Compressed Air System Management

Sigma Air Manager 4.0

Key technology for Industry 4.0

kaeser.com

Sigma Air Manager 4.0

Why you need a system controller

Compressed air is one of your biggest utility costs. Too often, compressors in multi-unit systems operate on their individual control signals and are not well integrated. Much energy is wasted by running more machines than necessary and at higher pressures than needed. Other problems include fluctuating pressure, as well as increased maintenance and repair costs due to excess valve cycling and motor starts.

Kaeser's Sigma Air Manager 4.0 offers complete compressed air system management for industrial plants by tying your compressors, blowers, or vacuum units together into a secure Sigma Network. SAM 4.0 can also balance load hours for more effective maintenance scheduling. It's powerful 3D^{advanced} Control improves pressure stability and system reliability, while the built-in Kaeser Connect web server provides remote monitoring and ongoing energy audit information according to ISO 50001 energy management.

Identify, analyze, react—in real time

SAM 4.0 is the heart of the Sigma Network and is key technology in the advanced world of the Industrial Internet of Things (IIoT) and Industry 4.0. As the central mastermind, it controls the entire compressed air supply system and—via Kaeser Internet of Things (IoT) clients—is responsible for data streaming to the centralized Kaeser Sigma Smart Air application. Process data from the compressed air system in the Sigma Network is transmitted in real time. Specialized software ensures continuous system evaluation and dependable data transmission to control centers or end-user digital devices.

Centralized compressed air system monitoring is performed in the Kaeser Data Center and it is here where warning, maintenance, alarm, and operational messages, as well as energy management, analysis, and reports for optimized system performance are processed.

## Kaeser Sigma Smart Air: Predictive Maintenance

The combination of remote diagnostics and needs-based, preventative maintenance helps ensure maximum compressed air supply dependability. Through permanent availability of compressed air system process data and the resulting permanent analysis, it is possible to identify the perfect point in the future when your compressed air supply system should be maintained and serviced. This prevents costly periods of downtime, increases energy efficiency (thanks to monitoring key parameters), and allows compressed air system performance to be precisely matched according to demand throughout the entire life cycle of the system.

This combination of remote diagnostics and demand oriented preventive maintenance ensures maximum availability and potentially reduces service costs by up to 30%.

Innovative: Adaptive 3D^{advanced} Control

The algorithms in the Adaptive 3D^{advanced} Control orchestrate interplay between all components and equipment in your Kaeser compressed air system. As a result, just the right amount of compressed air power is provided to suit the specific needs of the application, which in turn assures maximum energy efficiency at all times.

The unique 3D^{advanced} Control continuously analyzes the relationship between various parameters (e.g. switching and control efficiency), and proactively calculates the optimum combination from a range of many in order to achieve optimum efficiency. Not only are starts and stops taken into consideration, but so too are idling and frequency converter losses. Moreover, the compressed air system's pressure values are optimized and average pressure is reduced.
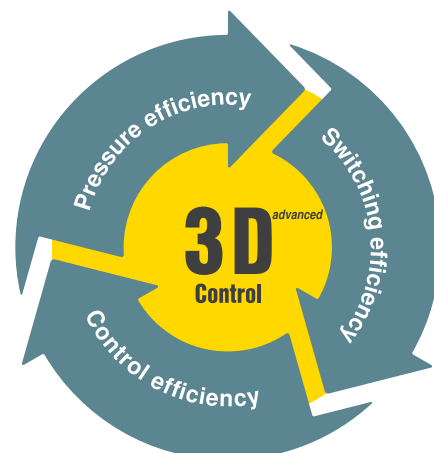
What's on the inside and what's in it for you…

Kaeser Sigma Network

Safe and secure network

System components can easily be connected to the secure Kaeser Sigma Network.

See page 6 for more information

Upgrade your compressed air system

SAM 4.0 grows with you

A simple software upgrade allows you to expand your control capability. There's no need to change master controller hardware.

See page 8 for more information

Adaptive 3D*advanced* Control

Optimum efficiency

Monitors and controls compressed air system operation and proactively calculates the most efficient performance solution from numerous potential options.

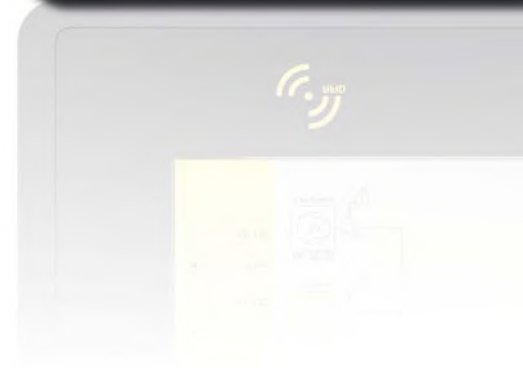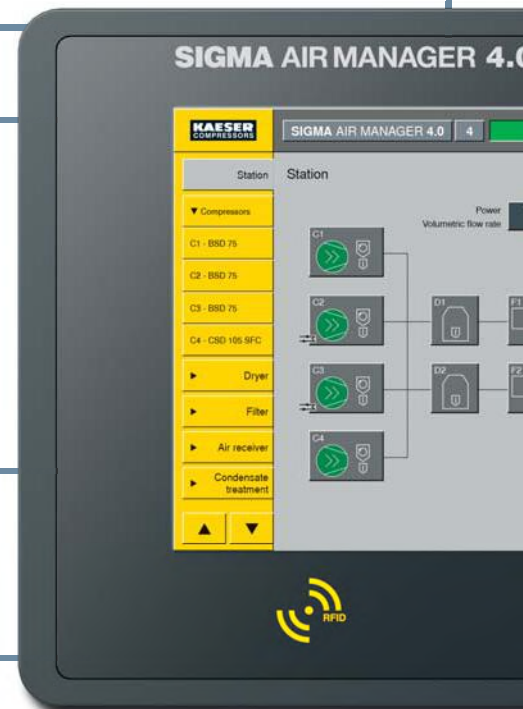## Kaeser Sigma Smart Air

All-around carefree service package

The unique combination of remote diagnostics and service ensures supply dependability and significant cost savings.

See page 14 for more information

RFID access

Secure login

The integrated RFID interface ensures secure login for authorized personnel—without the need for passwords.

Live P&I diagram

Everything at a glance

Your entire system shown as a P&I diagram on a 12", color touch screen display.

See page 9 for more information

Industrial Internet of Things (IIoT)

Communication and data exchange in real time

Real-time data exchange enables continuous energy and cost optimization for efficient plant operation.

Energy Management per ISO 50001

On demand energy reports

SAM 4.0 generates reports in accordance with ISO 50001.

See page 10 for more information

SAM 4.0 Logic

Integrated programmable control

Individually programmable, system-specific functions, for example the temperature dependant control of inlet, circulation, and exhaust air louvers, can be implemented using this planning tool—without the need for additional PLC's.
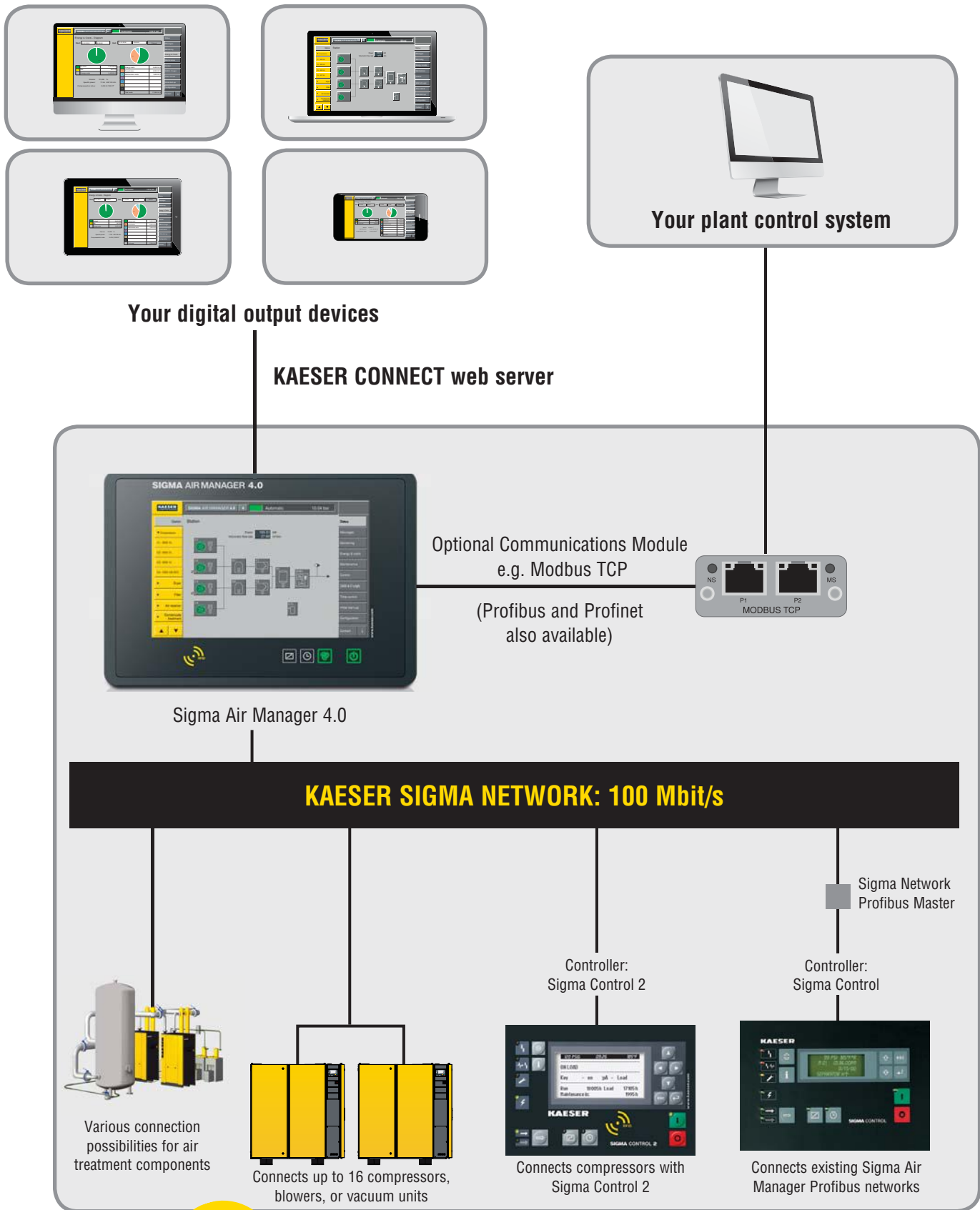
See page 11 for more information

Kaeser Connect

Operation, consumption, and cost overview. Anytime, anywhere.

All operational and energy consumption data, as well as cost information, can be called up on any network-compatible device anytime, anywhere.

See page 6 for more information

Automatic   10.04 bar

65.51 kW
27.60 m³/min

Status
Messages
Monitoring
Energy & costs
Maintenance
Control
SAM 4.0 Logic
Time control
Initial start-up
Configuration
Contact   i

www.kaeser.com

Your digital output devices

KAESER CONNECT web server

Your plant control system

Optional Communications Module
e.g. Modbus TCP

(Profibus and Profinet
also available)

NS ● | P1 | P2 | ● MS
MODBUS TCP

Sigma Air Manager 4.0

KAESER SIGMA NETWORK: 100 Mbit/s

Sigma Network
Profibus Master

Controller:
Sigma Control 2

Controller:
Sigma Control

Various connection
possibilities for air
treatment components

Connects up to 16 compressors,
blowers, or vacuum units

Connects compressors with
Sigma Control 2

Connects existing Sigma Air
Manager Profibus networks

Secure data—secure business

With high speed and rigorous security standards

The Industrial Internet of Things places high demands on a data network—it needs to be fast, secure, and future-dynamic. The powerful Ethernet-based Sigma Network developed by Kaeser provides optimal monitoring and efficient control of the compressed air system and enables operation within the context of the IIoT.

Furthermore, industrial applications have special demands when it comes to communications technology—including machine to machine communication, which is the basis of the IIoT. Not only must the technology be durable and easily manageable on site, but it should also be globally compatible, fast, secure, and able to transfer large volumes of data with maximum integrity. The Kaeser Sigma Network meets all of these requirements and more.

Secure data

Based on secure Ethernet technology, the future-dynamic network is a local network within the compressed air system that enables optimized integration of a system's components. Unlike current field-bus solutions such as Profibus, CAN, or similar technologies that operate at relatively slow speeds (maximum 12 Mbit/s), this network boasts a data transfer speed of 100 Mbit/s. The widely accepted TCP/IP protocol standard forms the basis for data traffic in the Sigma Network. The Sigma Network uses Kaeser-own MAC addresses and creates a closed and secure network segment in accordance with the recommendations for industrial control systems. A defined transfer node enables secure data exchange with external partners.

Predictive maintenance

Together, Sigma Air Manager 4.0 and the Sigma Network create a perfectly matched infrastructure and provide the basis for future services, such as predictive maintenance or energy management, for example. This not only reduces costs, but also increases operations reliability and availability.

If requested by the operator, the operating data from the compressed air system can be securely transmitted to the Kaeser Data Center via a broadband connection. This is the prerequisite for Kaeser Smart Air.

Compatible

Needless to say, existing Kaeser Profibus networks can be integrated into the Sigma Network.

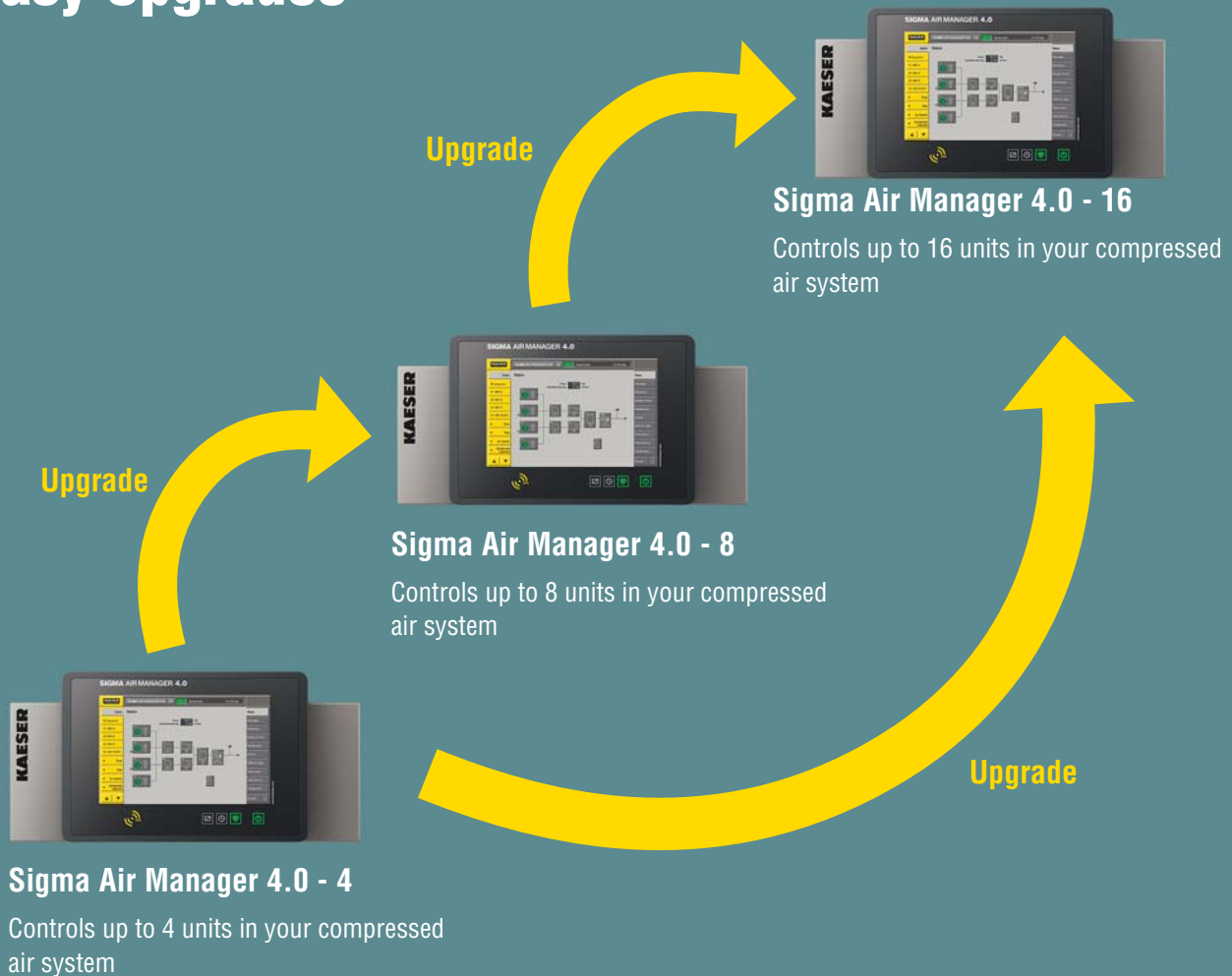# The future-dynamic solution that grows with your compressed air demand

If your business is growing and so too is your compressed air demand, then it's time to consider expanding your compressed air supply system.
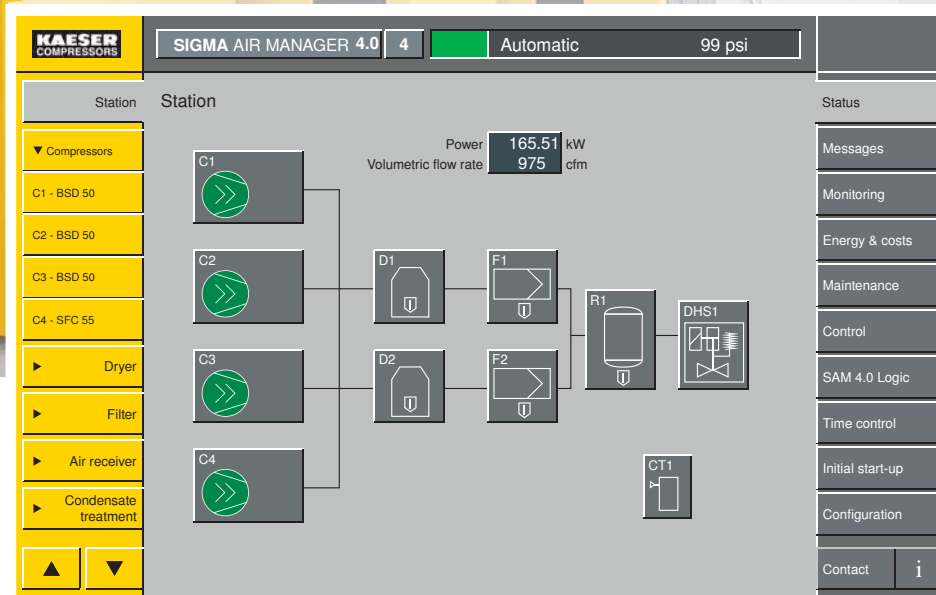
This poses no problem for Sigma Air Manager 4.0, which is designed to accommodate your growing compressed air demand. A straightforward software update is all that's required to expand the master controller's functionality—there's no need for additional investment in new hardware.

Therefore, with a software upgrade, SAM 4.0 initially capable of controlling only up to four units can be updated to control up to eight, or even sixteen. This means the capacity of your Sigma Air Manager 4.0 can easily be adapted to suit your current compressed air needs.

For you, this ensures planning security and is an essential prerequisite for you to be able to lead your company safely into the future.

Easy Upgrades

Upgrade

Sigma Air Manager 4.0 - 16

Controls up to 16 units in your compressed air system

Upgrade

Sigma Air Manager 4.0 - 8

Controls up to 8 units in your compressed air system

Upgrade

Sigma Air Manager 4.0 - 4

Controls up to 4 units in your compressed air system

SIGMA AIR MANAGER 4.0 | 4 | Automatic | 99 psi

	Station
▼ Compressors	
C1 - BSD 50	
C2 - BSD 50	
C3 - BSD 50	
C4 - SFC 55	
► Dryer	
► Filter	
► Air receiver	
► Condensate treatment	

Station

Power 165.51 kW
Volumetric flow rate 975 cfm

C1 C2 C3 C4 D1 D2 F1 F2 R1 DHS1 CT1

Status
Messages
Monitoring
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Maintenance
Control
SAM 4.0 Logic
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Initial start-up
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View your entire system in a live P&I diagram

Sigma Air Manager 4.0's pipework and instrumentation (P&I) flow diagram shows all the components in your compressed air system. Data can also be displayed for subsequently installed equipment and is available in SAM 4.0. All of the connected components are visible at a glance and can be quickly identified via clear, individual, designation.

Operational statuses are color-coded for visualization. Everything you see is live!

The live P&I diagram displays the following parameters:

- Operational status, alarm, and maintenance messages of individual components
- Flow rate
- Power
- Pressure
- Additional measurement signals, such as pressure, dew point, and ambient temperature can also be processed.
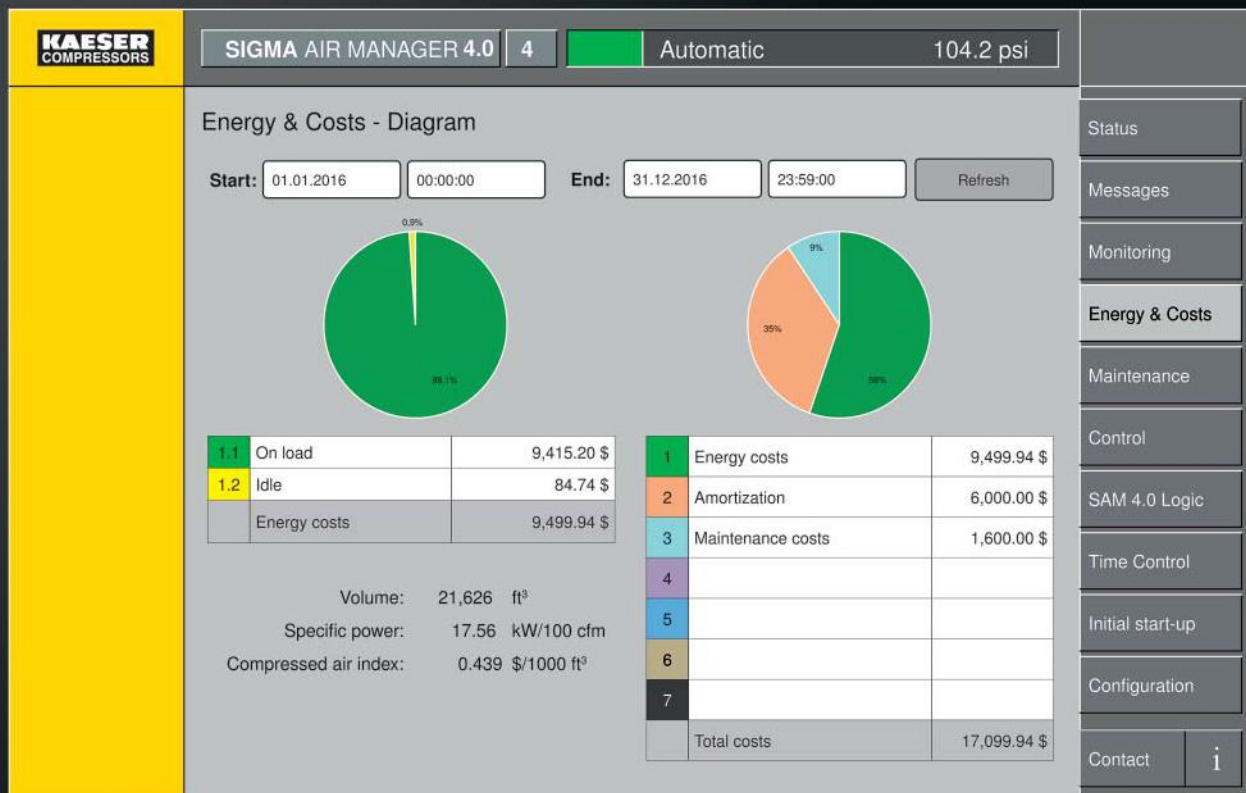
On demand energy reports—in the blink of an eye

As a leading compressed air systems provider, Kaeser provides unrivaled service and expertise when it comes to energy efficiency. Sigma Air Manager 4.0 is a comprehensive solution that allows you to store and analyze all relevant energy-related data from your compressed air supply, and then create specific reports for your certification—all in the blink of an eye.

How SAM 4.0 works for you

To reduce both the environmental impacts and costs for your business, ISO 50001 outlines how businesses should systematically and continuously improve their energy efficiency and rewards them accordingly through tax incentives and renewable energy surcharge rebates where available.

SAM 4.0 helps you create the associated certification reports effectively and quickly: it provides secure storage of your compressed air system's operating data and allows detailed analysis and energy balances.

The following information is provided:

- Performance figures for the compressed air system or individual components for energy management certification in accordance with ISO 50001

- Compressor load data, air delivery, performance, specific power
- Total costs
- Graphical display of cost overview (with the possibility of manually adding costs such as maintenance and repair)
- Operating data from the long-term memory for measuring signals (over an elapsed period of up to one year)
- Energy cost settings
- Compressed air performance figures up to 6 years

The data can also be exported. The cost center report can be called up at any time via Kaeser Connect with a network compatible device. Furthermore, a report can also be sent to a user-defined e-mail address.
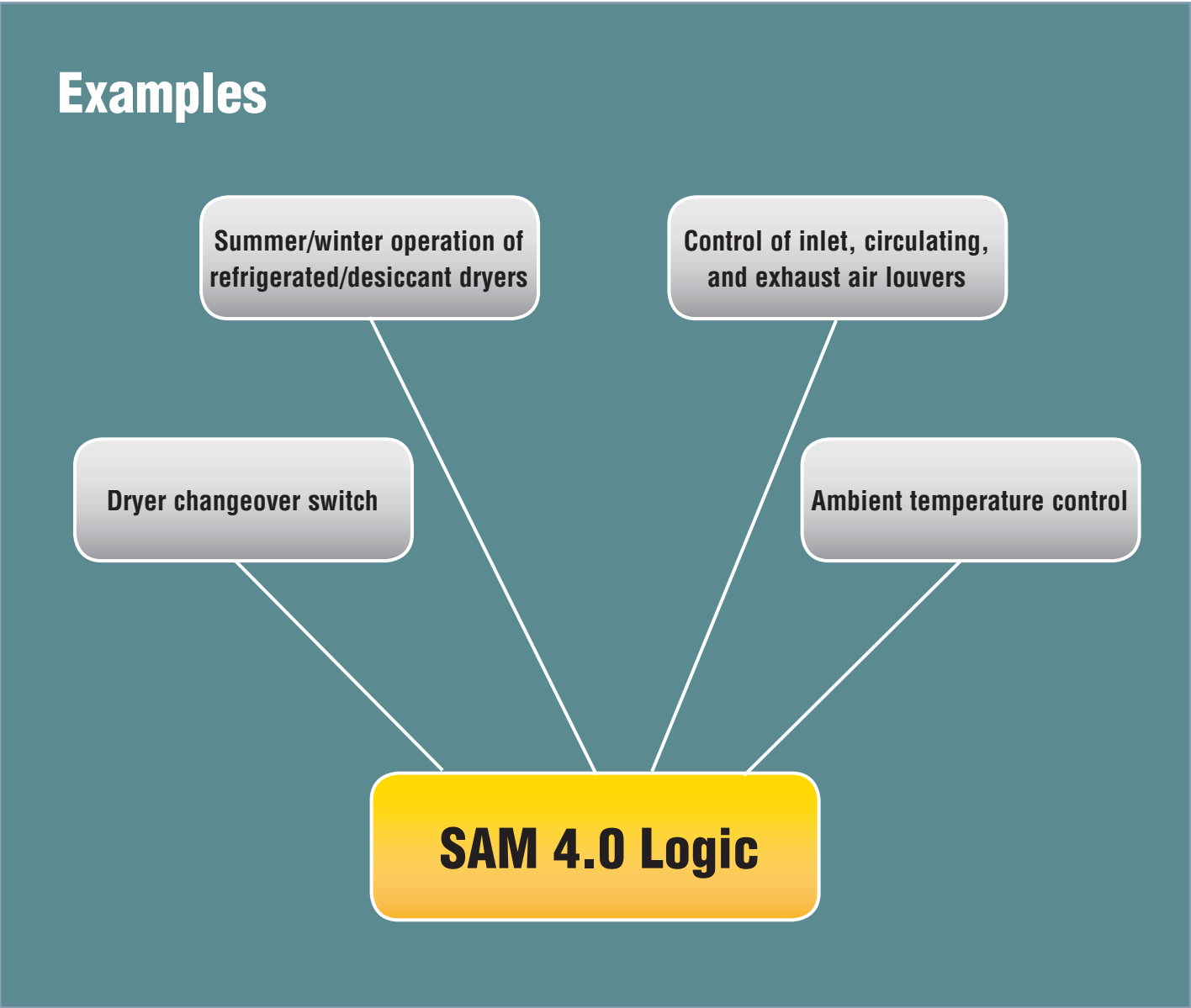
Integrated programmable control for individual programmable functions

SAM 4.0 Logic allows customized functions to be individually programmed via the Kaeser "Engineering Base" planning tool.

Therefore, using logic functions, it is possible to make inlet, circulating, and exhaust air louvers operate according to temperature, for example. This powerful feature essentially makes any programmable logic controller (PLC) or logic control redundant.

This integration not only makes operation simpler, but also provides a significant cost advantage compared to the usual combination of a conventional controller with an additional PLC.

If you would like to learn more about SAM 4.0 Logic, simply contact your local authorized Kaeser representative for more information about this optional service.

Examples

Summer/winter operation of refrigerated/desiccant dryers

Control of inlet, circulating, and exhaust air louvers

Dryer changeover switch

Ambient temperature control

SAM 4.0 Logic

Durable, easy-to-use touch screen

Advanced, capacitive touch technology, offset supplementary keys, and durable LED illumination make Sigma Air Manager 4.0 an exceptionally user-friendly tool, and not just on the haptic level since it also supports 30 languages.

1) Status

- Overview: pressure curve information, pressure display, current values, history
- Manual pre-selection: compressor selection
- Sources: displays pressure and power, pre-selection, priorities
- Station: displays your system in the P&I diagram, measurement values, current statuses, running hours, and serial data

2) Messages

- Unacknowledged messages
- Current messages
- Message history

3) Monitoring

- Compressed air consumption
- Specific power
- Measurement data

4) Energy and costs

- Energy cost table
- Energy cost diagram
- Energy costs in user-defined time frame comparisons
- Tariff configuration
- Report: Sending report to a user defined e-mail address at a user defined interval, e.g. key energy management figures in accordance with ISO 50001

5) Maintenance

Graphical representation of maintenance statuses of system components (compressors, blowers, vacuum units, dryers, filters, etc.). The maintenance statuses of the individual components are visible at a glance.

6) Control

- Nominal and actual pressure values
- Pressure monitoring

7) SAM 4.0 Logic

SAM 4.0 Logic enables users to take advantage of customized functions tailored to their specific compressed air system. Using logic functions, it is possible to make inlet, circulating, and exhaust louvers operate according to temperature, for example.

8) Time control

The compressed air system can be controlled via the integrated timer: 99 switching points are available.

9) Initial start-up

- Overview of all Sigma Network inputs and outputs
- Overview of all units connected via Profibus and all PBU's (Profibus I/O's)
- Overview of all connected units with Sigma Control 2 via Sigma Network
- Update to most current software version
- Importing of expanded/customized compressed air system configuration
- Saving of settings data, event history, and log files on SD card
- Information and settings for connection to control center

10) Configuration

- SAM 4.0 serial data
- Interface settings
- E-mail settings
- Date, time, language
- User management
- Display settings, key lock

11) Contact

Kaeser contact information

12) i-Button

Online operating instructions can be called up via the i-Button.

Kaeser Sigma Smart Air:
Your all-around carefree service package

Each individual component from the Kaeser Sigma Network is a premium quality product based on Kaeser's decades of engineering and manufacturing expertise.

The benefits derived from this knowledge can be decisive for your business, since only Kaeser ensures seamless compressed air supply and provides optimum energy-efficiency for your compressed air system.

Furthermore, the unique combination of remote diagnostics—performed by Kaeser compressed air experts—and needs-based preventive maintenance offers you an unparalleled degree of compressed air supply security and significant cost savings.

With the Kaeser Sigma Smart Air service package, you benefit from Kaeser's complete full-service spectrum—from hardware to software, installation to commissioning, and data analysis to dynamic maintenance. Kaeser delivers and oversees your business' entire compressed air supply, day in and day out, 24/7.

If you would like to learn more about the optional Kaeser Sigma Smart Air, contact your local authorized Kaeser representative.

Data transfer

Compressed air system with Sigma Air Manager 4.0

Advantages at a Glance

- Maximum availability
- Optimum efficiency
- Low life cycle costs
- Ideal service management
- Energy management certification as per ISO 50001
- Future-dynamic

24/7

Analysis and evaluation

Kaeser Data Center

Round-the-clock service and energy management

Applying Sigma Air Manager 4.0

SAM 4.0 is your round-the-clock compressed air expert—a simple solution to ensure optimum performance and record detailed information to inform your operational decisions.

Compressed air usage frequently changes in the dynamic production environment and simply purchasing efficient compressors won't ensure long term efficiency and reliability. A master controller is necessary to continually optimize the operation of the compressors. Further, compressed air is one of your largest utility costs yet, you probably have very little detail on how it is used and how efficiently you are creating it. With SAM 4.0, you have detailed data on your use of compressed air and the cost of making it. SAM 4.0 gives you insight into the ongoing energy costs that you can tie to production costs overall. Without the SAM 4.0, it is easy to lose sight of the high cost of compressed air and how production changes have impacted your system performance.

Benefits of Applying SAM 4.0

1. Reduce the initial costs for new projects and expansions by up to 20%.

2. Increase the productivity of your facility by creating greater flexibility and lowering redundancy costs.

3. Provide real time monitoring of your system both locally and remotely.

4. Provide detailed historical air demand information allowing for simple and accurate expansion planning as well as operating cost changes.

Optimizing system design with SAM 4.0

Reduce initial costs and increase productivity: SAM 4.0 eliminates the need for costly frequency drive compressors to provide peak efficiency. A SAM 4.0 installation replaces single large unit systems with multiple smaller unit systems providing for greater productivity, inherent redundancy and lower costs for expansion.

Reduce operational costs: SAM 4.0 manages both the flow and pressure of your system. This allows you to operate your system at the minimum pressure necessary to meet the demands of production. Operational costs are saved as compressors operate more efficiently at lower pressure and artificial demand from leaks and unregulated uses are reduced.

Real time monitoring: The connectivity options available with a SAM installation allows for real time system monitoring and evaluation of alarms from any authorized laptop. One key advantage to this feature is the ability to diagnose issues remotely reducing the frequency of late night trips back to your facility.

Historical performance: The detailed information the SAM 4.0 provides you will feed more knowledgeable decision-making. For example:

- Changes in production and their effect on compressed air consumption and costs. Are there expensive inappropriate uses of compressed air? How has your compressed air leak load changed over time?

- Allocation of unit production costs. Generally compressed air is the single largest contributor to your overall energy costs yet without SAM 4.0, it's difficult to track your real costs. Knowing how your compressed air system changes when production changes can help you better allocate costs within your organization.

How SAM 4.0 reduces costs

System Design	Option 1: Single 125 hp Variable Frequency Drive Compressor	Option 2: 2 x 60 hp Fixed Speed Compressors with SAM 4.0	Option 3: 75 hp Variable Frequency Drive and 40 hp Fixed Speed Compressors with SAM 4.0
Annual Energy Cost [1]	$45,444	$49,492	**$44,729**
Peak Power	93.74 kW	95.97 kW	**90.40 kW**
System Specific Power	17.60 kW/100 cfm	19.21 kW/100 cfm	**17.33 kW/100 cfm**
Footprint [2]	**348 ft^2**	425 ft^2	415 ft^2
Recommended System Storage[3]	3,000 gal.	**1,440 gal.**	1,775 gal.
Equipment Cost	$74,500	**$62,500**	$74,500
Redundancy [4]	0%	**50%**	35%
Cost for Growth or Backup [5]	$74,500	**$30,000**	$40,000
Annual Parts Cost [6]	$2,510	**$1,610**	$2,595
5-Year Life Cycle Cost	$314,270	$318,010	**$311,120**

(1) Assuming a typical industrial compressed air system with a max flow of 500 cfm, average of 280 cfm and minimum flow of 125 cfm. Operating 24/7 at 100 psig with a power cost of $0.10/kWh.

(2) Footprint: Includes the necessary area for compressors, storage, air treatment, and ventilation with sufficient clearance for maintenance.

(3) Recommended system storage: Based on the Compressed Air Challenge guideline of 5 gallons per cfm of the largest compressor.

(4) Redundancy: Compressed air system capacity if a single unit fails.

(5) Cost for growth: Cost for an additional compressor to create 100% redundancy.

(6) Annual parts cost: Preventive maintenance filters and oil based on 8,760 hours a year and the system profile described above.

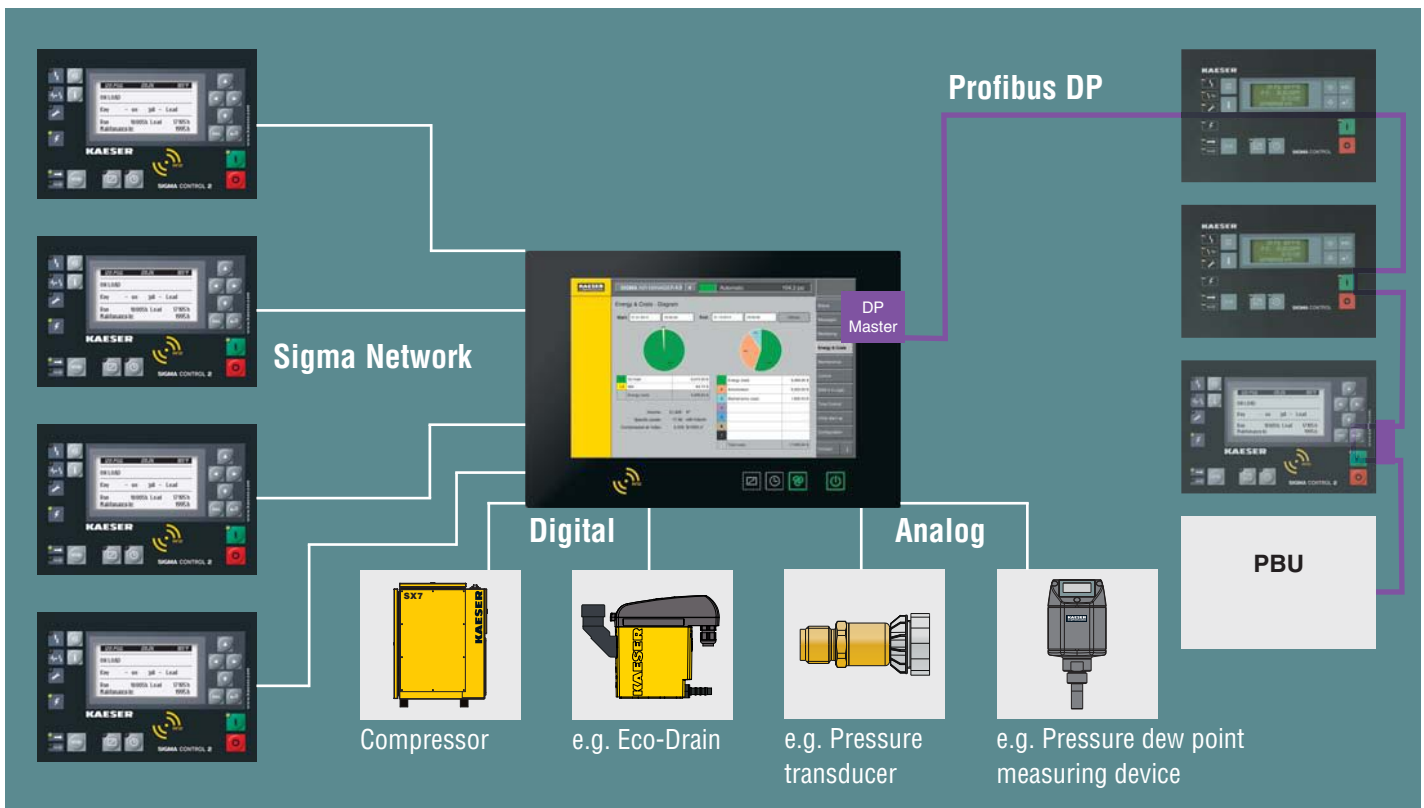**Option 1: smallest footprint, but most expensive and offers no redundancy**

Option 2: lowest initial equipment cost and annual parts cost, offers redundancy, but not as efficient as option 3

Option 3: most efficient, lowest 5-year life cycle costs, and offers some redundancy

Equipment

Compressed air system with Sigma Air Manager 4.0—possible connections

Control Systems

Specially adapted industrial PC with powerful "Quad Core" processor, featuring an operating panel, control, and processing unit, communications interfaces, and integrated web server, Sigma Network ports, digital and analog input and output signals.

Man / machine interface

Intuitive operation; LED-backlit 12.1-inch TFT, 16:10 ratio industrial color display with capacitive touch technology. 1280 x 800 pixel resolution, four LED backlit touch keys, RFID read / write device for Kaeser Equipment Cards and Kaeser RFID keys. 30 selectable languages.

Communications interfaces

Gigabit Ethernet for remote visualization (web server), e-mail, slot for communications module (for connecting to control center), SD HC/XC card slot (e.g. for updates).

Control cabinet

Stainless steel / polymer control cabinet for wall mounting, dust and splash proof to IP 54, CE, cULus, international radio licenses.

Options

SNW ports RJ 45 (+6 ports); SNW-Profibus master, e.g. to connect compressors with Sigma Control. Communications module: Profibus DP, Profinet IO, Modbus TCP, EtherNet/IP.

Upgrade

Software upgrade to increase the number of controllable components. Hardware change not required.

Accessories

Sigma Network bus convertor (SBC) is available to expand the control unit. The SBC can be equipped with digital and analog input and output modules as well as with Sigma Network ports.

Technical Specifications

	SAM 4.0 - 4	SAM 4.0 - 8	SAM 4.0 - 16
Pressure Control			
Adaptive 3D*advanced* Control	Standard		
Possible air system interconnections			
Maximum number of controllable compressors	4	8	16
Compressors with Sigma Control 2 via Sigma Network	4	7	7
SNW Port RJ 45	Standard: 7 ports		
Available input signals			
Digital 24V DC (e.g. Eco-Drain, compressors without Sigma Control, remote On-Off)	6		
Analog 4-20 mA (e.g. Pressure dewpoint measuring device, pressure transducer)	4		
Available output signals			
Relay outputs (e.g. third party compressors, compressors with Sigma Control Basic, group alarm)	5		
Equipment			
Visualization via integrated web server	Standard		
Operating data long-term memory 1 year	Standard		
Pressure transducer	Standard		
Communications interfaces			
Gigabit Ethernet for remote visualization (web server)	Standard		
Slot for communications module (e.g. Profibus DP, Profinet IO, Modbus TCP)	Standard		
SD HC/XC card slot (e.g. updates)	Standard		
Plug in Profibus DP, Profinet IO, Modbus TCP, EtherNet/IP communications adapter	Option		
Dimensions, weight			
W x D x H (in.)	$21^{1}/_{4}$ x $11^{3}/_{16}$ x 19		
Weight (lbs.)	44.1		

Specifications are subject to change without notice.

The world is our home

As one of the world's largest compressed air systems providers and compressor manufacturers, Kaeser Compressors is represented throughout the world by a comprehensive network of branches, subsidiary companies and factory trained partners.

With innovative products and services, Kaeser Compressors' experienced consultants and engineers help customers to enhance their competitive edge by working in close partnership to develop progressive system concepts that continuously push the boundaries of performance and compressed air efficiency. Every Kaeser customer benefits from the decades of knowledge and experience gained from hundreds of thousands of installations worldwide and over ten thousand formal compressed air system audits.

These advantages, coupled with Kaeser's worldwide service organization, ensure that our compressed air products and systems deliver superior performance with maximum uptime.

KAESER COMPRESSORS

Built for a lifetime.™