Model, Type K 1846 19200816	Serial No. 414491

SCHAEFER
Robust - Reliable Power Solutions

Unit test plan for the K 1846 Left / Right Modules (Half MVC):	June 22nd, 2020
Document number:	200622DR

K 1846 Left / Right Module Serial Number	
K 1846 Left Module	✓
K 1846 Right Module	○

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Model, Type K 1846 19200816	Serial No. 414491

Calibration Record			
Item	**Manufacturer**	**Type**	**Calibration Due**
Main load resistor	SCHAEFER	1000R	----------
Adj. Load resistor	SCHAEFER	2 * 120R	----------
Oscilloscope	TEKTRONIX	TDS 3014B	----------
Amperemeter - Input current	FLUKE	175	31.08.2020
Amperemeter - Output current	FLUKE	175	31.08.2020
Voltmeter – Input	HAMEG	HM 8012	31.08.2020
Voltmeter – Output	HAMEG	HM 8012	31.08.2020
Voltmeter – Telemetry Vin	HAMEG	HM 8012	31.08.2020
Voltmeter – Telemetry Vout	HAMEG	HM 8012	31.08.2020
Voltmeter – Telemetry Iin	HAMEG	HM 8012	31.08.2020
Voltmeter – Telemetry Iout	HAMEG	HM 8012	31.08.2020
10:1 Divider	SCHAEFER	----------	31.01.2021
Insulation Resistance meter	SCHAEFER	----------	10.06.2023
Power source	SCHAEFER	----------	31.01.2021
Cable simulator	----------	----------	----------

Date: 25/6/2020 location: SCHAEFER factory	Signature: Mr. [signature] / Mr. _____ SCHAEFER

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The tests are performed under nominal environmental conditions, i.e. room temperature 22°C ± 5° and relative humidity 70%.

1. High voltage test, 1min (Both input lines connected together, and all output lines (power and signals) connected together.)

Description	Test Parameters	Required value	Actual Value	
a.) Input against (Outputs + signals + Ground)	3k6V DC 1min	<5mA	o.k.	✓
b.) Output 375V DC against (Input + signals + Ground)	3k6V DC 1min	<5mA	o.k.	✓
c.) Signals against (Output 375V DC + Input + Ground)	3k6V DC 1min	<5mA	o.k.	✓

The High Voltage Test is to establish the compliance with the DIN / EN 60950-1:2003 NORM.
This dictates that the tested points, primary / input cct against the secondary / output circuit, and the mechanical earth circuit / metalwork (chassis & casing etc) should yield a current less than a pre-determined Ampere value.
Any current measured in excess of this value is interpreted as an insulation value of less than the acceptable NORM and thus shall fail the test.

The procedure to perform the test is as follows.

a. Ensure the dedicated environment is dry and clean.
b. Ensure the High Voltage Test equipment is available and authorised for use (ISO 9001 criteria / calibration & marking).
c. Ensure the High Voltage Test equipment is set to 0V DC.
d. Examine the K 1846 (subject for test).
e. Ensure the mechanical integrity of the K 1846 is such that the test may be performed.
f. Locate on the accompanying documentation for the K 1846 the input / primary terminal connections.
g. Connect them together creating a single link for the High Voltage Test equipment.
h. Locate on the accompanying documentation for the K 1846 the output / secondary terminal connections.
i. Connect them together creating a single link for the High Voltage Test equipment.
j. Locate on the accompanying documentation for the K 1846 the signals / voltage free terminal connections.
k. Connect them together creating a single link for the High Voltage Test equipment.
l. Locate on the accompanying documentation for the K 1846 the earth / mechanical terminal connections.
m. Connect them together creating a single link for the High Voltage Test equipment.
n. Close off the dedicated area and observe the warning apparatus has been activated to indicate that a High Voltage Test is about to be performed.
o. Test steps – each step and test value is indicated below. Duration of test step is 1 minute.
   - Input against the rest (output, signals & earth connections connected together).
   - Output against the rest (input, signals & earth connections connected together).
   - Signals against the rest (input, output & earth connections connected together).

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2. Grounding test			
Test current < 10Amps			
Ground connection → Cover R=V/I	< 0.1Ω	✓	

a. The Ground test establishes that a short circuit is present between the ground / earth potential and the mechanical earth point.
b. The continuation of the High Voltage Test area use is under the same auspices as before.
c. Locate the test equipment for the earth test procedure.
d. Successful test completion is complied with when the current indication exceeds 25Amp.
e. Test step – the test value is indicated below. Duration of this test step is 1 minute.
   - Earth against the rest (input, output & signals connections connected together).

3. Power up test		
Power up test with no external 24V supply	o.k.	✓

4. Functional Tests

Test Item	Description	Desired value	Actual value
4.1 Input	Lower turn on value $V_{o/p}$ 375V DC / 0.67A (250W)	$V_{i/p\,(on)}$ < 1200V DC	$V_{i/p\,(on)}$ = 1163 V DC
4.1 Input	Lower turn off value $V_{o/p}$ 375V DC / 0.67A (250W)	$V_{i/p\,(off)}$ < 1150V DC	$V_{i/p\,(off)}$ = 1109 V DC
4.2 Input	Upper shut off value $V_{o/p}$ 375V DC / 0.67A (250W)	$V_{i/p\,(off)}$ > 2300V DC	$V_{i/p\,(off)}$ = 2331 V DC
4.2 Input	Upper shut on value $V_{o/p}$ 375V DC / 0.67A (250W)	$V_{i/p\,(on)}$ > 2000V DC	$V_{i/p\,(on)}$ = 2112 V DC

The above test measurements indicate the input voltage values at which the K 1846 turns on and off.
The test is performed by increasing the input voltage applied to the K 1846 until the unit turns on.
Then increasing the input voltage until the unit turns off.
Correspondingly, the voltage is reduced until the unit turns back on again, and reduced further until the unit turns back off again.
This establishes the turn on / off values at both the lower voltage level and the higher voltage level.
As a point of comparison, the current of the output is both noted and recorded for this test.

Test Item	Description		Desired value	Actual value
4.3 Output	Line regulation $V_{o/p}$ 375V DC / 4.0A (1,5kW)	$V_{i/p}$ = 1200V DC	$V_{o/p}$ = 375V DC ± 1%	$V_{o/p}$ = 375 V DC
		$V_{i/p}$ = 1800V DC	$V_{o/p}$ = 375V DC ± 1%	$V_{o/p}$ = 375 V DC

The Line regulation test establishes the variance of the output voltage setting – its true calibrated value – when the input is altered from its minimum operational value to its maximum operational value.
The K 1846 manufacturer specification has this expected tolerance noted as a percentage value in the desired value column.

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Test Item	Description		Desired value	Actual value
4.4 Output	Load regulation $V_{i/p}$ = 1500V DC I_N = 4,0A	$I_{o/p}$ = 0,4A (10%)	$V_{o/p}$ = 375V DC ± 1%	$V_{o/p}$ 376 V DC / 0.4 A
		$I_{o/p}$ = 3,6A (90%)	$V_{o/p}$ = 375V DC ± 1%	$V_{o/p}$ 375.3 V DC / 3.6 A

The output load regulation is the alteration of the output voltages when each of the loads is individually altered from 10% to 90% of its nominal value.
The test is performed without alteration to the nominal input voltage applied.
The K 1846 manufacturer specification has this expected tolerance noted as a percentage value in the desired value column.

Test Item	Description	Desired value	Actual value	
4.5 Output	Current limitation $V_{i/p}$ = 1500V DC (per half)	$I_{o/p}$ > 4.0A	$I_{o/p}$ = 4.23 A	$I_{i/p}$ = 1.18 A
4.6 Output	Short circuit test	$I_{o/p}$ = 4.0A ± 0.4A	$I_{o/p}$ = 4.2 A	$I_{i/p}$ = 0.1 A

This Step is the current limitation calibration setting verification.
The test is performed without alteration to the nominal input voltage applied.
The test is performed with the respective other output not being altered.
The K 1846 manufacturer specification has this expected value in the desired value column.
The desired value is the minimum value required to be specification compliant.
The actual value is that which is recorded in the test sequence.
To achieve the test condition where the value may be noted,

- The 375V DC output has a load applied to its output terminal connections so that the output current extracted may be increased, noted and recorded until the output voltage begins to reduce from its nominal value (refer to cross load regulation value) and enters a constant current mode of operation. This is the points at which current limitation takes place.
- Reduce to resistive loading further, and observe the corresponding output voltage reduction, without any increase in the output current being supplied. Apply a direct short circuit, note the current value.

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Test Item	Description	Desired value	Actual value
4.7 Output	Output ripple $I_{o/p}$ = 4.0A	$V_{o/p}$ < 5%$_{p/p}$	$V_{o/p}$ = 1 $V_{p/p}$

The output voltage ripple measurement is to establish the value and voltage tolerance being generated.
The test is performed without alteration to the nominal input voltage applied.
The test is performed with the respective other output not being altered.
The K 1846 manufacturer specification has this expected tolerance noted as a percentage value in the desired value column.
The outputs are individually loaded as before and the DC output voltage is measured with an oscilloscope in an AC setting where the DC output fluctuation can be seen and recorded.

Test Item	Description	Desired value	Actual value
4.8 Output	Start up time $V_{i/p}$ = 1200V DC	200ms < t < 5 sec	T = 0.6 sec

The start-up time, is the duration required for the primary power circuit to interpret the conditions that allow the output to be generated, controlled and delivered to the output terminal connection.
This is not to be confused with the soft-start sequence which is the pre-evaluation of the parameters that lead to the permission of the power circuit to operate.
The K 1846 manufacturer specification has this expected tolerance noted as a percentage value in the desired value column.
The test is carried out through the observation of the signals which permit and the output voltage value through the use of an oscilloscope. Each unit has its individual test result.
The input voltage is applied and the output is loaded to 1kW.
The input voltage is interrupted. The secondary and primary power circuits are allowed to discharge to zero by waiting for 3 minutes.
t = 0 is when $V_{i/p}$ reaches 1200V DC and t (recorded value) equates to the start of the rise of the output voltage
The input voltage is applied at 1200V DC and the time lag measured for the output voltage to be generated & stabilised is recorded.

Test Item	Description	Desired value	Actual value	
4.9a Output	Over Voltage Protection	415 < $V_{o/p}$ < 420V DC	$V_{o/p}$ = 419 V DC	
4.9b Output	Over Voltage Latches off	Latches off after 1 OVP	o.k.	✓

The OVP, Over Voltage Protection, circuit is the turning off of each of the outputs individually once a pre-determined value has been reached.
This value is noted in the above table.
The K 1846 manufacturer specification has this expected value in the desired value column.
The output voltage of each power output is individually increased through the manipulation of the Control Board regulation circuit.
The point at which the unit automatically shuts down is noted and termed the value at which OVP becomes active.

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Test Item	Description		Desired value	Actual value	
4.10 Output	Alarm indication Common Alarm tripped when:	a. Over temperature of K 1846 >60°C	Remote contact	o.k.	✓
		b. Over temperature of K 1846 >80°C	Changeover Contact	o.k.	✓
		c. DC ok ($V_{o/p}$ > 340V DC)	Changeover Contact	o.k.	✓

The alarm indication is the value at which the output voltage, or the listed other detected events, when reduced to raises a signal that indicates the pre-determined value has been reached.
The temperature are provided via heat gun.
The purpose of this alarm is the signalisation to an external source of operation outside of expected values.
It may result from an input power failure or output overload of the power element within the K 1846.
As a common alarm, it is integrated so that either power element signals this condition.
The procedure to detect and record this alarm is once again through the entering into current limitation where the slow reduction in resistive (load) value results in the output voltage being reduced.
The alarm can therefore be accurately recorded and noted in the table above.
The test is performed with the respective other output not being altered.
The K 1846 manufacturer specification has this expected value in the desired value column.

4.11 Telemetry							
$U_{i/p}$	Actual V		O	562,5	1125	1687,5	2250
	Telemetry V	Theoretical	O	1,25	2,5	3,75	5
		Actual		1.25	2.50	3.76	5.02
$I_{i/p}$	Actual A		O	0,35	0,7	1,05	1,4
	Telemetry A	Theoretical	O	1,25	2,5	3,75	5
		Actual		1.24	2.50	3.75	5.01
$U_{o/p}$	Actual V		O	105	210	315	375
	Telemetry V	Theoretical	O	1,25	2,5	3,75	4,47
		Actual		1.24	2.51	3.75	4.47
$I_{o/p}$	Actual A		O	1,0	2,0	3,0	4,0
	Telemetry A	Theoretical	O	1,25	2,5	3,75	5,0
		Actual		1.25	2.43	3.74	4.98

The telemetry signals shall have an accuracy of better than, or equal to1% (equal to <50mV of error on 5V signal).
They are linear, and supplied from the 24V DC CAN power supply in their power requirement.
The signals shall be noted during the test sequence and tabulated for graphic comparison with their expected resolution.
Measure the input voltage. Measure the input voltage telemetry signal. Record the results of the measurements.
Apply the minimum input voltage to the K 1846. Allow the output to exist under no load condition. Measure the input current, measure the input current telemetry signal. Increase the output load until nominal has been reached, recording at each step the input current telemetry value.

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Measure the output nominal voltage, record both this and its telemetry value.
Increase the output voltage to 375V DC, performing several output voltage telemetry measurements.
Measure the output current, record both this and its telemetry value. Increase the output current from 0Amp to 4,0Amp, performing several output current telemetry measurements.

5. Duration test		
Duration test 10 hours $V_{i/p}$ = 1800V DC, $P_{o/p}$ = 1500W	Completed.	✓

The duration test is the bench top burn in test sequence.
Fans and additional heat sinks can be used to ensure the K 1846 does not overheat
The finished K 1846 shall be exposed to a full load test sequence for the duration of time noted and recorded in the table above.

6. Visual tests		
Finish	o.k.	✓
Identification (label, terminal designation, …)	o.k.	✓

The visual and finish test is performed as a final quality before the packing occurs.
The standards are such that the Client receives a flawless mechanical solution mated to the completed electrical acceptance resulting for the successful conclusion of the manufacturing process.

Specific tests, highlighted, performed on the first article are not performed on the remaining of the K 1846 held under the 19200816 contract order.

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Unit test plan for the K 1846 Left / Right Modules (Half MVC):	June 22nd, 2020
Document number:	200622DR

K 1846 Left / Right Module Serial Number	
K 1846 Left Module	✓
K 1846 Right Module	○

Model, Type K 1846 19200816	Serial No. 414432

Calibration Record			
Item	**Manufacturer**	**Type**	**Calibration Due**
Main load resistor	SCHAEFER	1000R	----------
Adj. Load resistor	SCHAEFER	2 * 120R	----------
Oscilloscope	TEKTRONIX	TDS 3014B	----------
Amperemeter - Input current	FLUKE	175	31.08.2020
Amperemeter - Output current	FLUKE	175	31.08.2020
Voltmeter – Input	HAMEG	HM 8012	31.08.2020
Voltmeter – Output	HAMEG	HM 8012	31.08.2020
Voltmeter – Telemetry Vin	HAMEG	HM 8012	31.08.2020
Voltmeter – Telemetry Vout	HAMEG	HM 8012	31.08.2020
Voltmeter – Telemetry Iin	HAMEG	HM 8012	31.08.2020
Voltmeter – Telemetry Iout	HAMEG	HM 8012	31.08.2020
10:1 Divider	SCHAEFER	----------	31.01.2021
Insulation Resistance meter	SCHAEFER	----------	10.06.2023
Power source	SCHAEFER	----------	31.01.2021
Cable simulator	----------	----------	----------

Date: 25/6/2020 location: SCHAEFER factory	Signature: Mr. [signature] / Mr. _____ SCHAEFER

Model, Type K 1846 19200816	Serial No. 414432

The tests are performed under nominal environmental conditions, i.e. room temperature 22°C + 5° and relative humidity 70%.

1. High voltage test, 1min (Both input lines connected together, and all output lines (power and signals) connected together.)

Description	Test Parameters	Required value	Actual Value	
a.) Input against (Outputs + signals + Ground)	3k6V DC 1min	<5mA	o.k.	✓
b.) Output 375V DC against (Input + signals + Ground)	3k6V DC 1min	<5mA	o.k.	✓
c.) Signals against (Output 375V DC + Input + Ground)	3k6V DC 1min	<5mA	o.k.	✓

The High Voltage Test is to establish the compliance with the DIN / EN 60950-1:2003 NORM.
This dictates that the tested points, primary / input cct against the secondary / output circuit, and the mechanical earth circuit / metalwork (chassis & casing etc) should yield a current less than a pre-determined Ampere value.
Any current measured in excess of this value is interpreted as an insulation value of less than the acceptable NORM and thus shall fail the test.

The procedure to perform the test is as follows.

a. Ensure the dedicated environment is dry and clean.
b. Ensure the High Voltage Test equipment is available and authorised for use (ISO 9001 criteria / calibration & marking).
c. Ensure the High Voltage Test equipment is set to 0V DC.
d. Examine the K 1846 (subject for test).
e. Ensure the mechanical integrity of the K 1846 is such that the test may be performed.
f. Locate on the accompanying documentation for the K 1846 the input / primary terminal connections.
g. Connect them together creating a single link for the High Voltage Test equipment.
h. Locate on the accompanying documentation for the K 1846 the output / secondary terminal connections.
i. Connect them together creating a single link for the High Voltage Test equipment.
j. Locate on the accompanying documentation for the K 1846 the signals / voltage free terminal connections.
k. Connect them together creating a single link for the High Voltage Test equipment.
l. Locate on the accompanying documentation for the K 1846 the earth / mechanical terminal connections.
m. Connect them together creating a single link for the High Voltage Test equipment.
n. Close off the dedicated area and observe the warning apparatus has been activated to indicate that a High Voltage Test is about to be performed.
o. Test steps – each step and test value is indicated below. Duration of test step is 1 minute.
   - Input against the rest (output, signals & earth connections connected together).
   - Output against the rest (input, signals & earth connections connected together).
   - Signals against the rest (input, output & earth connections connected together).

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2. Grounding test			
Test current < 10Amps			
Ground connection → Cover R=V/I	< 0.1Ω	✓	

a. The Ground test establishes that a short circuit is present between the ground / earth potential and the mechanical earth point.
b. The continuation of the High Voltage Test area use is under the same auspices as before.
c. Locate the test equipment for the earth test procedure.
d. Successful test completion is complied with when the current indication exceeds 25Amp.
e. Test step – the test value is indicated below. Duration of this test step is 1 minute.
   - Earth against the rest (input, output & signals connections connected together).

3. Power up test		
Power up test with no external 24V supply	o.k.	✓

4. Functional Tests

Test Item	Description	Desired value	Actual value
4.1 Input	Lower turn on value $V_{o/p}$ 375V DC / 0.67A (250W)	$V_{i/p\,(on)}$ < 1200V DC	$V_{i/p\,(on)}$ = 1167 V DC
4.1 Input	Lower turn off value $V_{o/p}$ 375V DC / 0.67A (250W)	$V_{i/p\,(off)}$ < 1150V DC	$V_{i/p\,(off)}$ = 1037 V DC
4.2 Input	Upper shut off value $V_{o/p}$ 375V DC / 0.67A (250W)	$V_{i/p\,(off)}$ > 2300V DC	$V_{i/p\,(off)}$ 2324 V DC
4.2 Input	Upper shut on value $V_{o/p}$ 375V DC / 0.67A (250W)	$V_{i/p\,(on)}$ > 2000V DC	$V_{i/p\,(on)}$ 2115 V DC

The above test measurements indicate the input voltage values at which the K 1846 turns on and off.
The test is performed by increasing the input voltage applied to the K 1846 until the unit turns on.
Then increasing the input voltage until the unit turns off.
Correspondingly, the voltage is reduced until the unit turns back on again, and reduced further until the unit turns back off again.
This establishes the turn on / off values at both the lower voltage level and the higher voltage level.
As a point of comparison, the current of the output is both noted and recorded for this test.

Test Item	Description		Desired value	Actual value
4.3 Output	Line regulation $V_{o/p}$ 375V DC / 4.0A (1,5kW)	$V_{i/p}$ = 1200V DC	$V_{o/p}$ = 375V DC ± 1%	$V_{o/p}$ = 375 V DC
		$V_{i/p}$ = 1800V DC	$V_{o/p}$ = 375V DC ± 1%	$V_{o/p}$ = 375 V DC

The Line regulation test establishes the variance of the output voltage setting – its true calibrated value – when the input is altered from its minimum operational value to its maximum operational value.
The K 1846 manufacturer specification has this expected tolerance noted as a percentage value in the desired value column.

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Test Item	Description		Desired value	Actual value
4.4 Output	Load regulation $V_{i/p}$ = 1500V DC I_N = 4,0A	$I_{o/p}$ = 0,4A (10%)	$V_{o/p}$ = 375V DC ± 1%	$V_{o/p}$ 376.1 V DC / 0.4 A
		$I_{o/p}$ = 3,6A (90%)	$V_{o/p}$ = 375V DC ± 1%	$V_{o/p}$ 375.3 V DC / 3.6 A

The output load regulation is the alteration of the output voltages when each of the loads is individually altered from 10% to 90% of its nominal value.
The test is performed without alteration to the nominal input voltage applied.
The K 1846 manufacturer specification has this expected tolerance noted as a percentage value in the desired value column.

Test Item	Description	Desired value	Actual value	
4.5 Output	Current limitation $V_{i/p}$ = 1500V DC (per half)	$I_{o/p}$ > 4.0A	$I_{o/p}$ = 4.23 A	$I_{i/p}$ = 11.7 A
4.6 Output	Short circuit test	$I_{o/p}$ = 4.0A ± 0.4A	$I_{o/p}$ = 4.2 A	$I_{i/p}$ = 0.1 A

This Step is the current limitation calibration setting verification.
The test is performed without alteration to the nominal input voltage applied.
The test is performed with the respective other output not being altered.
The K 1846 manufacturer specification has this expected value in the desired value column.
The desired value is the minimum value required to be specification compliant.
The actual value is that which is recorded in the test sequence.
To achieve the test condition where the value may be noted,

- The 375V DC output has a load applied to its output terminal connections so that the output current extracted may be increased, noted and recorded until the output voltage begins to reduce from its nominal value (refer to cross load regulation value) and enters a constant current mode of operation. This is the points at which current limitation takes place.
- Reduce to resistive loading further, and observe the corresponding output voltage reduction, without any increase in the output current being supplied. Apply a direct short circuit, note the current value.

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Test Item	Description	Desired value	Actual value
4.7 Output	Output ripple $I_{o/p}$ = 4.0A	$V_{o/p}$ < 5%$_{p/p}$	$V_{o/p}$ = 1 $V_{p/p}$

The output voltage ripple measurement is to establish the value and voltage tolerance being generated.
The test is performed without alteration to the nominal input voltage applied.
The test is performed with the respective other output not being altered.
The K 1846 manufacturer specification has this expected tolerance noted as a percentage value in the desired value column.
The outputs are individually loaded as before and the DC output voltage is measured with an oscilloscope in an AC setting where the DC output fluctuation can be seen and recorded.

Test Item	Description	Desired value	Actual value
4.8 Output	Start up time $V_{i/p}$ = 1200V DC	200ms < t < 5 sec	T = 0.6 sec

The start-up time, is the duration required for the primary power circuit to interpret the conditions that allow the output to be generated, controlled and delivered to the output terminal connection.
This is not to be confused with the soft-start sequence which is the pre-evaluation of the parameters that lead to the permission of the power circuit to operate.
The K 1846 manufacturer specification has this expected tolerance noted as a percentage value in the desired value column.
The test is carried out through the observation of the signals which permit and the output voltage value through the use of an oscilloscope. Each unit has its individual test result.
The input voltage is applied and the output is loaded to 1kW.
The input voltage is interrupted. The secondary and primary power circuits are allowed to discharge to zero by waiting for 3 minutes.
t = 0 is when $V_{i/p}$ reaches 1200V DC and t (recorded value) equates to the start of the rise of the output voltage
The input voltage is applied at 1200V DC and the time lag measured for the output voltage to be generated & stabilised is recorded.

Test Item	Description	Desired value	Actual value	
4.9a Output	Over Voltage Protection	415 < $V_{o/p}$ < 420V DC	$V_{o/p}$ = 418 V DC	
4.9b Output	Over Voltage Latches off	Latches off after 1 OVP	o.k.	✓

The OVP, Over Voltage Protection, circuit is the turning off of each of the outputs individually once a pre-determined value has been reached.
This value is noted in the above table.
The K 1846 manufacturer specification has this expected value in the desired value column.
The output voltage of each power output is individually increased through the manipulation of the Control Board regulation circuit.
The point at which the unit automatically shuts down is noted and termed the value at which OVP becomes active.

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Test Item	Description		Desired value	Actual value	
4.10 Output	Alarm indication Common Alarm tripped when:	a. Over temperature of K 1846 >60°C	Remote contact	o.k.	✓
		b. Over temperature of K 1846 >80°C	Changeover Contact	o.k.	✓
		c. DC ok ($V_{o/p}$ > 340V DC)	Changeover Contact	o.k.	✓

The alarm indication is the value at which the output voltage, or the listed other detected events, when reduced to raises a signal that indicates the pre-determined value has been reached.
The temperature are provided via heat gun.
The purpose of this alarm is the signalisation to an external source of operation outside of expected values.
It may result from an input power failure or output overload of the power element within the K 1846.
As a common alarm, it is integrated so that either power element signals this condition.
The procedure to detect and record this alarm is once again through the entering into current limitation where the slow reduction in resistive (load) value results in the output voltage being reduced.
The alarm can therefore be accurately recorded and noted in the table above.
The test is performed with the respective other output not being altered.
The K 1846 manufacturer specification has this expected value in the desired value column.

4.11 Telemetry							
$U_{i/p}$	Actual V		O	562,5	1125	1687,5	2250
	Telemetry V	Theoretical	O	1,25	2,5	3,75	5
		Actual		1.25	2.50	3.76	5.02
$I_{i/p}$	Actual A		O	0,35	0,7	1,05	1,4
	Telemetry A	Theoretical	O	1,25	2,5	3,75	5
		Actual		1.25	2.50	3.76	5.01
$U_{o/p}$	Actual V		O	105	210	315	375
	Telemetry V	Theoretical	O	1,25	2,5	3,75	4,47
		Actual		1.26	2.51	3.75	4.47
$I_{o/p}$	Actual A		O	1,0	2,0	3,0	4,0
	Telemetry A	Theoretical	O	1,25	2,5	3,75	5,0
		Actual		1.25	2.5	3.74	4.33

The telemetry signals shall have an accuracy of better than, or equal to1% (equal to <50mV of error on 5V signal).
They are linear, and supplied from the 24V DC CAN power supply in their power requirement.
The signals shall be noted during the test sequence and tabulated for graphic comparison with their expected resolution.
Measure the input voltage. Measure the input voltage telemetry signal. Record the results of the measurements.
Apply the minimum input voltage to the K 1846. Allow the output to exist under no load condition. Measure the input current, measure the input current telemetry signal. Increase the output load until nominal has been reached, recording at each step the input current telemetry value.

Date: 25/6/2020	Signature: Mr. T. Schneider / Mr. _____
location: SCHAEFER factory ·	SCHAEFER

Model, Type K 1846 19200816	Serial No. 414432

Measure the output nominal voltage, record both this and its telemetry value.
Increase the output voltage to 375V DC, performing several output voltage telemetry measurements.
Measure the output current, record both this and its telemetry value. Increase the output current from 0Amp to 4,0Amp, performing several output current telemetry measurements.

5. Duration test		
Duration test 10 hours $V_{i/p}$ = 1800V DC, $P_{o/p}$ = 1500W	Completed.	✓

The duration test is the bench top burn in test sequence.
Fans and additional heat sinks can be used to ensure the K 1846 does not overheat
The finished K 1846 shall be exposed to a full load test sequence for the duration of time noted and recorded in the table above.

6. Visual tests		
Finish	o.k.	✓
Identification (label, terminal designation, …)	o.k.	✓

The visual and finish test is performed as a final quality before the packing occurs.
The standards are such that the Client receives a flawless mechanical solution mated to the completed electrical acceptance resulting for the successful conclusion of the manufacturing process.

Specific tests, highlighted, performed on the first article are not performed on the remaining of the K 1846 held under the 19200816 contract order.

Date: 25 / 6 / 2020 location: SCHAEFER factory	Signature: Mr. J. Schmidt Mr. _____ SCHAEFER

Model, Type K 1846 19200816	Serial No. 414493

SCHAEFER
Robust - Reliable Power Solutions

Unit test plan for the K 1846 Left / Right Modules (Half MVC):	June 22nd, 2020
Document number:	200622DR

K 1846 Left / Right Module Serial Number	
K 1846 Left Module	○
K 1846 Right Module	✓

Model, Type K 1846 19200816	Serial No. 414493

Calibration Record			
Item	**Manufacturer**	**Type**	**Calibration Due**
Main load resistor	SCHAEFER	1000R	----------
Adj. Load resistor	SCHAEFER	2 * 120R	----------
Oscilloscope	TEKTRONIX	TDS 3014B	----------
Amperemeter - Input current	FLUKE	175	31.08.2020
Amperemeter - Output current	FLUKE	175	31.08.2020
Voltmeter – Input	HAMEG	HM 8012	31.08.2020
Voltmeter – Output	HAMEG	HM 8012	31.08.2020
Voltmeter – Telemetry Vin	HAMEG	HM 8012	31.08.2020
Voltmeter – Telemetry Vout	HAMEG	HM 8012	31.08.2020
Voltmeter – Telemetry Iin	HAMEG	HM 8012	31.08.2020
Voltmeter – Telemetry Iout	HAMEG	HM 8012	31.08.2020
10:1 Divider	SCHAEFER	----------	31.01.2021
Insulation Resistance meter	SCHAEFER	----------	10.06.2023
Power source	SCHAEFER	----------	31.01.2021
Cable simulator	----------	----------	----------

Date: 24/6/2020 location: SCHAEFER factory	Signature: Mr. _____ / Mr. _____ SCHAEFER

Model, Type K 1846 19200816	Serial No. 414493

The tests are performed under nominal environmental conditions, i.e. room temperature 22°C ± 5° and relative humidity 70%.

1. High voltage test, 1min (Both input lines connected together, and all output lines (power and signals) connected together.)

Description	Test Parameters	Required value	Actual Value	
a.) Input against (Outputs + signals + Ground)	3k6V DC 1min	<5mA	o.k.	✓
b.) Output 375V DC against (Input + signals + Ground)	3k6V DC 1min	<5mA	o.k.	✓
c.) Signals against (Output 375V DC + Input + Ground)	3k6V DC 1min	<5mA	o.k.	✓

The High Voltage Test is to establish the compliance with the DIN / EN 60950-1:2003 NORM.
This dictates that the tested points, primary / input cct against the secondary / output circuit, and the mechanical earth circuit / metalwork (chassis & casing etc) should yield a current less than a pre-determined Ampere value.
Any current measured in excess of this value is interpreted as an insulation value of less than the acceptable NORM and thus shall fail the test.

The procedure to perform the test is as follows.

a. Ensure the dedicated environment is dry and clean.
b. Ensure the High Voltage Test equipment is available and authorised for use (ISO 9001 criteria / calibration & marking).
c. Ensure the High Voltage Test equipment is set to 0V DC.
d. Examine the K 1846 (subject for test).
e. Ensure the mechanical integrity of the K 1846 is such that the test may be performed.
f. Locate on the accompanying documentation for the K 1846 the input / primary terminal connections.
g. Connect them together creating a single link for the High Voltage Test equipment.
h. Locate on the accompanying documentation for the K 1846 the output / secondary terminal connections.
i. Connect them together creating a single link for the High Voltage Test equipment.
j. Locate on the accompanying documentation for the K 1846 the signals / voltage free terminal connections.
k. Connect them together creating a single link for the High Voltage Test equipment.
l. Locate on the accompanying documentation for the K 1846 the earth / mechanical terminal connections.
m. Connect them together creating a single link for the High Voltage Test equipment.
n. Close off the dedicated area and observe the warning apparatus has been activated to indicate that a High Voltage Test is about to be performed.
o. Test steps – each step and test value is indicated below. Duration of test step is 1 minute.
   - Input against the rest (output, signals & earth connections connected together).
   - Output against the rest (input, signals & earth connections connected together).
   - Signals against the rest (input, output & earth connections connected together).

Date: 25/6/2020 location: SCHAEFER factory -	Signature: Mr. [signature] / Mr. _____ SCHAEFER

Model, Type K 1846 19200816	Serial No. 414433

2. Grounding test			
Test current < 10Amps			
Ground connection → Cover R=V/I	< 0.1Ω	✓	

a. The Ground test establishes that a short circuit is present between the ground / earth potential and the mechanical earth point.
b. The continuation of the High Voltage Test area use is under the same auspices as before.
c. Locate the test equipment for the earth test procedure.
d. Successful test completion is complied with when the current indication exceeds 25Amp.
e. Test step – the test value is indicated below. Duration of this test step is 1 minute.
   - Earth against the rest (input, output & signals connections connected together).

3. Power up test		
Power up test with no external 24V supply	o.k.	✓

4. Functional Tests

Test Item	Description	Desired value	Actual value
4.1 Input	Lower turn on value $V_{o/p}$ 375V DC / 0.67A (250W)	$V_{i/p\,(on)}$ < 1200V DC	$V_{i/p\,(on)}$ = 1171 V DC
4.1 Input	Lower turn off value $V_{o/p}$ 375V DC / 0.67A (250W)	$V_{i/p\,(off)}$ < 1150V DC	$V_{i/p\,(off)}$ = 1108 V DC
4.2 Input	Upper shut off value $V_{o/p}$ 375V DC / 0.67A (250W)	$V_{i/p\,(off)}$ > 2300V DC	$V_{i/p\,(off)}$ = 2324 V DC
4.2 Input	Upper shut on value $V_{o/p}$ 375V DC / 0.67A (250W)	$V_{i/p\,(on)}$ > 2000V DC	$V_{i/p\,(on)}$ = 2108 V DC

The above test measurements indicate the input voltage values at which the K 1846 turns on and off.
The test is performed by increasing the input voltage applied to the K 1846 until the unit turns on.
Then increasing the input voltage until the unit turns off.
Correspondingly, the voltage is reduced until the unit turns back on again, and reduced further until the unit turns back off again.
This establishes the turn on / off values at both the lower voltage level and the higher voltage level.
As a point of comparison, the current of the output is both noted and recorded for this test.

Test Item	Description		Desired value	Actual value
4.3 Output	Line regulation $V_{o/p}$ 375V DC / 4.0A (1,5kW)	$V_{i/p}$ = 1200V DC	$V_{o/p}$ = 375V DC ± 1%	$V_{o/p}$ = 375 V DC
		$V_{i/p}$ = 1800V DC	$V_{o/p}$ = 375V DC ± 1%	$V_{o/p}$ = 375 V DC

The Line regulation test establishes the variance of the output voltage setting – its true calibrated value – when the input is altered from its minimum operational value to its maximum operational value.
The K 1846 manufacturer specification has this expected tolerance noted as a percentage value in the desired value column.

Date: 24/6/2020 location: SCHAEFER factory	Signature: Mr. [signature] / Mr. _____ SCHAEFER

Model, Type K 1846 19200816	Serial No. 414493

Test Item	Description		Desired value	Actual value	
4.10 Output	Alarm indication Common Alarm tripped when:	a. Over temperature of K 1846 >60°C	Remote contact	o.k.	✓
		b. Over temperature of K 1846 >80°C	Changeover Contact	o.k.	✓
		c. DC ok ($V_{o/p}$ > 340V DC)	Changeover Contact	o.k.	✓

The alarm indication is the value at which the output voltage, or the listed other detected events, when reduced to raises a signal that indicates the pre-determined value has been reached.
The temperature are provided via heat gun.
The purpose of this alarm is the signalisation to an external source of operation outside of expected values.
It may result from an input power failure or output overload of the power element within the K 1846.
As a common alarm, it is integrated so that either power element signals this condition.
The procedure to detect and record this alarm is once again through the entering into current limitation where the slow reduction in resistive (load) value results in the output voltage being reduced.
The alarm can therefore be accurately recorded and noted in the table above.
The test is performed with the respective other output not being altered.
The K 1846 manufacturer specification has this expected value in the desired value column.

4.11 Telemetry							
$U_{i/p}$	Actual V		O	562,5	1125	1687,5	2250
	Telemetry V	Theoretical	O	1,25	2,5	3,75	5
		Actual		1.25	2.51	3.76	5.02
$I_{i/p}$	Actual A		O	0,35	0,7	1,05	1,4
	Telemetry A	Theoretical	O	1,25	2,5	3,75	5
		Actual		1.25	2.50	3.76	4.99
$U_{o/p}$	Actual V		O	105	210	315	375
	Telemetry V	Theoretical	O	1,25	2,5	3,75	4,47
		Actual		1.24	2.51	3.75	4.47
$I_{o/p}$	Actual A		O	1,0	2,0	3,0	4,0
	Telemetry A	Theoretical	O	1,25	2,5	3,75	5,0
		Actual		1.25	2.50	3.75	4.99

The telemetry signals shall have an accuracy of better than, or equal to1% (equal to <50mV of error on 5V signal).
They are linear, and supplied from the 24V DC CAN power supply in their power requirement.
The signals shall be noted during the test sequence and tabulated for graphic comparison with their expected resolution.
Measure the input voltage. Measure the input voltage telemetry signal. Record the results of the measurements.
Apply the minimum input voltage to the K 1846. Allow the output to exist under no load condition. Measure the input current, measure the input current telemetry signal. Increase the output load until nominal has been reached, recording at each step the input current telemetry value.

Date: 24/6/2020 location: SCHAEFER factory	Signature: Mr. [signature] / Mr. _____ SCHAEFER

Model, Type K 1846 19200816	Serial No. 414433

Test Item	Description		Desired value	Actual value
4.4 Output	Load regulation $V_{i/p}$ = 1500V DC I_N = 4,0A	$I_{o/p}$ = 0,4A (10%)	$V_{o/p}$ = 375V DC ± 1%	$V_{o/p}$ 375.3 V DC / 0.4 A
		$I_{o/p}$ = 3,6A (90%)	$V_{o/p}$ = 375V DC ± 1%	$V_{o/p}$ 375 V DC / 3.6 A

The output load regulation is the alteration of the output voltages when each of the loads is individually altered from 10% to 90% of its nominal value.
The test is performed without alteration to the nominal input voltage applied.
The K 1846 manufacturer specification has this expected tolerance noted as a percentage value in the desired value column.

Test Item	Description	Desired value	Actual value	
4.5 Output	Current limitation $V_{i/p}$ = 1500V DC (per half)	$I_{o/p}$ > 4.0A	$I_{o/p}$ = 4.23 A	$I_{i/p}$ = 1.18 A
4.6 Output	Short circuit test	$I_{o/p}$ = 4.0A ± 0.4A	$I_{o/p}$ = 4.2 A	$I_{i/p}$ = 0.1 A

This Step is the current limitation calibration setting verification.
The test is performed without alteration to the nominal input voltage applied.
The test is performed with the respective other output not being altered.
The K 1846 manufacturer specification has this expected value in the desired value column.
The desired value is the minimum value required to be specification compliant.
The actual value is that which is recorded in the test sequence.
To achieve the test condition where the value may be noted,

- The 375V DC output has a load applied to its output terminal connections so that the output current extracted may be increased, noted and recorded until the output voltage begins to reduce from its nominal value (refer to cross load regulation value) and enters a constant current mode of operation. This is the points at which current limitation takes place.
- Reduce to resistive loading further, and observe the corresponding output voltage reduction, without any increase in the output current being supplied. Apply a direct short circuit, note the current value.

Date: 24/6/2020 location: SCHAEFER factory	Signature: Mr. [signature] / Mr. _____ SCHAEFER

Model, Type K 1846 19200816	Serial No. 414493

Test Item	Description	Desired value	Actual value
4.7 Output	Output ripple $I_{o/p}$ = 4.0A	$V_{o/p}$ < 5%$_{p/p}$	$V_{o/p}$ = 1 $V_{p/p}$

The output voltage ripple measurement is to establish the value and voltage tolerance being generated.
The test is performed without alteration to the nominal input voltage applied.
The test is performed with the respective other output not being altered.
The K 1846 manufacturer specification has this expected tolerance noted as a percentage value in the desired value column.
The outputs are individually loaded as before and the DC output voltage is measured with an oscilloscope in an AC setting where the DC output fluctuation can be seen and recorded.

Test Item	Description	Desired value	Actual value
4.8 Output	Start up time $V_{i/p}$ = 1200V DC	200ms < t < 5 sec	T = 0.6 sec

The start-up time, is the duration required for the primary power circuit to interpret the conditions that allow the output to be generated, controlled and delivered to the output terminal connection.
This is not to be confused with the soft-start sequence which is the pre-evaluation of the parameters that lead to the permission of the power circuit to operate.
The K 1846 manufacturer specification has this expected tolerance noted as a percentage value in the desired value column.
The test is carried out through the observation of the signals which permit and the output voltage value through the use of an oscilloscope. Each unit has its individual test result.
The input voltage is applied and the output is loaded to 1kW.
The input voltage is interrupted. The secondary and primary power circuits are allowed to discharge to zero by waiting for 3 minutes.
t = 0 is when $V_{i/p}$ reaches 1200V DC and t (recorded value) equates to the start of the rise of the output voltage
The input voltage is applied at 1200V DC and the time lag measured for the output voltage to be generated & stabilised is recorded.

Test Item	Description	Desired value	Actual value	
4.9a Output	Over Voltage Protection	415 < $V_{o/p}$ < 420V DC	$V_{o/p}$ = 417 V DC	
4.9b Output	Over Voltage Latches off	Latches off after 1 OVP	o.k.	✓

The OVP, Over Voltage Protection, circuit is the turning off of each of the outputs individually once a pre-determined value has been reached.
This value is noted in the above table.
The K 1846 manufacturer specification has this expected value in the desired value column.
The output voltage of each power output is individually increased through the manipulation of the Control Board regulation circuit.
The point at which the unit automatically shuts down is noted and termed the value at which OVP becomes active.

Date: 24/6/2020 location: SCHAEFER factory	Signature: Mr. [signature] / Mr. _____ SCHAEFER

Model, Type K 1846 19200816	Serial No. 414433

Measure the output nominal voltage, record both this and its telemetry value.
Increase the output voltage to 375V DC, performing several output voltage telemetry measurements.
Measure the output current, record both this and its telemetry value. Increase the output current from 0Amp to 4,0Amp, performing several output current telemetry measurements.

5. Duration test		
Duration test 10 hours $V_{i/p}$ = 1800V DC, $P_{o/p}$ = 1500W	Completed.	✓

The duration test is the bench top burn in test sequence.
Fans and additional heat sinks can be used to ensure the K 1846 does not overheat
The finished K 1846 shall be exposed to a full load test sequence for the duration of time noted and recorded in the table above.

6. Visual tests		
Finish	o.k.	✓
Identification (label, terminal designation, …)	o.k.	✓

The visual and finish test is performed as a final quality before the packing occurs.
The standards are such that the Client receives a flawless mechanical solution mated to the completed electrical acceptance resulting for the successful conclusion of the manufacturing process.

Specific tests, highlighted, performed on the first article are not performed on the remaining of the K 1846 held under the 19200816 contract order.

Date: 24/6/2020 location: SCHAEFER factory	Signature: Mr. T. Gelinde / Mr. _____ SCHAEFER

Model, Type K 1846 19200816	Serial No. 414434

SCHAEFER
Robust - Reliable Power Solutions

Unit test plan for the K 1846 Left / Right Modules (Half MVC):	June 22nd, 2020
Document number:	200622DR

K 1846 Left / Right Module Serial Number	
K 1846 Left Module	○
K 1846 Right Module	✓

Model, Type K 1846 19200816	Serial No. 414434

Calibration Record			
Item	**Manufacturer**	**Type**	**Calibration Due**
Main load resistor	SCHAEFER	1000R	----------
Adj. Load resistor	SCHAEFER	2 * 120R	----------
Oscilloscope	TEKTRONIX	TDS 3014B	----------
Amperemeter - Input current	FLUKE	175	31.08.2020
Amperemeter - Output current	FLUKE	175	31.08.2020
Voltmeter – Input	HAMEG	HM 8012	31.08.2020
Voltmeter – Output	HAMEG	HM 8012	31.08.2020
Voltmeter – Telemetry Vin	HAMEG	HM 8012	31.08.2020
Voltmeter – Telemetry Vout	HAMEG	HM 8012	31.08.2020
Voltmeter – Telemetry Iin	HAMEG	HM 8012	31.08.2020
Voltmeter – Telemetry Iout	HAMEG	HM 8012	31.08.2020
10:1 Divider	SCHAEFER	----------	31.01.2021
Insulation Resistance meter	SCHAEFER	----------	10.06.2023
Power source	SCHAEFER	----------	31.01.2021
Cable simulator	----------	----------	----------

Date: 24 / 6 / 2020 location: SCHAEFER factory	Signature: Mr. [signature] / Mr. _____ SCHAEFER

Model, Type K 1846 19200816	Serial No. 414434

The tests are performed under nominal environmental conditions, i.e. room temperature 22°C ± 5° and relative humidity 70%.

1. High voltage test, 1min (Both input lines connected together, and all output lines (power and signals) connected together.)

Description	Test Parameters	Required value	Actual Value	
a.) Input against (Outputs + signals + Ground)	3k6V DC 1min	<5mA	o.k.	✓
b.) Output 375V DC against (Input + signals + Ground)	3k6V DC 1min	<5mA	o.k.	✓
c.) Signals against (Output 375V DC + Input + Ground)	3k6V DC 1min	<5mA	o.k.	✓

The High Voltage Test is to establish the compliance with the DIN / EN 60950-1:2003 NORM.
This dictates that the tested points, primary / input cct against the secondary / output circuit, and the mechanical earth circuit / metalwork (chassis & casing etc) should yield a current less than a pre-determined Ampere value.
Any current measured in excess of this value is interpreted as an insulation value of less than the acceptable NORM and thus shall fail the test.

The procedure to perform the test is as follows.

a. Ensure the dedicated environment is dry and clean.
b. Ensure the High Voltage Test equipment is available and authorised for use (ISO 9001 criteria / calibration & marking).
c. Ensure the High Voltage Test equipment is set to 0V DC.
d. Examine the K 1846 (subject for test).
e. Ensure the mechanical integrity of the K 1846 is such that the test may be performed.
f. Locate on the accompanying documentation for the K 1846 the input / primary terminal connections.
g. Connect them together creating a single link for the High Voltage Test equipment.
h. Locate on the accompanying documentation for the K 1846 the output / secondary terminal connections.
i. Connect them together creating a single link for the High Voltage Test equipment.
j. Locate on the accompanying documentation for the K 1846 the signals / voltage free terminal connections.
k. Connect them together creating a single link for the High Voltage Test equipment.
l. Locate on the accompanying documentation for the K 1846 the earth / mechanical terminal connections.
m. Connect them together creating a single link for the High Voltage Test equipment.
n. Close off the dedicated area and observe the warning apparatus has been activated to indicate that a High Voltage Test is about to be performed.
o. Test steps – each step and test value is indicated below. Duration of test step is 1 minute.
   - Input against the rest (output, signals & earth connections connected together).
   - Output against the rest (input, signals & earth connections connected together).
   - Signals against the rest (input, output & earth connections connected together).

Date: 24/6/2020 location: SCHAEFER factory	Signature: Mr. M. Schaefer / Mr. _____ SCHAEFER

Model, Type K 1846 19200816	Serial No. 414494

2. Grounding test			
Test current < 10Amps			
Ground connection → Cover R=V/I	< 0.1Ω	✓	

a. The Ground test establishes that a short circuit is present between the ground / earth potential and the mechanical earth point.
b. The continuation of the High Voltage Test area use is under the same auspices as before.
c. Locate the test equipment for the earth test procedure.
d. Successful test completion is complied with when the current indication exceeds 25Amp.
e. Test step – the test value is indicated below. Duration of this test step is 1 minute.
   - Earth against the rest (input, output & signals connections connected together).

3. Power up test		
Power up test with no external 24V supply	o.k.	✓

4. Functional Tests

Test Item	Description	Desired value	Actual value
4.1 Input	Lower turn on value $V_{o/p}$ 375V DC / 0.67A (250W)	$V_{i/p\,(on)}$ < 1200V DC	$V_{i/p\,(on)}$ = 1178 V DC
4.1 Input	Lower turn off value $V_{o/p}$ 375V DC / 0.67A (250W)	$V_{i/p\,(off)}$ < 1150V DC	$V_{i/p\,(off)}$ = 1109 V DC
4.2 Input	Upper shut off value $V_{o/p}$ 375V DC / 0.67A (250W)	$V_{i/p\,(off)}$ > 2300V DC	$V_{i/p\,(off)}$ = 2321 V DC
4.2 Input	Upper shut on value $V_{o/p}$ 375V DC / 0.67A (250W)	$V_{i/p\,(on)}$ > 2000V DC	$V_{i/p\,(on)}$ = 2114 V DC

The above test measurements indicate the input voltage values at which the K 1846 turns on and off.
The test is performed by increasing the input voltage applied to the K 1846 until the unit turns on.
Then increasing the input voltage until the unit turns off.
Correspondingly, the voltage is reduced until the unit turns back on again, and reduced further until the unit turns back off again.
This establishes the turn on / off values at both the lower voltage level and the higher voltage level.
As a point of comparison, the current of the output is both noted and recorded for this test.

Test Item	Description		Desired value	Actual value
4.3 Output	Line regulation $V_{o/p}$ 375V DC / 4.0A (1,5kW)	$V_{i/p}$ = 1200V DC	$V_{o/p}$ = 375V DC ± 1%	$V_{o/p}$ = 375 V DC
		$V_{i/p}$ = 1800V DC	$V_{o/p}$ = 375V DC ± 1%	$V_{o/p}$ = 375 V DC

The Line regulation test establishes the variance of the output voltage setting – its true calibrated value – when the input is altered from its minimum operational value to its maximum operational value.
The K 1846 manufacturer specification has this expected tolerance noted as a percentage value in the desired value column.

Date: 24/6/2020 location: SCHAEFER	Signature: Mr. [signature] Mr. _____ SCHAEFER

Model, Type K 1846 19200816	Serial No. 414434

Test Item	Description		Desired value	Actual value
4.4 Output	Load regulation $V_{i/p}$ = 1500V DC I_N = 4,0A	$I_{o/p}$ = 0,4A (10%)	$V_{o/p}$ = 375V DC ± 1%	$V_{o/p}$ 376.0V DC / 0.4 A
		$I_{o/p}$ = 3,6A (90%)	$V_{o/p}$ = 375V DC ± 1%	$V_{o/p}$ 375.2V DC / 3.6 A

The output load regulation is the alteration of the output voltages when each of the loads is individually altered from 10% to 90% of its nominal value.
The test is performed without alteration to the nominal input voltage applied.
The K 1846 manufacturer specification has this expected tolerance noted as a percentage value in the desired value column.

Test Item	Description	Desired value	Actual value	
4.5 Output	Current limitation $V_{i/p}$ = 1500V DC (per half)	$I_{o/p}$ > 4.0A	$I_{o/p}$ = 4.25 A	$I_{i/p}$ = 1.18 A
4.6 Output	Short circuit test	$I_{o/p}$ = 4.0A ± 0.4A	$I_{o/p}$ = 4.2 A	$I_{i/p}$ = 0.1 A

This Step is the current limitation calibration setting verification.
The test is performed without alteration to the nominal input voltage applied.
The test is performed with the respective other output not being altered.
The K 1846 manufacturer specification has this expected value in the desired value column.
The desired value is the minimum value required to be specification compliant.
The actual value is that which is recorded in the test sequence.
To achieve the test condition where the value may be noted,

- The 375V DC output has a load applied to its output terminal connections so that the output current extracted may be increased, noted and recorded until the output voltage begins to reduce from its nominal value (refer to cross load regulation value) and enters a constant current mode of operation. This is the points at which current limitation takes place.
- Reduce to resistive loading further, and observe the corresponding output voltage reduction, without any increase in the output current being supplied. Apply a direct short circuit, note the current value.

Date: 24/6/2020 location: SCHAEFER factory	Signature: Mr. [signature] / Mr. _____ SCHAEFER

Model, Type K 1846 19200816	Serial No. 414494

Test Item	Description	Desired value	Actual value
4.7 Output	Output ripple $I_{o/p}$ = 4.0A	$V_{o/p}$ < 5%$_{p/p}$	$V_{o/p}$ = 1 $V_{p/p}$

The output voltage ripple measurement is to establish the value and voltage tolerance being generated.
The test is performed without alteration to the nominal input voltage applied.
The test is performed with the respective other output not being altered.
The K 1846 manufacturer specification has this expected tolerance noted as a percentage value in the desired value column.
The outputs are individually loaded as before and the DC output voltage is measured with an oscilloscope in an AC setting where the DC output fluctuation can be seen and recorded.

Test Item	Description	Desired value	Actual value
4.8 Output	Start up time $V_{i/p}$ = 1200V DC	200ms < t < 5 sec	T = 0.6 sec

The start-up time, is the duration required for the primary power circuit to interpret the conditions that allow the output to be generated, controlled and delivered to the output terminal connection.
This is not to be confused with the soft-start sequence which is the pre-evaluation of the parameters that lead to the permission of the power circuit to operate.
The K 1846 manufacturer specification has this expected tolerance noted as a percentage value in the desired value column.
The test is carried out through the observation of the signals which permit and the output voltage value through the use of an oscilloscope. Each unit has its individual test result.
The input voltage is applied and the output is loaded to 1kW.
The input voltage is interrupted. The secondary and primary power circuits are allowed to discharge to zero by waiting for 3 minutes.
t = 0 is when $V_{i/p}$ reaches 1200V DC and t (recorded value) equates to the start of the rise of the output voltage
The input voltage is applied at 1200V DC and the time lag measured for the output voltage to be generated & stabilised is recorded.

Test Item	Description	Desired value	Actual value	
4.9a Output	Over Voltage Protection	415 < $V_{o/p}$ < 420V DC	$V_{o/p}$ = 417 V DC	
4.9b Output	Over Voltage Latches off	Latches off after 1 OVP	o.k.	✓

The OVP, Over Voltage Protection, circuit is the turning off of each of the outputs individually once a pre-determined value has been reached.
This value is noted in the above table.
The K 1846 manufacturer specification has this expected value in the desired value column.
The output voltage of each power output is individually increased through the manipulation of the Control Board regulation circuit.
The point at which the unit automatically shuts down is noted and termed the value at which OVP becomes active.

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Test Item	Description		Desired value	Actual value	
4.10 Output	Alarm indication Common Alarm tripped when:	a. Over temperature of K 1846 >60°C	Remote contact	o.k.	✓
		b. Over temperature of K 1846 >80°C	Changeover Contact	o.k.	✓
		c. DC ok ($V_{o/p}$ > 340V DC)	Changeover Contact	o.k.	✓

The alarm indication is the value at which the output voltage, or the listed other detected events, when reduced to raises a signal that indicates the pre-determined value has been reached.
The temperature are provided via heat gun.
The purpose of this alarm is the signalisation to an external source of operation outside of expected values.
It may result from an input power failure or output overload of the power element within the K 1846.
As a common alarm, it is integrated so that either power element signals this condition.
The procedure to detect and record this alarm is once again through the entering into current limitation where the slow reduction in resistive (load) value results in the output voltage being reduced.
The alarm can therefore be accurately recorded and noted in the table above.
The test is performed with the respective other output not being altered.
The K 1846 manufacturer specification has this expected value in the desired value column.

4.11 Telemetry							
$U_{i/p}$	Actual V		O	562,5	1125	1687,5	2250
	Telemetry V	Theoretical	O	1,25	2,5	3,75	5
		Actual		1.25	2.50	3.76	5.02
$I_{i/p}$	Actual A		O	0,35	0,7	1,05	1,4
	Telemetry A	Theoretical	O	1,25	2,5	3,75	5
		Actual		1.24	2.50	3.75	5.01
$U_{o/p}$	Actual V		O	105	210	315	375
	Telemetry V	Theoretical	O	1,25	2,5	3,75	4,47
		Actual		1.25	2.50	3.75	4.47
$I_{o/p}$	Actual A		O	1,0	2,0	3,0	4,0
	Telemetry A	Theoretical	O	1,25	2,5	3,75	5,0
		Actual		1.26	2.50	3.75	5.01

The telemetry signals shall have an accuracy of better than, or equal to1% (equal to <50mV of error on 5V signal).
They are linear, and supplied from the 24V DC CAN power supply in their power requirement.
The signals shall be noted during the test sequence and tabulated for graphic comparison with their expected resolution.
Measure the input voltage. Measure the input voltage telemetry signal. Record the results of the measurements.
Apply the minimum input voltage to the K 1846. Allow the output to exist under no load condition. Measure the input current, measure the input current telemetry signal. Increase the output load until nominal has been reached, recording at each step the input current telemetry value.

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Measure the output nominal voltage, record both this and its telemetry value.
Increase the output voltage to 375V DC, performing several output voltage telemetry measurements.
Measure the output current, record both this and its telemetry value. Increase the output current from 0Amp to 4,0Amp, performing several output current telemetry measurements.

5. Duration test		
Duration test 10 hours $V_{i/p}$ = 1800V DC, $P_{o/p}$ = 1500W	Completed.	✓

The duration test is the bench top burn in test sequence.
Fans and additional heat sinks can be used to ensure the K 1846 does not overheat
The finished K 1846 shall be exposed to a full load test sequence for the duration of time noted and recorded in the table above.

6. Visual tests		
Finish	o.k.	✓
Identification (label, terminal designation, …)	o.k.	✓

The visual and finish test is performed as a final quality before the packing occurs.
The standards are such that the Client receives a flawless mechanical solution mated to the completed electrical acceptance resulting for the successful conclusion of the manufacturing process.

Specific tests, highlighted, performed on the first article are not performed on the remaining of the K 1846 held under the 19200816 contract order.

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