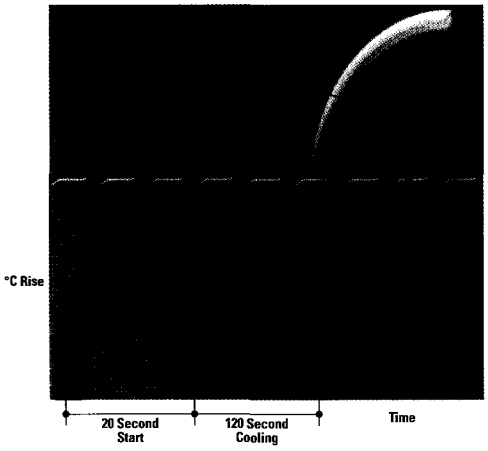
SIEMENS

SAMMS™ Advanced protection & control for today's motors

Do you know why motors fail?

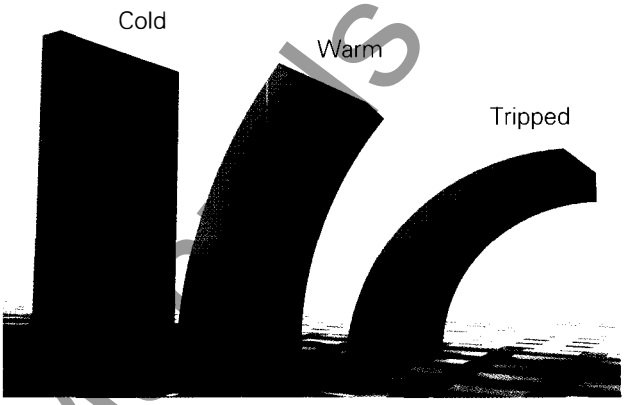
Failure modes and how to prevent them

Electrical failures in motors are primarily due to a breakdown in the winding insulation, and this breakdown is most often caused by high temperatures. On a low voltage motor the stator winding is vulnerable to excessive temperatures under both running and starting conditions. The rotor is the weakest link on medium voltage motors during starting while the stator winding is the limiting element during running conditions.



The time-honored protection method for motors has been to use a device called an overload relay. These devices usually have bi-metallic elements, or "bi-metals" for short. A bi-metal is designed to bend when heated and is calibrated to bend at a certain rate based on the amount of motor current through it. When it bends far enough, the contactor opens, interrupting the current.

Bi-metals are made to perform this operation in either 10 seconds or 20 seconds (Class 10 or Class 20). Since bi-metals are usually small components, they can cool off rapidly when the current stops flowing. That means your protection can reset itself even when the motor is still quite hot. This sets the stage for exceeding the maximum winding temperature limits on the next attempted start. Or, the protection trips on restart even when the motor is cool enough to successfully start.



On the other hand, most multi-function relays use indirect (and less accurate) methods to attempt to protect the rotor. These devices do not provide true rotor protection during starting, even though this is the most critical time in the operation of medium voltage machines.

Only an adaptive protection system that can accurately track instantaneous temperatures can give a motor the protection it needs. The temperatures of the housing, stator winding and rotor must all be tracked if thermal failures are to be prevented. If you consider other motor problems such as jams, loss of load, current unbalance and ground fault, you can easily see why a simple bi-metal, or any device which acts like a bi-metal, is not enough.

Technology for improved protection

Medium and low voltage motor protection

Siemens Advanced Motor Master System (SAMMS™) is a major technological improvement over the simplistic motor protection available for the last 50 or so years. With the computing power of today's microprocessors, the time has come to address the real physics of motor construction and use. And who better to bring this system to you than Siemens, a leading manufacturer of both low voltage and medium voltage motors, and motor protection.

The SAMMS unit utilizes a microprocessor-based mathematical model of the thermal behavior of a motor. With a proven mathematical model as its guide, the SAMMS system uses the full load current, service factor, motor type and acceleration time of the actual motor being protected to determine the temperatures of both the stator winding and the housing. In medium voltage applications, the SAMMS-MV™ unit also calculates the temperature of the rotor. The SAMMS unit uses the actual heating and cooling rates of the motor to determine the parameters of protection. Temperature is the enemy of motors and the SAMMS unit provides temperature-based protection.

Look closely and you will see that true rotor protection is not provided by most of the competitive relays sold for medium voltage motor protection, even the microprocessor-based relays. SAMMS-MV units give you this and lots more. Both SAMMS-LV™ and MV models give you all of the protection functions your motors need, such as current unbalance, jam, loss of load, and ground fault protection. Add in control logic and communications, and you'll agree there is nothing like the SAMMS system available from anyone else but Siemens.

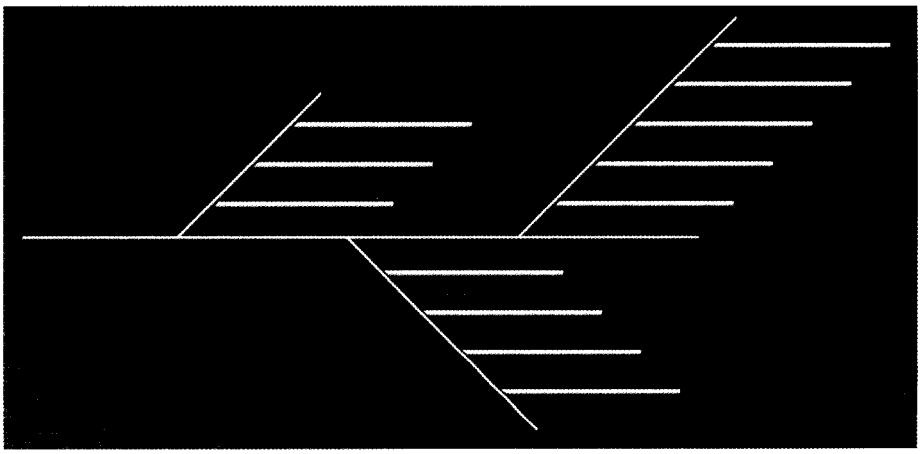
Control logic

In addition to superior motor protection, the SAMMS system provides all of the control logic involved with most common starters. The SAMMS family includes a library of over 70 standard control circuits for across-the-line, reversing, two speed and reduced voltage starters. This capability saves you components, wiring, space and money. And because of its advanced capabilities, the SAMMS unit essentially functions as a dedicated Programmable Logic Controller (PLC) for your custom motor applications. The SAMMS family can accommodate virtually any motor starter configuration you require.

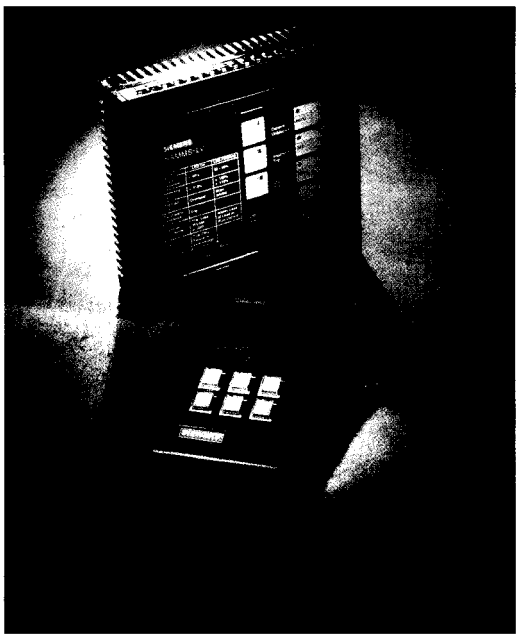
Communications

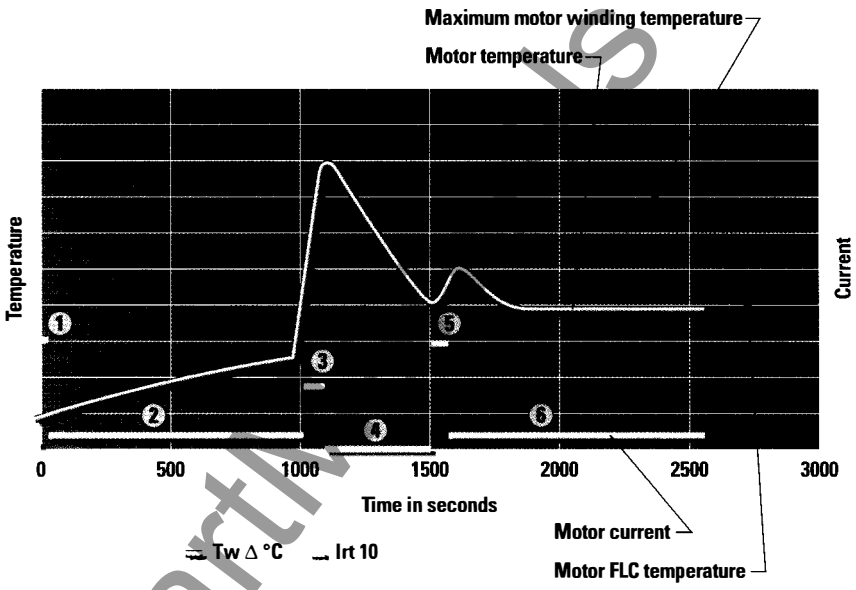
With all this information available in the SAMMS system, it makes sense to have the data available to your facility management system. The SAMMS system does just that with an optional communications capability. Outfitted with this communications capability, The SAMMS unit serves as a field level device for the Siemens ACCESS™ electrical distribution communications system.

The ACCESS system links all of your electrical circuit control and protection devices and allows you to present this data on a local network monitor, a PC or your facility's host computer. On a local level, you can also access this electrical data using the Hand Held Communicator. It's just another example of how Siemens is using advanced technology to meet your needs.



Low Voltage Motor Control and Protection – SAMMS-LV





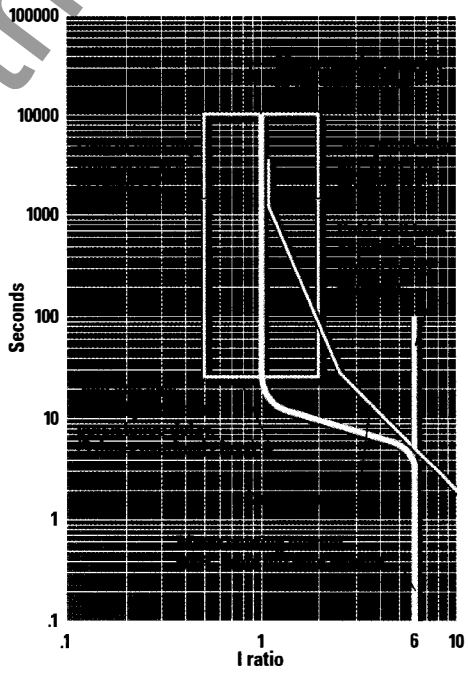
SAMMS units are available in low voltage and medium voltage configurations. The low voltage models, SAMMS-LVX and SAMMS-LVE, include protection specifically tailored to your low voltage motors.

LV motor protection

SAMMS-LV units address the two concerns of low voltage motor operation: winding temperature and housing temperature. The SAMMS-LV motor model tracks the winding temperature and takes the motor off line when the maximum winding or housing temperature is exceeded. Winding temperature protection is especially important during starting operations because the high starting currents can quickly cause permanent damage due to excessive temperature. The SAMMS unit will also open the motor circuit when maximum housing temperature is exceeded.

Far superior to the older bi-metal type of protection, the SAMMS unit will accurately track the critical temperatures even as the motor slowly cools off after a trip. This is a critical feature when the motor is stopped and no longer has the benefit of its cooling fan. And the SAMMS unit gives you a full range of starting times (Overload Classes) from 2 to 23 seconds.

The SAMMS-LVE and LVX units were specifically designed with the modern motor control center (MCC) in mind. The low, compact profile case of the SAMMS device takes less room in an MCC pan than most conventional starter components. Plus the SAMMS device contains all of the pushbuttons and indicator lights needed to control the motor and indicate status including:



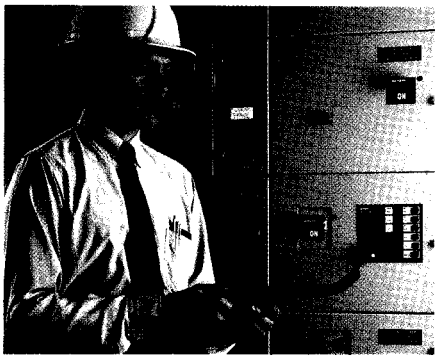
- Running
- Stopped
- Current unbalance
- Impending trip
- Overload trip
- Incomplete starting sequence
- External trip / alarm
- Ground fault trip / alarm
- CPU fault

All pushbuttons and indicators are protected with dirt and oil resistant construction.

Extended protection

In addition to the all-important winding temperature protection, SAMMS-LV units can provide:

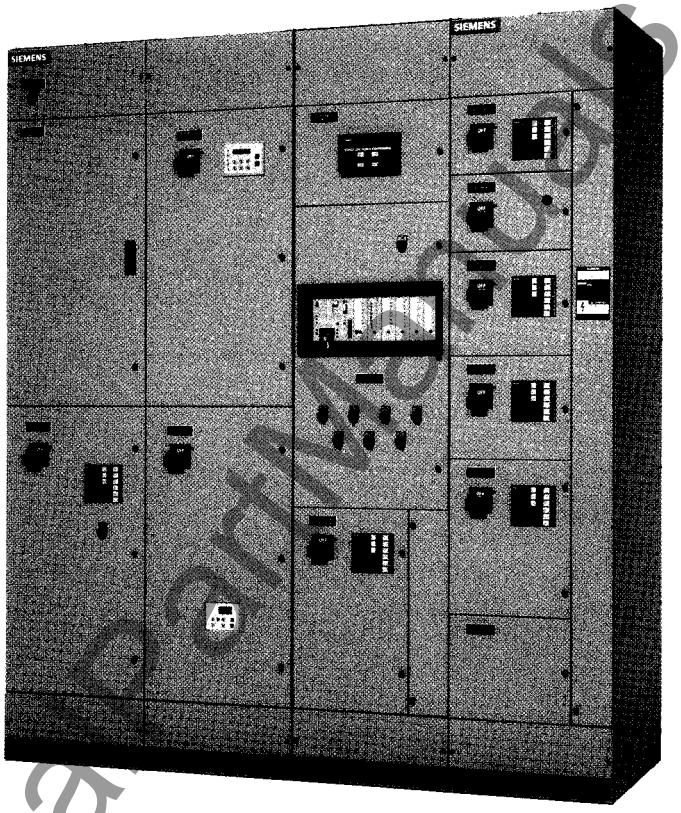
- Current unbalance protection
- Ground fault protection or alarm
- Process current alarm
- Jam protection
- Loss of load protection or alarm

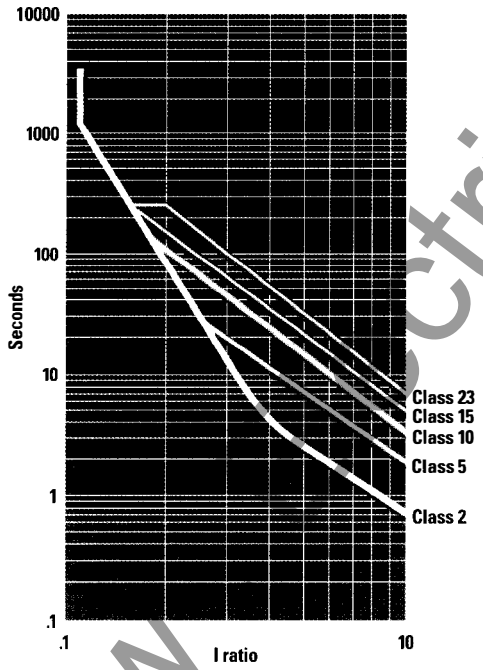


Hand Held Communicator

The Hand Held Communicator (HHC) gives the user immediate access to the data within the SAMMS unit The HHC plugs into the front of the SAMMS unit and with its LED display, keypad and user-friendly routine, you can interface 33 different functions. (A complete list of these functions is found in the table on page 10.)

The HHC can be used as a portable device to enter information or read data.





Superior protection

SAMMS-LVX and LVE provide your low voltage motors with a level of protection that will change the way you think about motor circuits. In addition to all of the above functions, you also have the benefit of a dedicated PLC. With this superior technology, SAMMS-LV units can address all your low voltage motor protection needs.

Medium Voltage Motor Control and Protection – SAMMS-MV

Your medium voltage motors represent a large capital investment and deserve the best protection available. And SAMMS-MV is the best product to provide that protection. Not only will you have all of the functions the low voltage SAMMS unit is famous for, you'll also have rotor protection.

The rotor's special needs

Looking at the typical medium voltage starting curve, you'll see that the rotor temperature races to its maximum limit at a rate much faster than that of the stator winding. Because rotor failure is the dominant failure mode when starting medium voltage machines, this overheating characteristic of the rotor is the medium voltage motor's Achilles' heel.

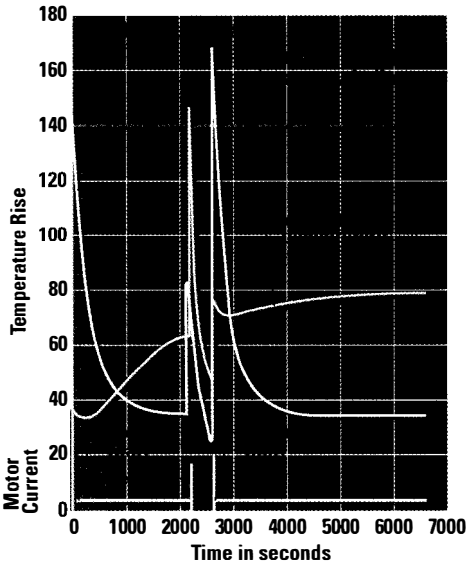
Yet most competitive motor protection relays on the market today offer inadequate rotor protection or none at all. SAMMS-MV models provide true rotor protection. SAMMS-MV units not only do the same superior job as SAMMS-LV units of tracking stator and housing temperatures, but they also determine the rotor temperature. Look at the graph of a typical motor's operation. The rotor temperature must be taken into account, especially during starting, if you're serious about protecting your medium voltage motor investment.

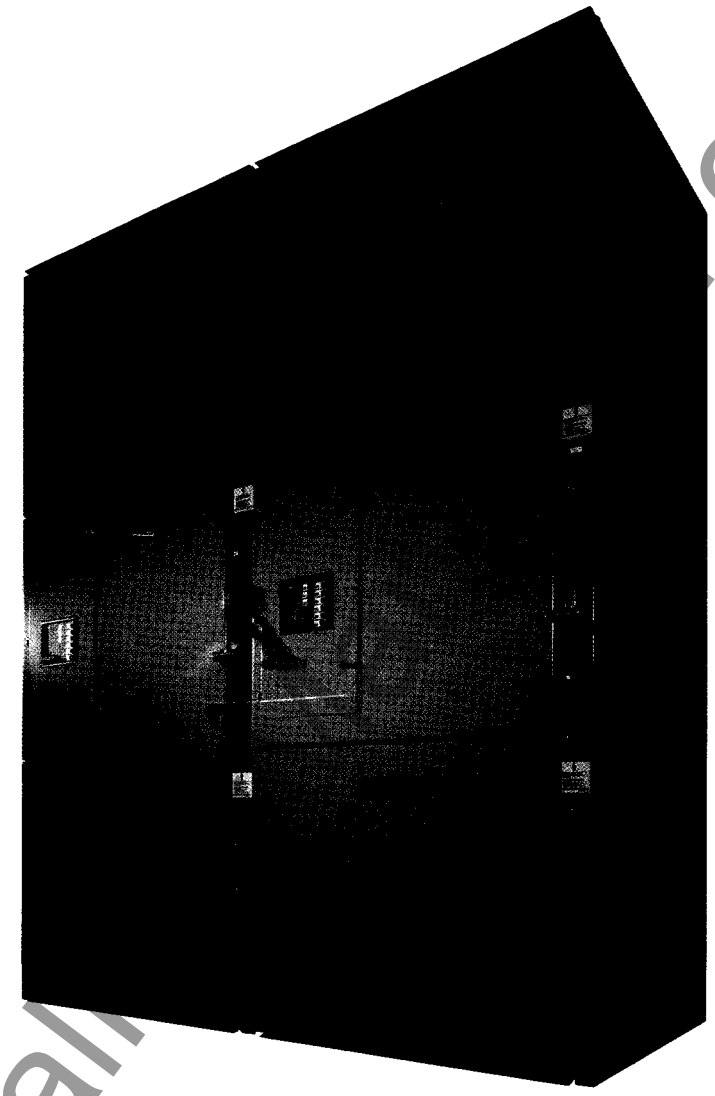
Some other motor relay manufacturers claim to monitor the rotor temperature through "inference." That is, they ask you to put an RTD in the stator, and they infer that the rotor temperature is proportional. RTDs cannot respond quickly enough to save the rotor of a large machine, especially during starting. Further, RTDs are susceptible to failure.

Medium voltage controllers (MVCs)

Just like the SAMMS-LV unit, the SAMMS-MV medium voltage protection and control unit is housed in a compact, low profile case. With SAMMS-MV units, you do not need a separate compartment just to house the protective relays. With a SAMMS-MV unit in the low voltage compartment of each controller, you save space in your MVC lineup.

SAMMS-MV units have the same dedicated PLC capability as the SAMMS-LV unit. This means that all of the space, wiring and control component savings are yours in medium voltage as well. No other single relay or protection device on the market today can give you the combination of protection and control you get with SAMMS-LV and SAMMS-MV units.

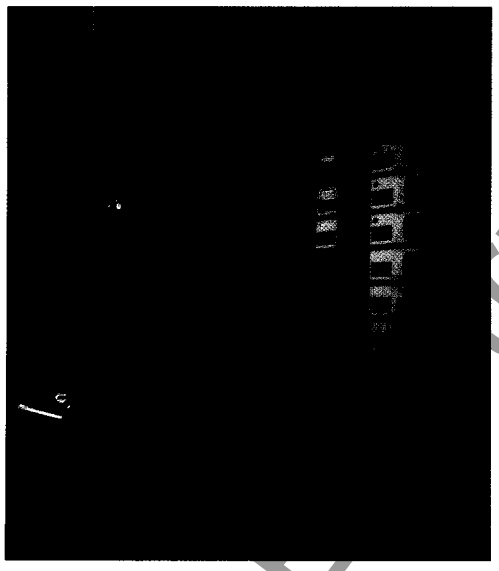




Compare and see the difference

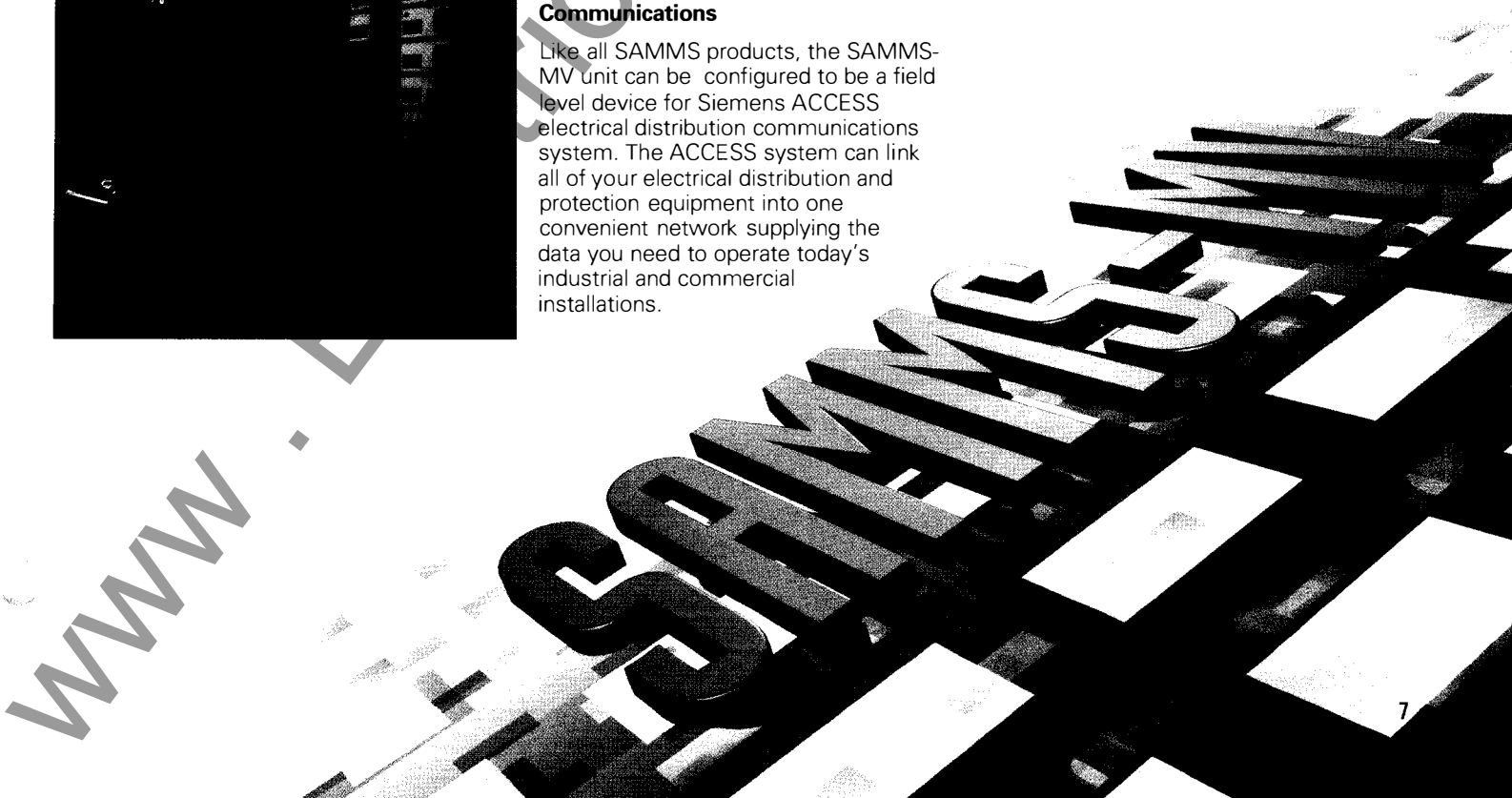
No competitive product offers the combination of temperature-based protection and dedicated control logic incorporated in the SAMMS family. First of all, there is no other protective device that uses a motor temperature model quite like the SAMMS products. And what other device provides true rotor protection? Can you afford to let your medium voltage machines operate without them?

The SAMMS system is more than just a relay. No protective relay alone also gives you the control logic capability of the SAMMS-MV. With over 40 standard medium voltage starter circuits in a library ready to download into your SAMMS-MV unit, it's easy to appreciate the power of this truly unique system.



Communications

Like all SAMMS products, the SAMMS-MV unit can be configured to be a field level device for Siemens ACCESS electrical distribution communications system. The ACCESS system can link all of your electrical distribution and protection equipment into one convenient network supplying the data you need to operate today's industrial and commercial installations.



Configuring SAMMS-LV and SAMMS-MV Units

SAMMS-LVE and SAMMS-MVE units are tailored to the needs of across-the-line non-reversing applications. SAMMS-LVX and SAMMS-MVX units are programmable to provide the control logic for all common starter arrangements, including:

- across-the-line, non-reversing
- across-the-line, reversing
- two-speed, two-winding
- two-speed, one-winding, constant or variable torque
- two-speed, one-winding, constant horsepower
- reduced-voltage, autotransformer
- reduced-voltage, reactor

Each one of the above starter types can be further modified to include the following control configurations:

- local two-wire
- local three-wire
- local two-wire, remote two-wire
- local three-wire, remote two-wire
- local three-wire, remote three-wire
- remote two-wire
- remote three-wire

For a complete description of each of the starter arrangements and control arrangement combinations, ask your local Siemens Sales representative for the SAMMS Standard Circuit Manual.

The logic for all of the standard "across-the-line" starter combinations is pre-loaded into the SAMMS-LVE and the SAMMS-MVE models. The desired circuit is selected using the HHC to set the F1 function code for the appropriate across-the-line circuit number. Alternatively, a custom circuit can be downloaded to a SAMMS-LVE or SAMMS-MVE unit. If one of the standard across-the-line circuits is utilized, the SAMMS-LVE and SAMMS-MVE devices can be fully configured using the hand-held communicator.

The logic for the full capability SAMMS-LVX and SAMMS-MVX models can be downloaded from a PC or laptop computer using an optional software package. This capability allows the user to make changes in the motor control arrangement without the customary re-wiring and heater replacement necessary with older bi-metal and discrete control and protection components. This, along with the rest of the programmable features, gives the user maximum flexibility.

Setting function configurations

The real beauty of the SAMMS unit is its ability to match your motor installation exactly. Through the Hand Held Communicator you can enter the exact parameters for high and for low speed overloads, full load current for high and for low speed operation, service factor, overload trip class, timer settings, process current alarm setpoint and the activation of different non-overload protection functions. And you can change these settings in the field with the same ease as your system changes. This ability to match the initial installation and be quickly adapted to system changes means your protection is maximized and your downtime is minimized.

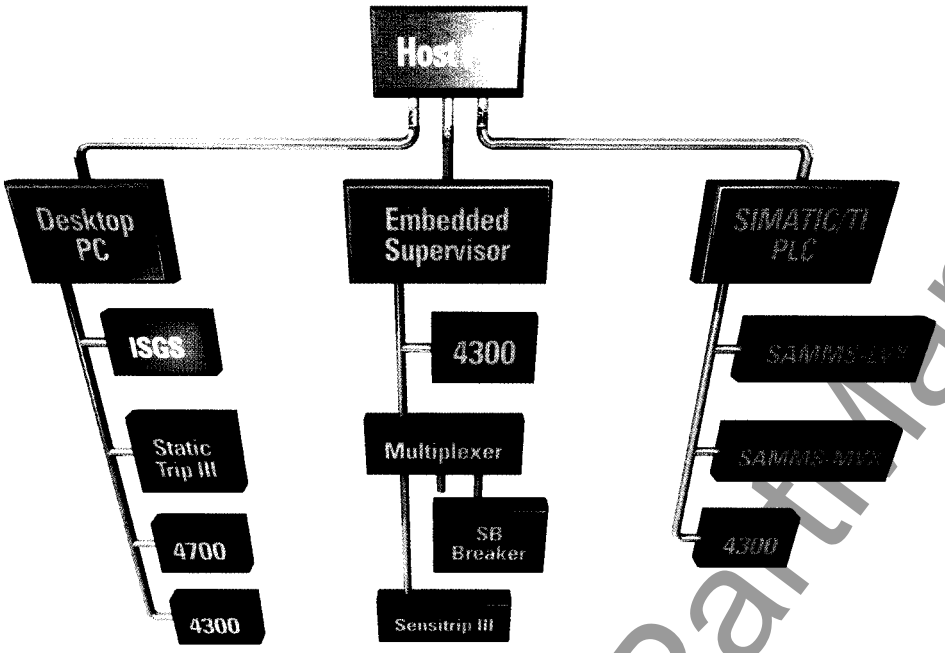
Custom circuit programming

There may be an occasion when the standard control logic circuits need slight modification or a totally new control logic circuit. The SAMMS unit has the capability of being custom-programmed using standard ladder logic symbols and software. A PC equipped with this optional software is used to develop the desired logic diagram which is then down-loaded into the SAMMS unit through the connector on the front of the device.

Siemens offers an IBM compatible software program that includes over 70 standard control circuits and the ability to download them into the SAMMS unit. Siemens also offers an IBM compatible software package that allows the exact motor parameters and control circuits as originally specified to be downloaded in the field.

Control Type	Starter Type					
	FVNR	FVR	2 Speed 1 Winding Constant or Variable Torque	2 Speed 1 Winding Constant HP	Autotransformer RVA	Reactor RVA
Local 2-Wire	•	•	•	•	•	•
Local 3-Wire	•	•	•	•	•	•
Local 3-Wire Remote 2-Wire	•	•	•	•	•	•
Local/Remote 2-Wire	•	•	•	•	•	•
Local/Remote 3-Wire	•	•	•	•	•	•
Local/Remote 3-Wire Electrically Interlocked	•	•	•	•	•	•
Remote 2-Wire	•	•	•	•	•	•
Remote 3-Wire	•	•	•	•	•	•

Remote Communications



The ACCESS electrical distribution communication system

The ACCESS system from Siemens gives you an effective way to centrally monitor and control your entire electrical distribution system. With the ACCESS system, a wealth of information to assist with troubleshooting, preventive maintenance, cost allocation and facilities planning is always right at your fingertips. Armed with this information, you're better prepared than ever before to minimize energy consumption costs and to take a proactive approach in anticipating problems.

As the intelligence behind your electrical distribution monitoring , the ACCESS system collects vital data from "smart" field level devices — circuit breakers, trip units, meters and protective relays, including SAMMS-LV and SAMMS-MV units — throughout your facility and stores and processes the data at a central host computer. Now, the answers about what's happening to load levels, where power is being consumed, what's causing peaks, and when, where and why a circuit breaker or controller has tripped are just a few keystrokes away.

Two of the key advantages of the ACCESS communications system are flexibility and expandability. No two ACCESS systems are alike. You choose which communicating devices make the most sense for your facility requirements — perhaps a Sensitrip® III equipped molded case circuit breaker connected in series by a simple twisted pair to a multiplexer, a SAMMS unit and a Power Monitor™ display and monitoring unit. At the top of the system is a host computer with software customized to display critical operating information in forms that are most useful to your operators and maintenance technicians.

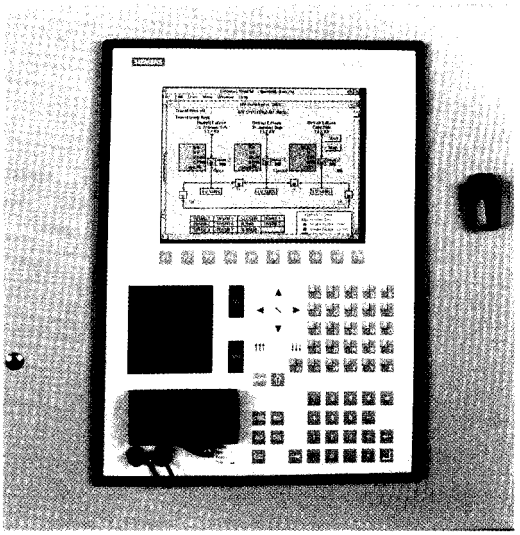
Then, as your communications needs grow, so can your ACCESS system. In fact, the ACCESS host computer is designed to monitor an electrical system including up to 2,000 field devices. Plus, the open protocol of ACCESS means you can select any Siemens smart trip unit, power meter or protective relay and know that they will be able to communicate with other Siemens devices when you're ready.

Communications via your PC

For electrical systems that require communications capabilities on a smaller scale, Siemens offers two solutions:

- Our exclusive SIEServe™ software, using your existing PC. SIEServe software is a Windows™-based application designed to retrieve and display real-time data from up to 128 devices such as SAMMS units, smart Siemens trip units, power meters or relays.
- Our WinPM™ software is a Windows-based application offering all of the features of the SIEServe software, plus custom graphics, trend analysis, harmonic analysis. waveform capture, alarming, event logging and manual control.

Both the SIEServe and WinPM software packages support direct connection to devices via serial ports, or dial-up or radio modems. For a limited time, the SIEServe software program will be supplied with the purchase of any communicating device at no additional charge. Contact your local Siemens Sales office for availability.



Catalog Number System

SAMMS Functions					
Function Number	Function	SAMMS MVX	SAMMS MVE	SAMMS LVX	SAMMS LVE
F0	Ambient temperature	•	•	•	•
F1	Control circuit number	•	•	•	•
F2	Size for overload No. 1	•	•	•	•
F3	Size for overload No. 2 (low speed)	•		•	
F4	Full load current for OLR No. 1	•	•	•	•
F4A	5A CT primary current (if used)	•	•	•	•
F5	Full load current for OLR No. 2	•		•	
F5A	5A CT primary current (if used)	•		•	
F6	Service Factor	•	•	•	•
F6A	Motor type	•	•	•	•
F7	Overload trip class (2 thru 23)	•	•	•	•
F7A	Cold stall time	•	•	•	•
F8	Automatic reset	•		•	
F9	Phase unbalance	•	•	•	•
F10	Time to restart	•	•	•	•
F11	Emergency restart	•	•	•	•
F12	Ground fault protection or warning	•	•	•	•
F12A	Ground fault pickup current	•	•	•	•
F13	Timer No. 1	•	•	•	•
F14	Timer No. 2	•	•	•	•
F15	Motor current	•	•	•	•
F16	Last trip current	•	•	•	•
F17	Percent unbalance current	•	•	•	•
F18	Total elapsed run-time on motor	•	•	•	•
F19	Total number of motor starts	•	•	•	•
F20	Number of overload trips	•	•	•	•
F21	Reset motor data	•	•	•	•
F22	Set process current warning	•		•	
F23	Jam protection	•		•	
F23A	Jam pickup current	•		•	
F24	Loss of load protection or warning	•		•	
F24A	Loss of load pickup current	•		•	
F25	Motor winding temp. as % of full load temp.	•	•	•	•
F26	Baud rate	•	•	•	•
F27	Address	•	•	•	•

Catalog Number

SAM5

SAMMS Model Numbers
SAM4 – SAMMS-LVE
SAM5 – SAMMS-LVX
SAM6 – SAMMS-MVE
SAM7 – SAMMS-MVX

Configuration

L 1 A L G 0000

Control Type
L – Local and/or Remote Control

Alarm Contacts Configuration (SAMMS-LVX and MVX Only)
0 – None
1 – Normally Closed Contacts (N.C.)
2 – Normally Open Contacts (N.O.)

Alarm Contacts Output (SAMMS-LVX and MVX Only)
A – Any of the Below
B – Impending Trip
C – Overload Trip
D – External Trip
E – Ground Fault
F – None

Loss of Voltage (SAMMS-LVX and MVX Only)
L – Loss of Voltage Ridethrough
0 – None

Ground Fault
G – Ground Fault Protection
0 – None

Control Circuit Number
Control Circuit Number Loaded at Factory
0 – None

Guide Form Specification

The following specification can be added to the appropriate section of your motor control equipment specifications to guarantee that important features and functions of the SAMMS system are provided.

Each motor controller shall be provided with a microprocessor-based motor control and protection device. Motor protection shall be based on the calculated temperatures of the stator winding and housing (for low voltage motors) or stator winding, rotor and housing (for medium voltage motors) as a function of the motor RMS current and the motor cooling and heating time constants. The minimum acceptable repeatable accuracy level for overload protection shall be plus or minus 1% during motor starting and running conditions. The following motor protection features shall be provided.

- Flexibility to change the motor protection settings without replacing heater elements.
- Eliminate nuisance tripping by allowing the maximum number of motor starts without damage to the motor insulation.
- Motor lockout on thermal overload trip.
- Phase loss and phase unbalance protection.
- Impending trip alarm.
- Choice of Overload Classes 2 through 23 (in one second intervals) to match the motor characteristics and provide stall protection.
- (Optional) Process current (load) alarm
- (Optional) Mechanical jam protection
- (Optional) Undercurrent/loss of load protection or alarm.

The device shall offer programmable control logic. Local control devices such as timers, control relays, pushbuttons and selector switches shall be replaced by software and the standard push-buttons and lights on the device control panel.

Diagnostic LEDs shall provide visual indication of the condition of the controller and the motor including current phase unbalance, impending trip, overload trip, external trip, incomplete sequence, CPU failure, ready (control power) and ground fault. A reset/test button shall be provided to allow resetting and testing of the overload function as well as testing the control panel LEDs.

A hand-held communicator shall be furnished with each order. The hand-held communicator shall provide access to configure changes to motor data functions and shall allow display of statistical motor data and currents.

Statistical motor data including the elapsed motor running time, number of starts, number of overload trips and current at the last trip, shall be stored in the microprocessor's memory shall be accessible using the hand-held communicator.

(Optional) RTD temperature inputs for monitoring purposes (for medium voltage motors) shall be provided to trip the motor when any RTD exceeds the allowable temperature.

The following options shall be provided:

- Backup software: (standard)
  Include an IBM compatible software package to allow the exact motor parameters and control circuits as originally specified from the factory to be downloaded into a spare SAMMS unit to backup multiple applications in the field.
- Standard circuit software: (optional)
  Include an IBM compatible software package to allow selection from over 70 standard control circuits and the ability to download the selected circuit and motor parameters in the field.
- Custom circuit software:
  Include a PC compatible software package that can allow development of customized control circuits and the ability to download a control circuit and motor parameters in the field.
- Provisions for communications to a host computer or the Power Monitor panel using the ACCESS electrical data communications system.

The microprocessor-based protection and control device shall be Siemens Advanced Motor Master System (SAMMS-LVE, SAMMS-LVX, SAMMS-MVE or SAMMS-MVX) or engineer-approved equal.

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(604) 321-8687

International
TLX: 822024SEA
IBU UF
Fax: (404) 751-2496
Phone: (404) 751-2291

Siemens Energy & Automation, Inc.
P.O. Box 29503
Raleigh, NC 27626-0503

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