^{4}	1.355×10^{7}
oz-in	6.25×10^{-2}	5.208×10^{-3}	1	7.061×10^{-3}	7.200×10^{-2}	7.200×10^{-4}	72.007	7.061×10^{4}
N-m	8.850	0.737	141.612	1	10.197	0.102	1.019×10^{4}	1×10^{7}
Kg-cm	0.8679	7.233×10^{-2}	13.877	9.806×10^{-2}	1	10^{-2}	1000	9.806×10^{5}
Kg-m	86.796	7.233	1.388×10^{3}	9.806	100	1	1×10^{5}	9.806×10^{7}
gm-cm	8.679×10^{-4}	7.233×10^{-5}	1.388×10^{-2}	9.806×10^{-5}	1×10^{-3}	1×10^{-5}	1	980.665
dyne-cm	8.850×10^{-7}	7.375×10^{-8}	1.416×10^{-5}	10^{-7}	1.0197×10^{-6}	1.019×10^{-8}	1.019×10^{-3}	1

Length (to convert from A to B, multiply by entry in table)

A \ B	Inches	feet	cm	yd	mm	m
Inches	1	0.0833	2.54	0.028	25.4	0.0254
feet	12	1	30.48	0.333	304.8	0.3048
cm	0.3937	0.03281	1	1.09×10^{-2}	10	0.01
yd	36	3	91.44	1	914.4	0.914
mm	0.03937	0.00328	0.1	1.09×10^{-3}	1	0.001
m	39.37	3.281	100	1.09	1000	1

Mass (to convert from A to B, multiply by entry in table)

A \ B	lb	oz	gm	slug
lb	1	16	453.6	0.0311
oz	6.25×10^{-2}	1	28.35	1.93×10^{-3}
gm	2.205×10^{-3}	3.527×10^{-3}	1	6.852×10^{-5}
slug	32.17	514.8	1.459×10^{4}	1

Power (to convert from A to B, multiply by entry in table)

A \ B	H.P.	Watts
H.P. (english)	1	745.7
(lb-in)(deg./sec)	2.645×10^{-6}	1.972×10^{-3}
(lb-in)(RPM)	1.587×10^{-5}	1.183×10^{-2}
(lb-ft)(deg./sec)	3.173×10^{-5}	2.366×10^{-2}
(lb-ft)(RPM)	1.904×10^{-4}	.1420
Watts	1.341×10^{-3}	1

Rotation (to convert from A to B, multiply by entry in table)

A \ B	RPM	rad/sec.	degrees/sec.
RPM	1	0.105	6.0
rad/sec.	9.55	1	57.30
degrees/sec.	0.167	1.745×10^{-2}	1

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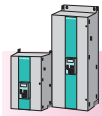


6RA70
DC MASTER

Conversion Tables

Temperature conversion

°F	°C	°C	°F
0	–17.8	–10	14
32	0	0	32
50	10	10	50
70	21.1	20	68
90	32.2	30	86
98.4	37	37	98.4
212	100	100	212
subtract 32 and multiply by $^5/_9$		multiply by $^9/_5$ and add 32	

Force (to convert from A to B, multiply by entry in table)

A \ B	lb	oz	gm	dyne	N
lb	1	16	453.6	4.448×10^5	4.4482
oz	.0625	1	28.35	2.780×10^4	0.27801
gm	2.205×10^{-3}	0.03527	1	1.02×10^{-3}	N.A.
dyne	2.248×10^{-6}	3.59×10^{-5}	980.7	1	0.00001
N	0.22481	3.5967	N.A.	100.000	1

Mechanism Efficiencies

Acme-screw with brass nut	~ 0.35 – 0.65
Acme-screw with plastic nut	~ 0.50 – 0.85
Ball-screw	~ 0.85 – 0.95
Chain and Sprocket	~ 0.95 – 0.98
Preloaded Ball-screw	~ 0.75 – 0.85
Spur or Bevel gears	~ 0.90
Timing Belts	~ 0.96 – 0.98
Worm Gears	~ 0.45 – 0.85
Helical Gear (1 reduction)	~ 0.92

Material Densities

Material	lb-in^3	gm-cm^3
Aluminum	0.096	2.66
Brass	0.299	8.30
Bronze	0.295	8.17
Copper	0.322	8.91
Hard Wood	0.029	0.80
Soft Wood	0.018	0.48
Plastic	0.040	1.11
Glass	0.079 – 0.090	2.2 – 2.5
Titanium	0.163	4.51
Paper	0.025 – 0.043	0.7 – 1.2
Polyvinyl chloride	0.047 – 0.050	1.3 – 1.4
Rubber	0.033 – 0.036	0.92 – 0.99
Silicone rubber, without filler	0.043	1.2
Cast iron, gray	0.274	7.6
Steel	0.280	7.75

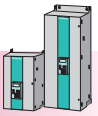
Friction Coefficients

Materials	m
Steel on Steel (greased)	~ 0.15
Plastic on Steel	~ 0.15 – 0.25
Copper on Steel	~ 0.30
Brass on Steel	~ 0.35
Aluminum on Steel	~ 0.45
Steel on Steel	~ 0.58

Mechanism	m
Ball Bushings	<0.001
Linear Bearings	<0.001
Dove-tail slides	~0.2 ++
Gibb Ways	~0.5 ++

A

Appendix



Important Note

The technical data is intended for general information.

Please note the operating instructions and the references indicated on the products for installation, operation and maintenance.

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