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File E63615
Project 00SC11837

October 9, 2000

REPORT

ON

COMPONENT - SWITCHES, INDUSTRIAL CONTROL

Fujitsu Takamisawa Component Ltd.
Tokyo, Japan

DESCRIPTION

PRODUCT COVERED:

USR, CNR - Component - Magnetically Operated Switches, Type C2, with or without Prefix FTR - f/b C, G or S, f/b A, or B, f/b 3 through 012, f/b G, and may be f/b 01 through 99.

GENERAL:

These components are double-pole, double-throw magnetically operated switches using a DC operating coil, with normally open, and normally closed contacts. They are provided with terminals for direct printed circuit board mounting, through hole or surface mounting. These devices are single-stable type. The single-stable type have single-winding coil.

Double stable type has a single coil for the operation of the movable contacts. Switching is performed by operating the coil in both forward and reverse polarity. Contacts are maintained by magnetic latching.

These components are intended for use in Information Processing, and Business Equipment and similar devices.

Ratings -

Contact Ratings:

0.3 A, 125 V ac (Resistive)
1 A, 30 V dc
0.3 A, 110 V dc

Coil Ratings:

3 through 12 V dc

NOMENCLATURE:

Part No.	FTR-C2	C	A	003	G	01
	I	II	III	IV	V	VI

Note A: Part No. may be split and appear on two lines

I. Indicates relay type

FTR-C2: Type number, with or without Prefix FTR:

II. Indicates terminal configuration

C - Through hole type.
G - Surface mount type.

III. Indicates relay coil type

A: Single-stable
B: Double-Stable

IV. Indicates coil rated voltage

003 through 024 V dc.

V. Indicates contact material

G: Movable - AgPd
Stationary - Au/AgPd

VI. Indicates minor constructive variation.

01 through 99: Additional two digits used for special variation of construction as below.

A. Variation of coil resistance

B. Variation of operating voltage, non-operating voltage, release voltage, as hold voltage.

C. Variation of operating time, or release time.

ENGINEERING CONSIDERATIONS (NOT FOR FIELD REPRESENTATIVE'S USE):

Use - For use only in complete equipment or applications where the acceptability of the combination is determined by Underwriters Laboratories Inc.

This component has been judged on the basis of the required spacings in the Outline of Investigation for relays used in Information Technology Equipment, UL 508B, Issued Number 1, which would cover the component itself if submitted for unrestricted Listing.

These devices have also been evaluated to Canadian Standard, C22.2, No. 950-93.

Conditions of Acceptability -

1. A suitable enclosure shall be provided.

2. The terminals are to be factory wired only, and the suitability of the connection shall be determined.

3. These devices are suitable for use in Information Technology Equipment only.

4. These devices shall be used within its intended ratings.

CONSTRUCTION DETAILS:

The product shall be constructed in accordance with the following description.

Tolerances - Unless specified otherwise, all indicated dimensions are nominal.

Corrosion Protection - All parts are of corrosion resistant material, or are plated or painted as corrosion protection.

Marking - Ink-stamped or molded in Recognized Company name, or Trademark F&T or F.T, and model number.

Spacings are to be in accordance with UL 1950, as follow:

Working Voltage	Minimum Clearance	Minimum Creepage Distance
250 V rms	2.0 mm	2.5 mm

FTR-C2 SERIES - FIG. (ILL.) 1

General - Represents all type relays covered by this Report. See also ILL. 2 for overall dimensions, contact configurations, and terminal types.

1. Dust Cover - R/C (QMFZ2), Sumitomo Chemical, Type E4009. Overall dimensions, 20.05 by 9.85 by 11.4 mm, minimum 0.3 mm thick.

2. Spool Assembly - R/C (QMFZ2), Sumitomo Chemical, Type E4009. Minimum 0.1 mm thick.

3. Armature Mold - R/C (QMFZ2), Sumitomo Chemical, Type E4009. Overall dimensions, 11.0 by 6.6 by 2.2 mm.

4. Base Mold - R/C (QMFZ2), Sumitomo Chemical, Type E4009. Overall dimensions, 18.8 by 8.6 by 4.8 mm, minimum 0.3 mm thick.

5. Core - Steel or magnetic iron. Held in place in center of bobbin.

6. Magnet - Permanent magnet. Molded in Armature Mold, Item 3, Fig. 1.

7. Armature - Same material as Core, Item 5, overall dimension 17.8 by 2.8 by 0.8 mm. Molded in Armature Mold, Item 3, Fig. 1.

8. Magnetic Wire - Polyurethane enameled copper wire.

9. Movable Spring - Copper alloy, two provided, molded in place to Armature Mold, Item 3, located on both sides of armature.

10. Stationary Contact Arm - Copper alloy.

11. Terminals - Copper alloy, dimension 0.5 by 0.3 mm, maximum 5 mm long, held in place on Base Mold, Item 4, Fig. 1, through fitted slots.

12. Movable Contacts - See ILL. 1. Overall dimensions 0.4 by 0.8 by 0.275 mm thick.

    Cu-Ni alloy base, silver-alloy contact Ag-Pd 40%/60%, 0.275 mm thick.

    Alternate - Overall dimensions 0.35mm by 0.8 mm, 0.275 mm thick Cu-Ni alloy base, silver alloy contact Ag-Pd 70/30, 0.275 mm thick.

13. Stationary Contacts - See ILL. 1. Overall dimensions 0.4 by 1.2 by 0.275 mm thick.

    Cu-Ni alloy base, silver-alloy contact Ag-Pd 40%/60%, 0.275 mm thick, which is further overlaid with gold, 2 µm thick.

    Alternate - Overall dimensions 0.35mm by 0.8 mm, 0.275 mm thick Cu-Ni alloy base, silver alloy contact Ag-Pd 70/30, 0.275 mm thick. Contact is further overlaid with gold, 0.002 mm thick.

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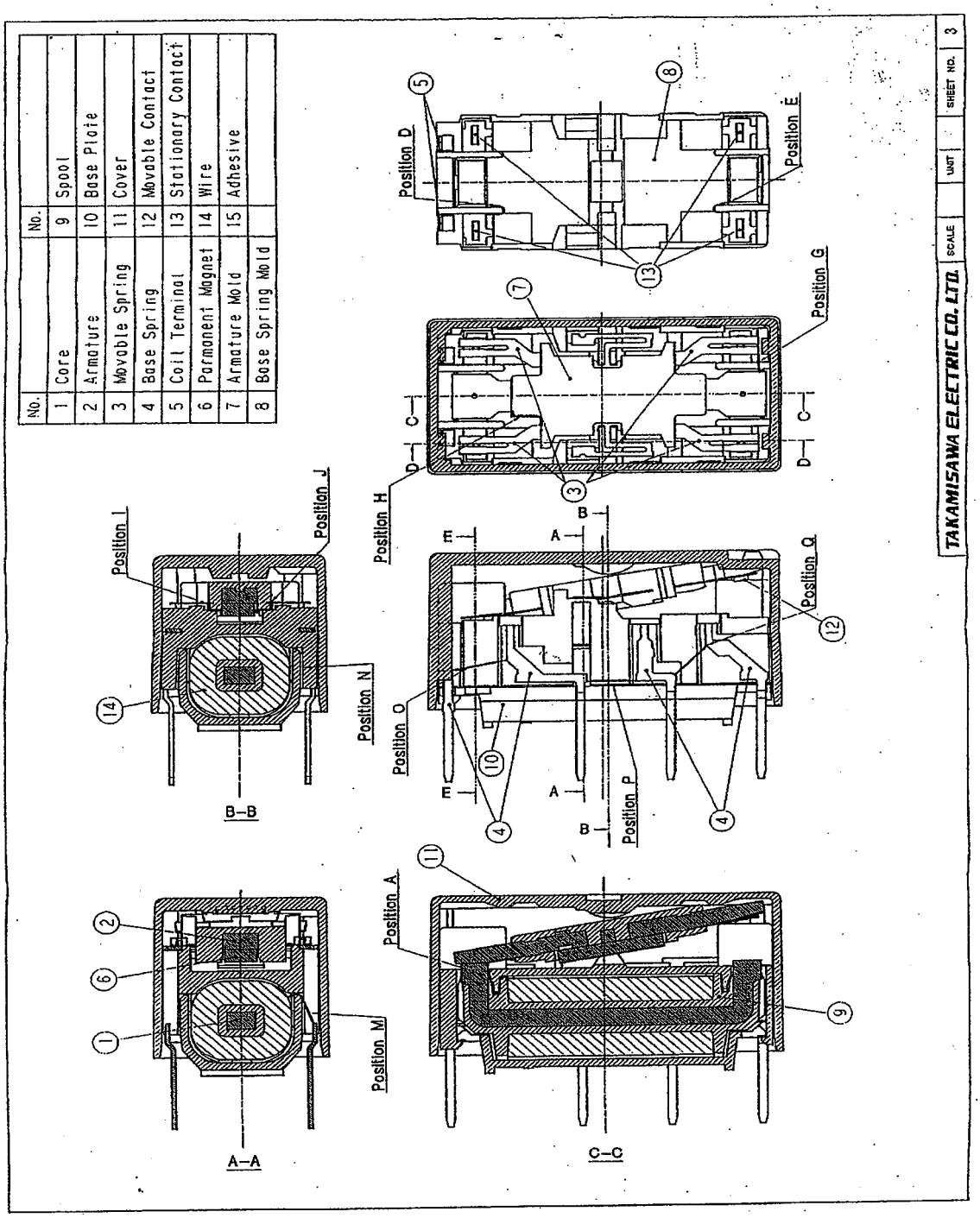
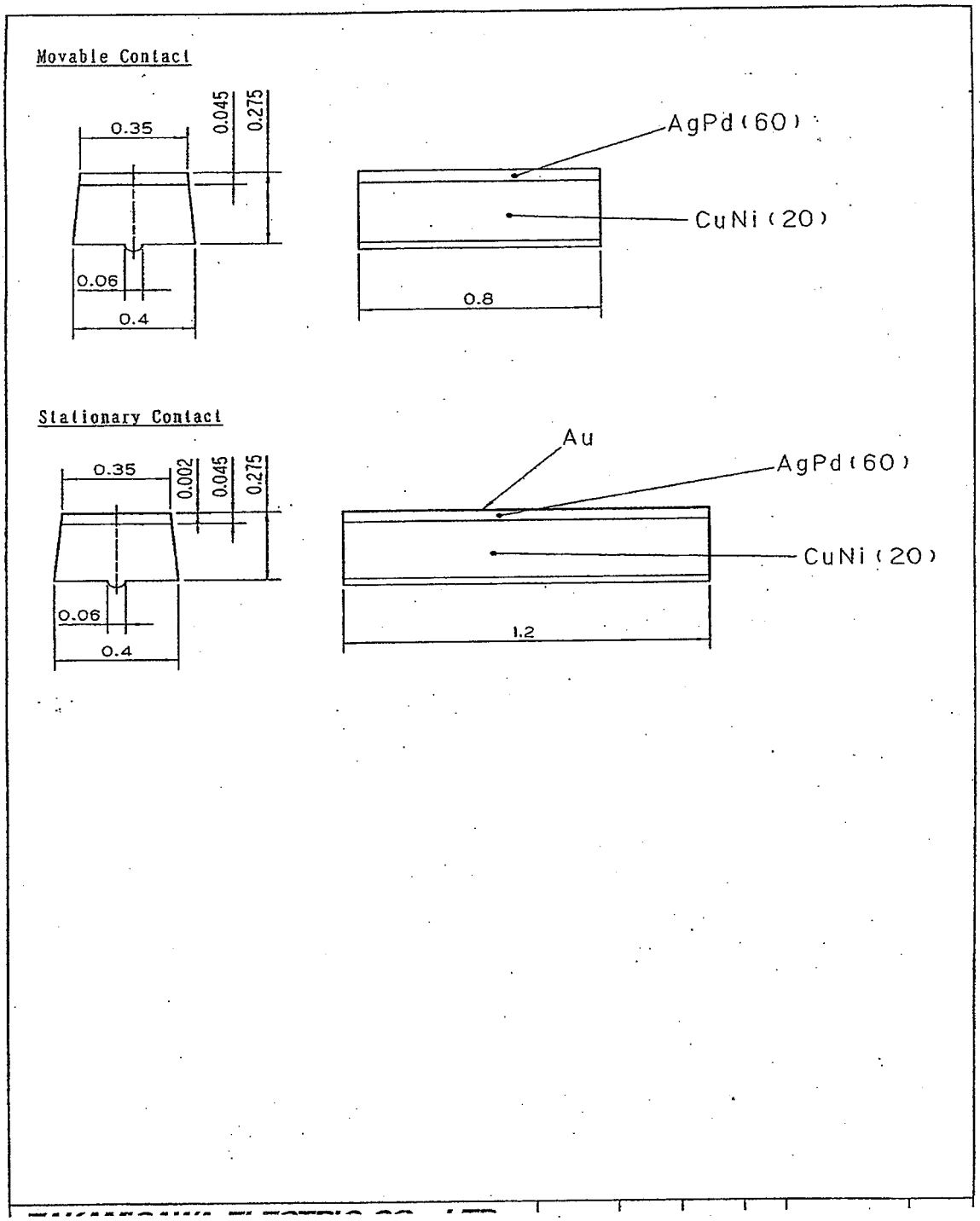
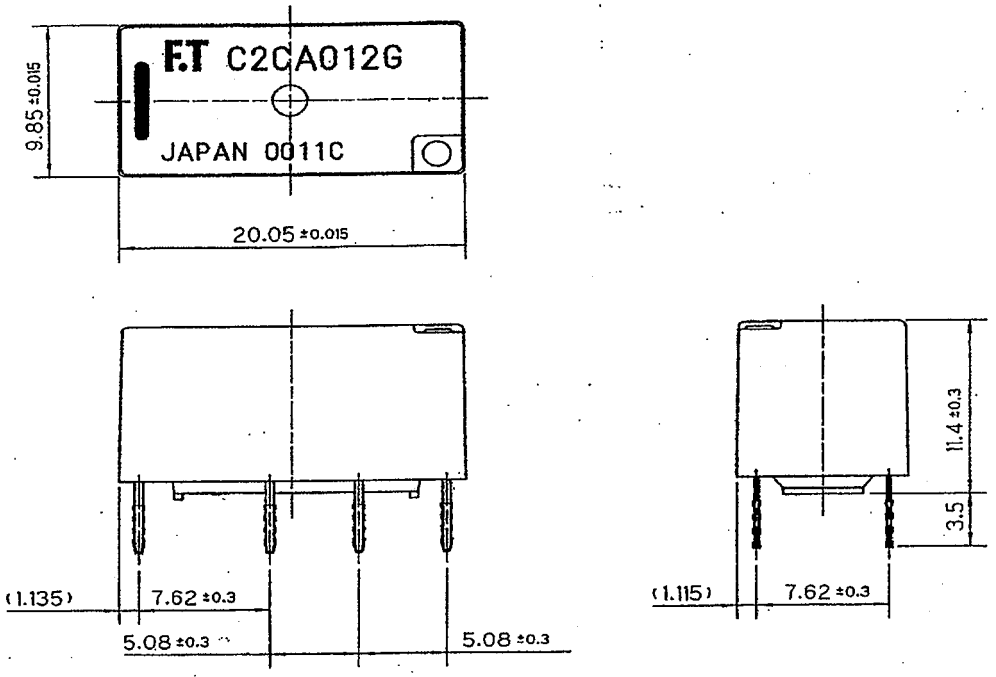

No. | No.
1 Core | 9 Spool
2 Armature | 10 Base Plate
3 Movable Spring | 11 Cover
4 Base Spring | 12 Movable Contact
5 Coil Terminal | 13 Stationary Contact
6 Permanent Magnet | 14 Wire
7 Armature Mold | 15 Adhesive
8 Base Spring Mold
TAKAMISAWA ELECTRIC CO. LTD.
SCALE
UNIT
SHEET NO. 3
Position D
Position E
Position G
Position H
Position I
Position J
Position N
Position O
Position Q
Position A
Position M
Position P
A-A
B-B
C-C


Movable Contact
0.35
0.045
0.275
0.06
0.4
AgPd(60)
CuNi(20)
0.8
Stationary Contact
0.35
0.002
0.045
0.275
0.06
0.4
Au
AgPd(60)
CuNi(20)
1.2

S0041153

Dimensions

2 Form C
Relay Type : FTR-C2CA( )G

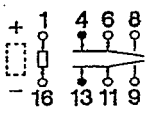


Marking Seal

2 Form C
Relay Type : FTR-C2CA( )G

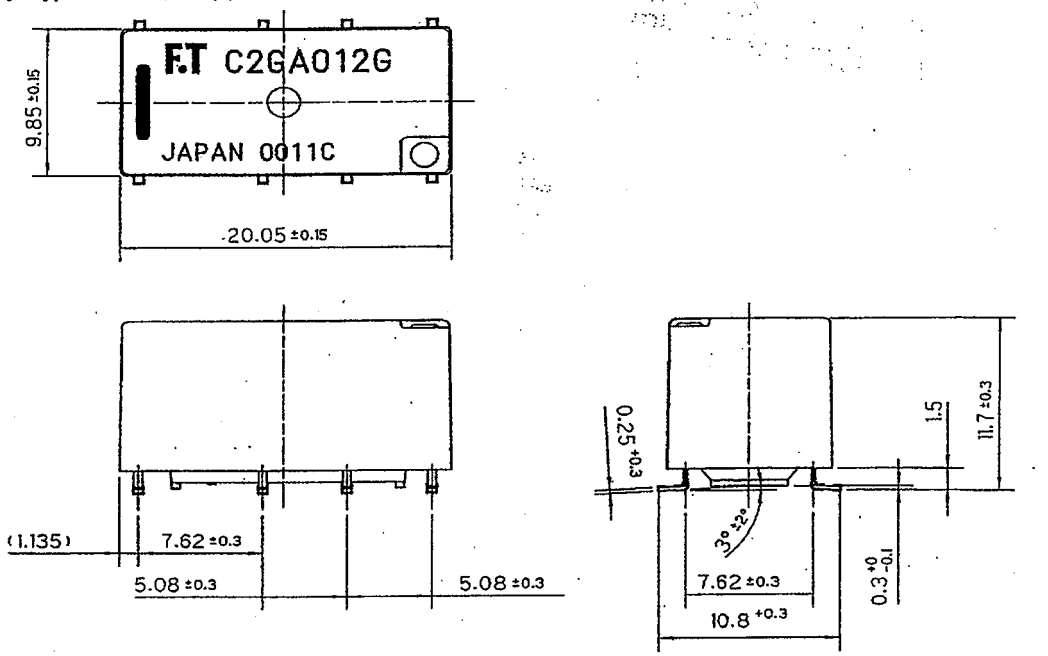
CONNECTIONS SAME POLARITY
ELECTRICAL RATING
1A 30V DC
0.3A 110V DC
0.3A 125V AC

TERMINAL ARRANGEMENT (BOTTTOM VIEW)



Dimensions

2 Form C
Relay Type : FTR-C2GA( )G

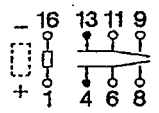


Marking Seal

2 Form C
Relay Type : FTR-C2GA( )Z

CONNECTIONS SAME POLARITY
ELECTRICAL RATING
1A 30V DC
0.3A 110V DC
0.3A 125V AC

TERMINAL ARRANGEMENT (TOP VIEW)



TAKAMISAWA ELECTRIC CO., LTD.

TEST RECORD NO. 1

TEMPERATURE TEST:

METHOD

Samples of the relay, Model FTR-C2CA012G, were mounted, and connected as intended in service, or as indicated below in Special Instructions.

The contact or load terminals were connected in series to a low voltage current source (for non-voltage specific coils).

The load was connected by using 1.2 m (4 ft) length of wire, of size specified under Results.

The coil or control terminals were connected with No. 18 AWG wire to a supply source of rated voltage and energized to allow the maximum rated current to pass through the device continuously until temperatures stabilized. The temperature was considered to have stabilized when three successive reading taken at intervals of 10% of the previously elapsed duration of the test but not less than ten minutes indicate no change.

The coil winding temperatures were measured using the Change-Of-Resistance Method.

Special Instructions:

Three samples of Model FTR-C2CA003G and two additional samples of FTR-C2CA012G are to be conditioned in an oven at the maximum coil temperature measured. These samples shall be used for the crossover lead dielectric, undervoltage, overvoltage and repeated Crossover Lead Dielectric Tests.

RESULTS

Relay Designation: FTR-C2CA012G
Load Wire Size: No. 18 AWG or less
Test Load Current: 1 A
Poles Used: 2
Test Coil Voltage: 12 V dc

	Thermocouple Location	Maximum Temperature, °C
1.	Ambient	26.8
2.	Base	38.9
3.	Cover, above contacts	32.0
4.	Movable/stationary contact arm	34.5

CHANGE-OF-RESISTANCE MEASUREMENTS AND CALCULATIONS:

When conducting change-of-resistance measurements, follow the practices itemized below:

1. Ohmmeters used to meaasure the resistance of coils must have an accuracy of no worse than 2% for the range used and a precision of no worse than 2% of the resistance measured. Make sure the ohmmeter is appropriate for the resistance measured.

2. The same ohmmeter must be used for all resistances associated with the change-of-resistance measurements.

3. The ohmmeter must be "soaked" in the test set-up ambient for a period of time no less than that specified by the ohmmeter manufacturer.

4. Coil extension leads added to facilitate making coil resistance measurements must be sized no less than the size of the conductor used in the coil under test. The coil extension leads or the ohmmeter probe leads must be connected to the circuit as close to the coil under test as possible.

5. Unless appropriate analysis is completed to confirm that the circuit connected to the coil under test will not affect the resistance measurements, the coil is to be disconnected from the rest of the circuit during the resistance measurements.

6. The coil must be at the room ambient temperature when measuring the combined resistance of the ohmmeter leads, coil extension leads, and coil immediately prior to coil energization.

7. The 234.5 value in the Calculated Data section applies to copper conductors. It is "the inferred absolute zero of temperature" for the copper having a certain assumed standard conductivity. For aluminum conductors, this value is to be replaced with 225.0. For a coil conductor of a different metal, the inferred absolute zero of temperature for the metal involved is to be used in the calculation.

Data Recorded Immediately Prior To Coil Energization

Ambient at beginning of test: T_{cold} = 23.1°C

Combined resistance of coil and ohmmeter and extension leads: $R_{coldcoil + leads}$ = 482 ohm

Data Recorded Upon Coil De-energization

Time After Coil De-eneragization t_x (seconds)	Resistance of coil With Leads (Ohms) $R_{coil+leads@tx}$
t_1 = 10	244
t_2 = 20	233
t_3 = 30	231
t_4 = 40	230
t_5 = 50	229
t_6 = 60	228

Ambient at coil de-energization: T_{hot} = 26.8°C

DIELECTRIC VOLTAGE WITHSTAND TEST:

METHOD

While at its maximum normal operating temperature, the unit was subjected to a potential of 2 V + 1,000, 60 Hz, essentially sinusoidal potential, or direct-current potential:

A) Between uninsulated live parts and enclosure wrapped-in-foil.
B) Between terminals of opposite polarity.
C) Between primary and secondary circuit

RESULTS

There was no dielectric breakdown.

CROSSOVER LEAD DIELECTRIC VOLTAGE WITHSTAND TEST:

METHOD

While still in heated condition from the Temperature Test, the coil of each device was subjected to an alternating current potential of twice the rated voltage for 7,200 electrical cycles (___ Hz for ___ seconds). Indications of breakdown in the insulation system were observed.

RESULTS

Model Number	Rated Coil Voltage	Test Potential	Results
FTR-C2CA003G (A1)	3 V dc	6 V	NB
FTR-C2CA012G (B6, B8, B10)	12 V dc	24 V	NB

NB = No Breakdown.

UNDERVOLTAGE TEST:

METHOD

The coil terminals were connected to a rated source as indicated in the following table. The load terminals were connected to a 30 V dc, 1 A source. The thermocouples were connected to the coil of the device. The device was operated until temperatures, and conditions were stabilized.

After temperature, and conditions were stabilized, the control circuit (coil) voltage was reduced to 80% of its rated voltage. The device was cycled several times, and the device was observed to see if it opened, and closed normally at the reduced voltage.

RESULTS

Model	Sample	Rated coil Voltage (V dc)	Test Voltage (V dc)	Did unit operate Correctly?	Was there any chattering of the contact?
FTR-C2CA003G - A1	1	3	2.4	Yes	No
	2	3	2.4	Yes	No
	3	3	2.4	Yes	No
FTR-C2CA012G - B6, B8, B10	1	12	9.6	Yes	No
	2	12	9.6	Yes	No
	3	12	9.6	Yes	No

OVERVOLTAGE TEST:

METHOD

Immediately following the Undervoltage Test, the voltage was increased to 110% of the rated control circuit (coil) voltage. After temperature and conditions stabilized, immediately the control circuit (coil) voltage was reduced to that used during the Temperature Test. The device was cycled several times, and device was observed to see if the armature closed fully.

RESULTS

Does the armature close fully?

FTR-C2CA003G	Yes - A1
FTR-C2CA012G	Yes - B6, B8, B10

REPEAT CROSSOVER LEAD DIELECTRIC TEST:

METHOD

The coil terminals were connected to a rated source as indicated in the following table. The load terminals were connected to a 30 V dc, 1 A source. The thermocouples were connected to the coil of the device. The device was operated until temperatures and conditions were stabilized.

After temperature and conditions were stabilized, the control circuit (coil) voltage was reduced to 65 percent of the potential used in the previous Crossover Lead Dielectric Test. Indications of a breakdown in the insulation system were observed.

RESULTS

Model No.	Rated Coil Voltage	Test Voltage	Results
FTR-C2CA003G - A1	3 V dc	3.9 V	NB
FTR-C2CA012G - B6, B8, B10	12 V dc	15.6 V	NB

The spacings and insulation withstood the application of the specified potential without breakdown.

OVERLOAD AND ENDURANCE TEST:

METHOD

Samples of the relay, model numbers indicated under Results, were subjected to this Test.

The samples were mounted, and connected as intended in service.

The ratings used as a basis of these tests, the characteristics of the loads controlled, the number of operations, and internals between operations are given in the Results section.

SPECIAL INSTRUCTIONS:

The special instructions described below may apply to one, or more different model numbers as indicated in the Results section.

Relay Model No.: FTR-C2CA012G

DEVICE RATING				
Voltage (AC or DC)	125 V ac			
Phase (or DC)	1			
Ampere Rating	0.3 A			
Horsepower Rating	---			
Tungsten Load	---			
TEST SPECIFICATIONS				
Test:	Overload:		Endurance:	
Wire Size (AWG):	18		18	
Poles Used	1		1	
Enclosure connected to:				
Closed Circuit Voltage (AC or DC)	125 V ac		125 V ac	
Current (Amps)	0.45		0.3	
Percent of Rated Current (%)	150		100	
Power Factor	0.7-0.8		0.7-0.8	
Phase (or DC)	1		1	
Operations/Minute	6		60	
Number of Operations	50		6,000	
Cycle Rate, CLOSE/OPEN (Seconds)	1/9		1/1	
TEST DATA	NO	NC	NO	NC
Open Circuit Voltage	125.6	125.6	125.1	125.1
Closed Circuit Voltage	125.3	125.3	125.0	125.0
Current	0.45	0.45	0.30	0.30
Wattage	42.0	42.0	28.5	28.5
Power Factor	0.75	0.75	0.75	0.75
Shunt Resistance (or)	---	---	---	---
Number of Cycles	50	50	6,000	6,000
Pitting or Burning? (YES/NO)	NO	NO	NO	NO
Line/Load Terminals Reversed?	---		---	
Calibration Repeated?	---		---	
DIELECTRIC WITHSTAND				
Potential (Volts), From Live Parts To:				
Opposite Polarity				
Enclosure				
Dead-Metal Parts				

Relay Model No.: FTR-C2CA012G

DEVICE RATING				
Voltage (AC or DC)	30 V dc			
Phase (or DC)	DC			
Ampere Rating	1 A			
Horsepower Rating	---			
Tungsten Load	---			
TEST SPECIFICATIONS				
Test:	Overload:		Endurance:	
Wire Size (AWG):	18		18	
Poles Used	1		1	
Enclosure connected to:				
Closed Circuit Voltage (AC or DC)	30 V dc		30 V dc	
Current (Amps)	1.5		1.0	
Percent of Rated Current (%)	150		100	
Power Factor	---		---	
Phase (or DC)	DC		DC	
Operations/Minute	6		60	
Number of Operations	50		6,000	
Cycle Rate, CLOSE/OPEN (Seconds)	1/9		1/1	
TEST DATA	NO	NC	NO	NC
Open Circuit Voltage	30.14	30.14	30.21	30.21
Closed Circuit Voltage	30.06	30.06	30.16	30.16
Current	1.516	1,516	1.06	1.06
Wattage	45.8	45.8	32.08	32.08
Power Factor	---	---	---	---
Shunt Resistance (or)	---	---	---	---
Number of Cycles	50	50	6,000	6,000
Pitting or Burning? (YES/NO)	NO	NO	NO	NO
Line/Load Terminals Reversed?	---		---	
Calibration Repeated?	---		---	
DIELECTRIC WITHSTAND				
Potential (Volts), From Live Parts To:				
Opposite Polarity				
Enclosure				
Dead-Metal Parts				

Relay Model No.: FTR-C2CA012G

DEVICE RATING				
Voltage (AC or DC)	110 V dc			
Phase (or DC)	DC			
Ampere Rating	0.3 A			
Horsepower Rating	---			
Tungsten Load	---			
TEST SPECIFICATIONS				
Test:	Overload:		Endurance:	
Wire Size (AWG):	18		18	
Poles Used	1		1	
Enclosure connected to:				
Closed Circuit Voltage (AC or DC)	110 V dc		110 V dc	
Current (Amps)	0.45		0.3	
Percent of Rated Current (%)	150		100	
Power Factor	---		---	
Phase (or DC)	DC		DC	
Operations/Minute	6		60	
Number of Operations	50		6,000	
Cycle Rate, CLOSE/OPEN (Seconds)	1/9		1/1	
TEST DATA	NO	NC	NO	NC
Open Circuit Voltage	110.61	110.61	110.59	110.59
Closed Circuit Voltage	110.68	110.60	110.57	110.57
Current	0.45	0.45	0.30	0.30
Wattage	50.01	50.36	33.83	33.83
Power Factor	---	---	---	---
Shunt Resistance (or)	---	---	---	---
Number of Cycles	50	50	6,000	6,000
Pitting or Burning? (YES/NO)	NO	NO	NO	NO
Line/Load Terminals Reversed?	---		---	
Calibration Repeated?	---		---	
DIELECTRIC WITHSTAND				
Potential (Volts), From Live-parts to:				
Opposite Polarity				
Enclosure				
Dead-Metal Parts				

TEST RECORD NO. 2

SAMPLES:

Samples of catalog number C2-FTR configured with the double stable and 24 V dc coil, were subjected to the following. The test results apply only to the samples that were tested.

TEMPERATURE TEST:

METHOD

Samples of the relay, Model NO. C2-FTR, were mounted and connected as intended in service or as indicated below in Special Instructions. The contact or load terminals were connected in series to a low voltage current source for non-voltage specific coils. The load was connected by using 1.2 m (4 ft.) length of wire, of size specified under Results.

The coil or control terminals were connected with 18 AWG wire to a supply source of rated voltage and energized to allow the maximum rated current to pass through the device continuously until temperatures stabilized. The temperature is considered to have stabilized when three successive reading that at intervals of 10% of the previously elapsed duration of the test but not less than 10 minutes indicate no change.

The coil winding temperature was measured using the Change-Of-Resistance Method.

RESULTS

Relay Designation: C2-FTR
Test Load Current: 1 A
Test Coil Voltage: 24 V dc
Load Wire Size: 24 AWG
Poles Used: 1
Ambient: 25C

Thermocouple Location	Maximum Temperature, °C
Ambient	25
Base	33
Enclosure	32
Stationary contact arm	27
Coil, Change of Resistance	39

DIELECTRIC VOLTAGE WITHSTAND:

METHOD

At the conclusion of the temperature test, the relay was subjected to the dielectric test as described in 49.1 of UL508.

RESULTS

There was no dielectric breakdown

OVERLOAD AND ENDURANCE TESTS:

METHOD

Samples of the C2-FTR relay were subjected to the tests described in sections 42 and 43 of UL508. The samples were mounted and connected as intended in service.

The ratings used as a basis of these tests, the characteristics of the loads controlled, the number of operations and internals between operations are noted below.

Test 1: For 120 V dc, 0.3 A rating

TEST SPECIFICATIONS		
Test:	Overload	Endurance
Wire Size (AWG)	24	24
Poles Used	1	1
Enclosure connected to:	Grnd Fuse	Grnd Fuse
Closed Circuit Voltage (AC or DC)	120 V dc	120 V dc
Current (Amps)	0.45A	0.3A
Percent of Rated Current (%)	150	100
Power Factor	1.0	1.0
Phase (φ or DC)	DC	DC
Operations/Minute	6	6
Number of Operations	50	6K
Cycle Rate, close/open (seconds)	1/9	1/9

Test 2: For 30 Vdc, 1.0 A rating

TEST SPECIFICATIONS		
Test:	Overload	Endurance
Wire Size (AWG)	24	24
Poles Used	1	1
Enclosure connected to:	Grnd Fuse	Grnd Fuse
Closed Circuit Voltage (AC or DC)	30 V dc	30 V dc
Current (Amps)	1.5A	1.0A
Percent of Rated Current (%)	150	100
Power Factor	1.0	1.0
Phase (φ or DC)	DC	DC
Operations/Minute	6	6
Number of Operations	50	6K
Cycle Rate, close/open (seconds)	1/9	1/59

Test 3: For 125 V ac, 0.3 A rating

TEST SPECIFICATIONS		
Test:	Overload	Endurance
Wire Size (AWG)	24	24
Poles Used	1	1
Enclosure connected to:	Grnd Fuse	Grnd Fuse
Closed Circuit Voltage (AC or DC)	125 V ac	125 V ac
Current (Amps)	0.45A	0.3A
Percent of Rated Current (%)	150	100
Power Factor	1.0	1.0
Phase (φ or DC)	1	1
Operations/Minute	6	6
Number of Operations	50	6K
Cycle Rate, close/open (seconds)	1/9	1/59

RESULTS

As a result of the overload and endurance test, there was no pitting or burning of the contacts, the relays remained operational, there was no dielectric breakdown.

Test Record Summary:

The results of the investigation covered by Test Record No. 2 indicate that the samples of the C2-FTR relays complies with the applicable requirements. Therefore these products are eligible to bear UL's Mark as described in the Conclusion Page of this report.

Test Record byy:

James Shaw

JAMES SHAW
Staff Engineer
Conformity Assessment Services

Reviewed By:

Ian McDonald

IAN MCDONALD
Project Engineer
Conformity Assessment Services

CONCLUSION

Samples of the products covered by this Report have been found to comply with the requirements covering the class and the products are judged to be eligible for Listing and Follow-Up Service. The manufacturer is authorized to use the Laboratories' Mark on such products which comply with the Follow-Up Service Procedure and any other applicable requirements of Underwriters Laboratories Inc. Only those products which properly bear the Laboratories' Mark are considered as Listed by Underwriters Laboratories Inc.

Report by:

Froilan S. Mercado/tn

FROILAN S. MERCADO
Project Engineer
Conformity Assessment Services

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Nathaniel Caditan/tn

NATHANIEL CADITAN
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