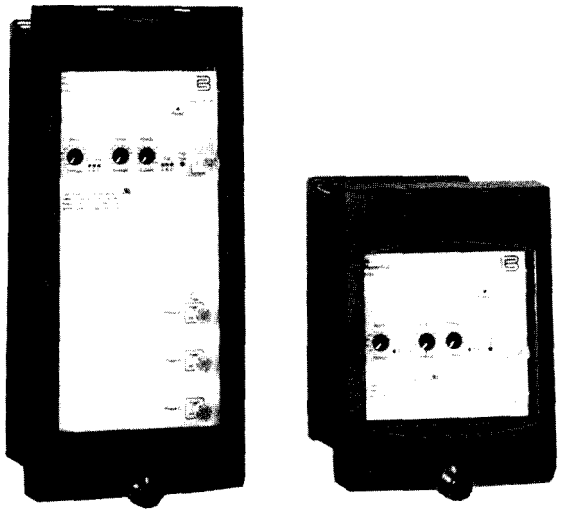


BE1-87B HIGH IMPEDANCE BUS DIFFERENTIAL RELAY

The BE1-87B Bus Differential Relay provides economical high speed protection in a conventional package for all high impedance differential applications.

ADVANTAGES

- Proven performance of High Impedance Differential for optimum speed and selectivity.
- Available in single phase or three phase configurations to allow space and cost benefits.
- Fully drawout, testable in case design, compatible with existing panel mount configurations.
- CT Circuit Diagnostic function and Steady State Unbalance alarm to verify external wiring and prevent misoperation.
- Includes an intentional 20msec delay timer that can be inserted in the trip logic to aid in coordination when the bus is tapped with high speed fuses.
- Warranty 5 years.

ADDITIONAL INFORMATION

INSTRUCTION MANUAL

Request publication 9282300990

Basler Electric

P. O. BOX 269 HIGHLAND, ILLINOIS, U.S.A. 62249 PHONE 618-654-2341 FAX 618-654-2351

APPLICATION

High impedance bus differential relaying is the leading means of bus protection on high voltage and critical application buses. The differential recognizes faults by detecting an unbalance between currents flowing into and out of the protected bus. The high impedance operate circuit (5kΩ) of the relay forces the unbalance currents through the CTs and limits the effect of unequal CT performance. For non-fault conditions, the resulting voltage across the relay's impedance is near zero. For an internal fault, however, the resulting voltage is essentially the open circuit voltage of the CTs. The relay defines a voltage level tripping threshold between fault and non-fault conditions. When a fault condition is detected, back-to-back SCRs gate and short out the high impedance of the operate circuit, thus clamping the voltage rise across the CT circuit and providing a low impedance path for differential current flow. Security of the relay is enhanced by using the current flow in the low impedance path (fault detector) to supervise a differential trip. Refer to the functional block diagram, Figure 1.

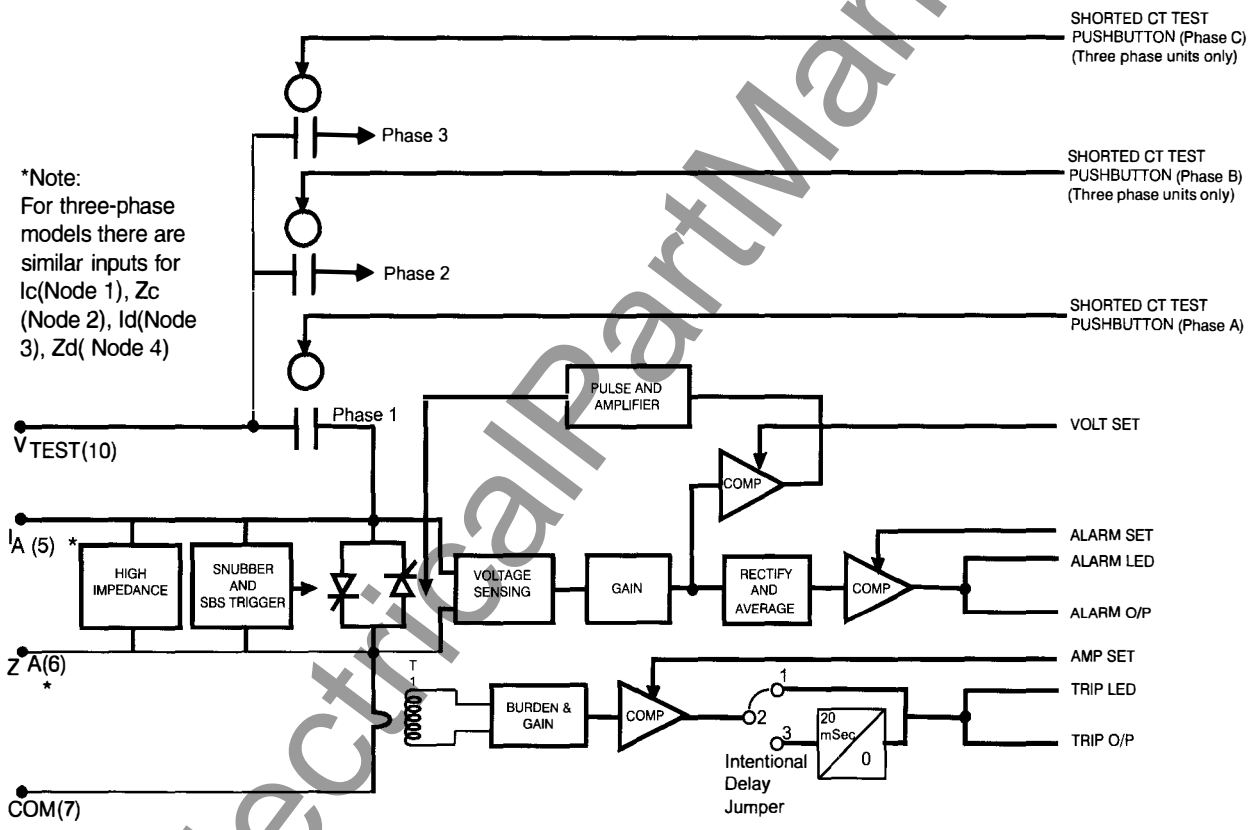


Figure 1 - Functional Block Diagram

FUNCTIONAL DESCRIPTION

PROTECTION

Based on industry standard operating philosophies, the BE1-87B uses solid state components to achieve high speed operation. The relay uses high impedance differential, supervised by a current fault detector circuit.

The relay monitors the summed current from the CTs associated with the protected bus. This differential current is applied to a fixed impedance within the relay. The relay measures the voltage developed across the impedance. When the measured voltage exceeds the trip threshold, a back-to-back SCR circuit is triggered, that provides a low impedance differential current path. The relay confirms that differential current is flowing (fault detector) before initiating a trip signal.

Overall trip times are less than 7 milliseconds above 1.5 multiples of current pickup, and less than 5.5 milliseconds above 6 multiples of pickup. See Figure 2.

The BE1-87B adds the availability of a three phase configuration to provide additional space and cost benefits.

As with any high impedance differential scheme, all CTs should have the same ratio. The voltage "clamping" of the SCRs allows use of multi-ratio CTs connected at less than full ratio. Contacts from an external "86" device should be added to short the differential input(s) after a trip, to limit the current carrying duty of the relay's shunt circuitry. See the Instruction Manual for more detailed information.

The extremely high speed operation of this relay makes it difficult to prevent tripping for faults on taps off the bus that are protected by fuses. An intentional 20msec. time delay can be inserted in the trip logic to aid in coordination with a high speed fuse in these applications.

MONITORING AND DIAGNOSTICS

The BE1-87B relay provides unique CT circuit monitoring functions to prevent misoperation of the bus protection system.

Mismatch of currents due to CT connection errors can cause detectable steady state unbalance to be developed under load. The BE1-87B uses a separate voltage comparison to detect any abnormal unbalance below fault levels. If a problem is detected, the relay will close an alarm contact and actuate a front panel CT overvoltage LED.

A second diagnostic function is included to detect a shorted CT. A shorted CT shunts the relay's differential impedance and can effectively disable the relay. This condition can occur for situations such as inadvertently leaving CT shorting switches open, and is not easily detected by conventional instrumentation. The BE1-87B includes a CT Test Circuit to allow detection of this condition. A test switch on the front of the relay is used to connect an external voltage source to excite the CT circuits (requires CT Diagnostic Test Source Assembly, Basler part number 9282300014. See Figure 4). If the CT circuits are connected properly (not shorted), the external voltage will be sufficient to light an LED on the relay's front panel.

SENSING INPUTS

The sensing input of the relay is designed to simultaneously sense voltage and current. The input appears as a high impedance until the voltage pickup is exceeded, then as a low impedance.

TEST INPUT

An additional input is provided to connect a test voltage to the differential circuit. This voltage is switched in to detect short circuits in the CT circuit.

OUTPUTS

The BE1-87B includes dual redundant trip outputs. It also includes an output for the Monitoring and Diagnostic functions, and a power supply fail contact.

HUMAN MACHINE INTERFACE (HMI)

All necessary settings are achieved using easily read front panel rotary switches. No special tools are required to apply or read settings.

SELF TESTS

The BE1-87B includes a power supply fail alarm. This normally closed output contact is held open during normal relay operations. In the event of a failure in the relay's power supply, the contact will drop out to the closed state, providing an alarm signal.

FUNCTIONAL DESCRIPTION, continued

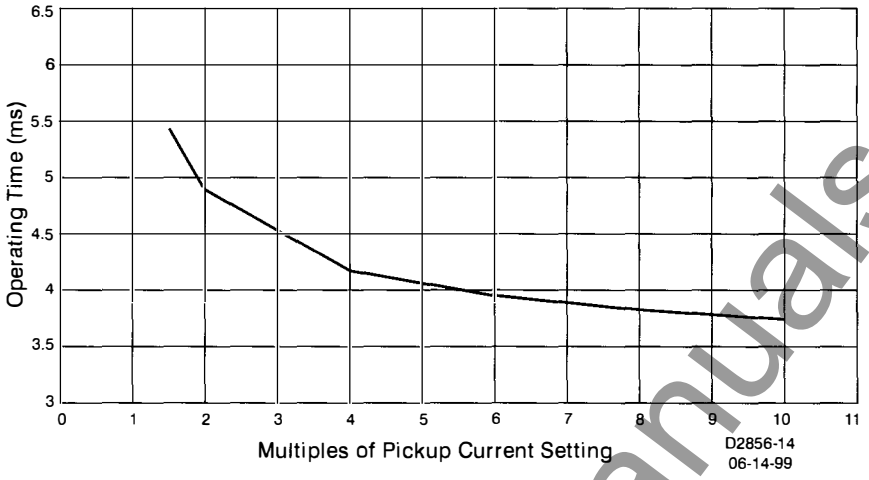


Figure 2 - Typical Pickup Current Response Time Without a Trip Delay

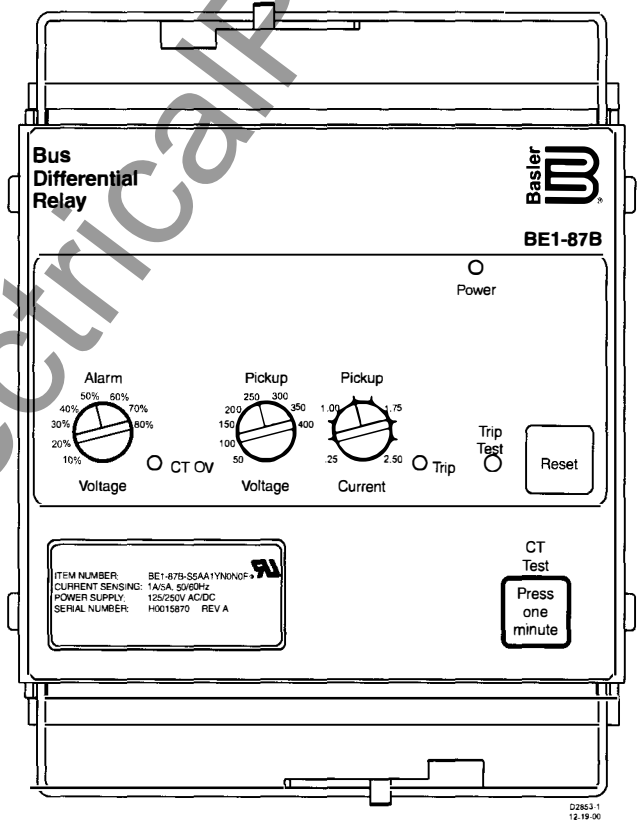


Figure 3 - Front Panel Layout (Single Phase Version)

FUNCTIONAL DESCRIPTION, continued

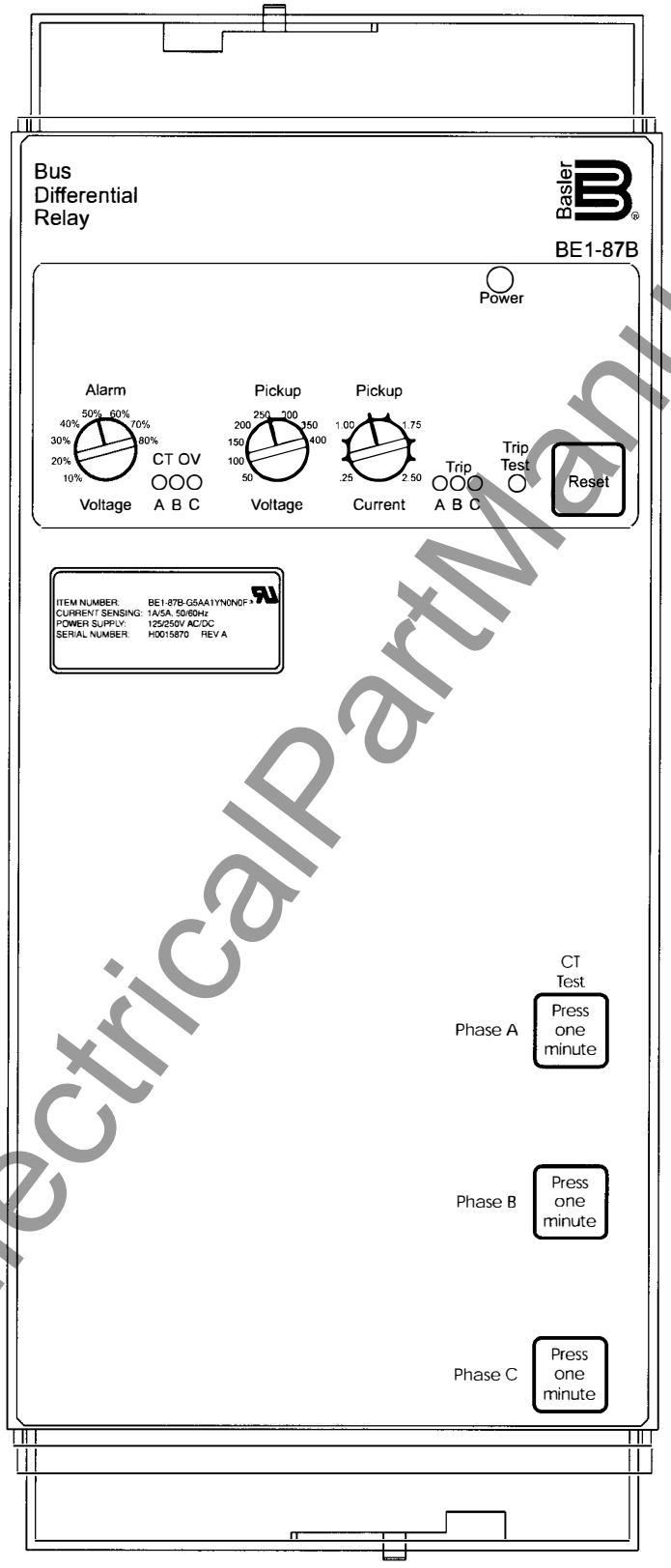


Figure 4 - Front Panel Layout (Three Phase Version)

GENERAL SPECIFICATIONS

FREQUENCY

50/60Hz

HIGH IMPEDANCE INPUTS

The high impedance unit of the relay provides a fixed impedance of 5000Ω. After operation of the SCR shorting, the impedance will be negligible.

TRIP CONTACTS

Make and carry:	30A (0.2sec) @250Vdc
Continuous:	7A
Break:	0.3A DC @ 125Vdc (L/R=0.04)

CURRENT AND VOLTAGE SETTINGS

Current Pickup:	0.25 - 2.5A in 0.25A increments
Voltage Pickup:	50 - 400V in 50V increments (calibrated to 2 times setpoint to accomodate asymetrical waveforms)
Voltage Alarm Pickup:	10 - 80% of voltage setpoint in 10% increments

CURRENT RATING

10A rms continuous
160A rms symmetrical at 1 second
480A rms symmetrical at 5 cycles
215A fully offset at 2 cycles

POWER SUPPLY

Input: 48/125 Volt nominal or 125/250 Volt nominal, depending on style selection. Each power supply is rated for operation at AC or DC voltage sources.

Type	Nominal Input Voltage	Input Voltage Range	Burden at Nominal
Y	48/125Vdc 110Vac	24-150Vdc 90-132Vac	7.5W 15.0VA
Z	125/250Vdc 110/230Vac	60 to 250Vdc 90-230Vac	7.5W 20.0VA

ENVIRONMENTAL

Operating conditions: Qualified to IEEE C37.90, IEC 255-14, and IEC 255-15

Operating temperature range: -40°C to 70°C (-40°F to 158°F)

Storage temperature range: -65°C to 85°C (-85°F to 185°F)

ISOLATION

In accordance with IEC 255-5 and ANSI/IEEE C37.90 one minute dielectric (high potential) tests as follows:

All circuits to ground:	2000Vac or 2828Vdc
Input to output circuits:	2000Vac or 2828Vdc

TRANSIENT SURGE (Fast Transient and SWC)

Qualified to IEEE C37.90.1-1989, IEC 255-22-4 and IEC 255-22-5.

RADIO FREQUENCY INTERFERENCE (RFI)

Qualified to ANSI C37.90.2 and IEC 255-22-3

ELECTROSTATIC DISCHARGE (ESD)

Qualified to ANSI/IEEE C37.90.3, eight kilovolts contact discharges and 15 kilovolts air discharges applied.

SEISMIC

Qualified to IEEE C37.98, IEC TC4CB

SHOCK VIBRATION AND BUMP

Qualified to IEC 255-21-1, IEC 255-21-2

AGENCY RATINGS

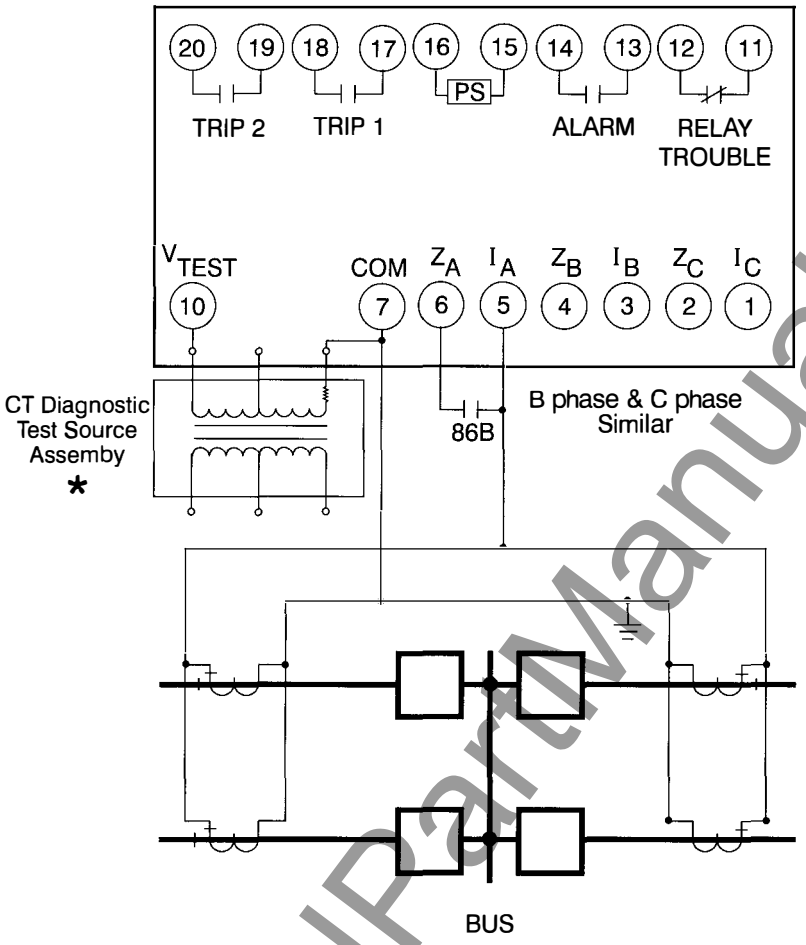
UL recognized

WEIGHT

Single phase: 14.3 pounds, 6.49 kg
Three phase: 19.2 pounds, 8.7 kg

CASE SIZE

Single phase (S1): 6.65"W x 9.32"H x 9.40"D
Three phase (M1): 6.65"W x 15.32"H x 9.40"D



* Optional Accessory, Basler P/N 9282300014

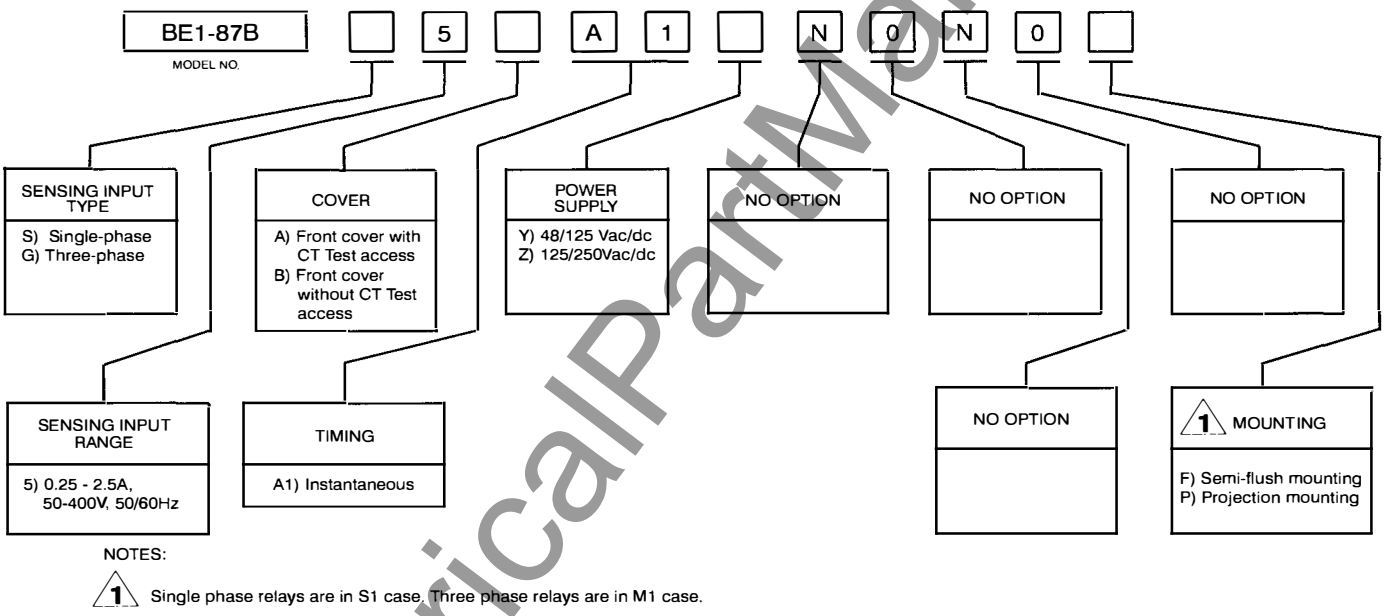
Figure 5 - Typical Connections Diagram

ORDERING

SAMPLE STYLE NUMBER

The style number identification chart defines the electrical characteristics and operation features included in the BE1-87B relay. For example, if the style number were **S5AA1YN0N0F**, the device would have the following:

(S) - Single phase
(5) - 5 Amp
(A) - Front cover with CT Test access
(A1) - Instantaneous timing
(Y) - 48/125 Vac/dc Power Supply
(N) - No Option
(0) - No Option
(N) - No Option
(0) - No Option
(F) - Semiflush Mounting



NOTES:

1 Single phase relays are in S1 case. Three phase relays are in M1 case.

ACCESSORIES

CT Diagnostic Test Source Assembly for BE1-87B, Basler part number 9282300014.

Basler Electric
ROUTE 143, BOX 269, HIGHLAND, ILLINOIS U.S.A. 62249
PHONE 618-654-2341 FAX 618-654-2351
P.A.E. Les Pins, 67319 Wasselonne Cedex FRANCE
PHONE (33-3-88) 87-1010 FAX (33-3-88) 87-0808
http://www.basler.com, info@basler.com

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