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Application Note AN310196 - Fast testing with the RT290 relay test system, and comparison between RT90 and RT290.

Contents.

Introduction.

This note discusses how to achieve the shortest possible test times for a relay device test and the typical time to be expected from a minimum device test sequence. It is based around the RT290 test system. Much of the detailed documentation is found in the application-specific manual ASY0632 which should be used in conjunction with this document.

Obtaining device test times.

The manual ASY0632 includes test times for each of the device test steps as follows:

Name of test type	Description of test.	Approx. time.
Adaptor Continuity.	Measures and confirms correct device adaptor connection.	38ms - but see note 'CTY'
Coil Resistance.	Measures the resistance of specified coil(s).	50ms - but see note 'CLR'
Contact Resistance.	Measures the resistance of specified contacts.	60-150ms - but see note 'CTR'
Contact Resistance Stability.	Measures the delta, min, mean, max. and standard deviation of a number of contact cycles.	From 105ms - but see note 'CRS'
Timing: Operate and Release	Measures the operate and release timing of specified contacts.	100ms - but see note 'TIM'
VRamp: Operate and Release.	Measures the operate and release voltage parameters of a device.	See note 'VRM'
IRamp: Operate and Release.	Measures the operate and release current parameters of a device.	See note 'IRM'
Diode check	Confirms presence or absence of a diode across the device coil.	65ms - but see note 'DIO'
V Functional	Applies various voltage levels to a device with the option of confirming the expected contacts state.	100ms but see note 'VFUN'
V Pulse	Measures the operate and release voltage parameters of a device using a pulse-based algorithm for faster determination than ramp.	0.75s, but see note 'VPLS'
Dynamic CR	Makes a 'capture' of the CR of a selected contact as it opens or closes, producing a graph of CR against time.	Not specified (but see note 'DYCR')
I/O Port control utility	Provides control and interrogation of spare handler port lines for the control of simple external equipment during a test sequence.	20ms - but see note 'PORT'
Contact set shorts	Detects shorts between contact sets.	25ms - but see note 'SHRT'

VRM (VRamp: Operate and Release).

For this test programmed for a 12V device, operate and release step sizes of 0.12V (i.e. 1% of nominal voltage), 10ms settling time and with the operate ramp starting at 0V and release ramp starting at nominal voltage, this test takes 1.44s testing a monostable 4pc/o device on all contacts.

This is very close to the theoretical time for this test, and this actual v theoretical performance is maintained for settling times down to around 1ms.

Add a further time for any initial pulse if required, or if testing bistable relays - see test diagram.

Note that these test settings are pessimistic, i.e. the operate and release ramps can easily be started 'later', and the step size possibly increased. In any case, the test execution time is generally close to (N * S) where 'N' is the number of total ramp steps required, and 'S' is the specified settling time.

CLR (Coil Resistance).

Typically 50ms including a programmed 10ms settling time.

CTY (Adaptor continuity).

Typically 38ms testing a monostable, 4pc/o device on all contacts, remove 3ms if testing 2pc/o.

CTR (Contact Resistance).

Between 60ms and 150ms depending on precision, based on a 4pc/o monostable device tested on all normally closed contacts. For normally open contacts, add twice the device settling time programmed.

CRS (Contact Resistance Stability).

Typically as follows:

For 2 cycles, 480ms at 'best stability'.
For 1 cycle, 250ms at 'best stability'.
For 1 cycle, 105ms at 'best speed'.
40ms /200Hz precision.

All measurements made testing a 4pc/o monostable device on all contacts.

TIM (Timing).

For this test programmed for a 12V device, test duration 20ms, this test takes 100ms testing a monostable 4pc/o device on all contacts with a maximum 15ms test limit.

Note that a further time should be added if an initial pulse is used or if testing bistable devices - see the test diagram.

DIO (Diode test).

This test takes 65ms.

VFUN (Vfunctional test).

For this test programmed for 5 levels and 15ms settling times, this test takes approx. 100ms testing a monostable 4pc/o device on all contacts.

This is very close to the theoretical time for this test, and this actual v theoretical performance is maintained for settling times down to around 1ms.

Note that a further time should be added if an initial pulse is used or if testing bistable devices - see the test diagram.

VPLS (VPulse test).

This test takes 0.75s testing a 4pc/o monostable device with 15ms settling times.

This is very close to the theoretical time for this test, and this actual v theoretical performance is maintained for settling times down to around 1ms.

DYCR (Dynamic CR).

Execution for this test is not specified.

PORT (I/O Port utility).

Typically 20ms, but note that time spent waiting during the programmed wait times must be added.

SHRT (Contact set shorts).

Typically 25ms testing a 4pc/o monostable device on all contact sets.

IRM (IRamp: Operate and Release).

For this test programmed for a 25mA device, operate and release step sizes of 0.25mA (i.e. 1% of nominal current), 10ms settling time and with the operate ramp starting at 0mA and release ramp starting at nominal current, this test takes 1.44s testing a monostable 4pc/o device on all contacts.

This is very close to the theoretical time for this test, and this actual v theoretical performance is maintained for settling times down to around 1ms.

Add a further time for any initial pulse if required, or if testing bistable relays - see test diagram.

Note that these test settings are pessimistic, i.e. the operate and release ramps can easily be started ‘later’, and the step size possibly increased. In any case, the test execution time is generally close to (N * S) where ‘N’ is the number of total ramp steps required, and ‘S’ is the specified settling time.

Measuring the speed of a test step.

The typical execution times for each test type are shown in the data for each test type. The times are measured by observing the BUSY output of the RT290 when only the specified test step is executed using 'Run', 'Next Test'. When observing this BUSY active time, the adaptor operate and release delays will be included in your observed time. These delays are specified in the BIOSCFG.INI file and have been removed from the quoted times, i.e. the published times are close to that of the actual test step. Where the test shows 'NA', the time has either not been measured, or is short enough to be neglected.

Calculating the execution time of a test sequence.

Use the equation:

Ao + T1 + T2 + T3 + Ar

to determine the length of a test sequence, where Ao and Ar are the operate and release delays for the adaptor respectively (these are programmed in the BIOSCFG.INI file with defaults of 100ms) and T1..Tn are the specified 'Speed of execution' times quoted in the test type documentation.

Note that this will be an approximation, and that there will be variations due to adaptor re-tries, any multi-tasking on the PC etc.

A fast, simple, relay device test.

AS an example of a fast, simple, relay device test, the listing 'FAST.R90' in appendix 1 shows a device test based on the following tests:

Adaptor check.
Coil Resistance.
Timing.
V Functional.
Contact Resistance Stability.

These 5 tests make a basic check on all parameters of the device. The part is a 4-pole changeover device, nominal 12V, 470R coil, and most times are based on a 15ms test limit.

This complete test executes in 340ms on the RT290, and ignoring the default 100ms adaptor operate and release delays.

If required, the 'Contact Resistance' tests can be substituted for the 'Contact Resistance Stability' test shown - there will be little change to the overall timing. The CR stability test was chosen because both NO and NC results are available in one test step, and statistical values are available if the number of measurements is set to greater than 1.

In many cases, the test can be further optimised, particularly by reducing the settling times shown. The CR measurement is made at a 'best speed' precision which has been found to be close to the full 'best stability' precision yet with a worthwhile time saving.

Comparison of test times between RT90 and RT290.

For Users of the RT90, this section reproduces the timing table above but with RT90 test times compared.

As an additional comparison, the listed file 'FAST.R90' executes on the RT90 at 860ms and on the RT290 at 340ms.

For more details on the RT90 performance, view the document AN180995 ‘Fast testing with the RT90’.

Name of test type	Description of test.	RT90 time	RT290 time
Adaptor Continuity.	Measures and confirms correct device adaptor connection.	180ms	38ms
Coil Resistance.	Measures the resistance of specified coil(s).	80ms	50ms
Contact Resistance.	Measures the resistance of specified contacts.	110ms-220ms	60-150ms
Contact Resistance Stability.	Measures the delta, min, mean, max. and standard deviation of a number of contact cycles.	260ms/cycle - 520ms/cycle	105ms - 250ms
Timing: Operate and Release	Measures the operate and release timing of specified contacts.	100ms	100ms
VRamp: Operate and Release.	Measures the operate and release voltage parameters of a device.	60ms + As theoretical down to approx. 5ms settling	60ms + As theoretical down to 1ms settling
IRamp: Operate and Release.	Measures the operate and release current parameters of a device.	As for VRamp	As for VRamp
Diode check	Confirms presence or absence of a diode across the device coil.	110ms	65ms
V Functional	Applies various voltage levels to a device with the option of confirming the expected contacts state.	105ms	100ms
V Pulse	Measures the operate and release voltage parameters of a device using a pulse-based algorithm for faster determination than ramp.	60ms + As theoretical down to approx. 5ms settling	60ms + As theoretical down to 1ms settling
Dynamic CR	Makes a ‘capture’ of the CR of a selected contact as it opens or closes, producing a graph of CR against time.	Not specified	Not specified
I/O Port control utility	Provides control and interrogation of spare handler port lines for the control of simple external equipment during a test sequence.	20ms	20ms
Contact set shorts	Detects shorts between contact sets.	60ms	25ms

Appendix 1: Print-out of relay device test FAST.R90.

```
[ ------------------------------------------------------------------------ ]
[ Printed from   : RT290 SOFTWARE, V1.00c 27/12/95                         ]
[ Description    : Immediate print of test sequence                        ]
[ Date and time  : 11:26:46, Wednesday, 31st January 1996                  ]
[ Test file path : 'C:\RT290\FAST.R90'                                     ]
[ File reference : 'A demonstration of a fast 4pc/o relay - 340ms RT290' ]
[ ------------------------------------------------------------------------ ]


  1[-] "Batch definition"
  CONDITION LIST
    C1   Part Number               = No part number
    C2   Device Type               = No Device Type
    C4   Operator                  = No operator
    C5   Batch                     = No batch
    C6   Lot                       = No lot
    C7   Sample Plan               = No sample plan
    C20  Device routing            = None specified
  RESULT SUMMARY
  TOTALS THIS STEP 0% (0/0)
  RESULT LIST
  DATALOG True [Always]
  PRINT   True [Always]
  HANDLER BIN Fail: 0, Pass: 0
  JUMP    False [Never], to step <End of program>
  ------------------------------------------------------------------------
  2[-] "Adaptor continuity"
  CONDITION LIST
    C121 Device coil format                      = As monostable A+
    C101 Device contact format                   = 4PCO   (Sets 1..4)
    C102 Contacts to test                        = C,C,C,C,X,X
    C416 Max adaptor resistance                  =  5.00  R
    C417 Max adaptor retries                     =  3
  RESULT SUMMARY
  TOTALS THIS STEP 0% (0/0)
  RESULT LIST
  DATALOG True [Always]
  PRINT   True [Always]
  HANDLER BIN Fail: 0, Pass: 0
  JUMP    False [Never], to step <End of program>
  ------------------------------------------------------------------------
  3[-] "Coil resistance"
  CONDITION LIST
    C122 Coil to measure                         = Coil-A (Monostable)
    C201  # Voltage default                      =   12.00   V
    C301  # Current default                      =    0.000 mA
    C401  # RCoil default                       =    0.000 kR
    C124 Device coil suppression                 = Network #0
    C123 Coil polarity                           = Normal ( high is +ve)
    C210 Voltage to apply                        =    6.00   V
    C310 Current to apply                        =  100.000 mA
    C510 Settling time                           =   10.000 ms
    C415 Max Rcoil pass limit           [414/   ]  =  100.000 kR
    C414 Min Rcoil pass limit           [   /415]  =   10.000  R
    C601 Use temperature probe                   = No
    C602 Temperature coeff of wire               =   0.400  %/Dg
    C603 Refer back to temperature               =  20.0    DegC
    C604 Non-probe correction factor             =   1.000
  RESULT SUMMARY
  TOTALS THIS STEP 0% (0/0)
  RESULT LIST
  DATALOG True [Always]
  PRINT   True [Always]
  HANDLER BIN Fail: 0, Pass: 0
  JUMP    False [Never], to step <End of program>
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--------------------------------------------------------------------------
4[-] "Timing:   Operate & Release"
CONDITION LIST
  C121 Device coil format                          = As monostable A+
  C101 Device contact format                       = 4PCO   (Sets 1..4)
  C102 Contacts to test                            = C,C,C,C,X,X
  C201  # Voltage default                          =   12.00   V
  C301  # Current default                          =    0.000 mA
  C401  # RCoil default                            =    0.000 kR
  C501  # TStable default                         =   15.000 ms
  C124 Device coil suppression                     = Network #0
  C250 Initial voltage                             =    0.00   V
  C313 Initial current                             =  100.000 mA
  C510 Settling time                               =   15.000 ms
  C529 System timebase                             = 1us   (1MHz)
  C700 Number of measurements                      =       1
  C701 Operate segment mode                        = Normal
  C221 Operate applied voltage                     =   12.00   V
  C311 Operate applied current                     =  100.000 mA
  C702 Release segment mode                        = Normal
  C241 Release applied voltage                     =   12.00   V
  C312 Release applied current                     =  100.000 mA
  C520 Opr: Min T stable               [   /521]   =    0.000 ms
  C521 Opr: max T stable               [520/   ]   =   15.000 ms
  C524 Opr: Min T transfer             [   /525]   =    0.000 ms
  C525 Opr: max T transfer             [524/521]   =   15.000 ms
  C512 Opr: Min T action               [   /513]   =    0.000 ms
  C513 Opr: max T action               [512/   ]   =   15.000 ms
  C514 Opr: Max T bounce                           =    3.750 ms
  C515 Opr: Max num bounces                        =    1000
  C522 Rel: Min T stable               [   /523]   =    0.000 ms
  C523 Rel: max T stable               [522/   ]   =   15.000 ms
  C526 Rel: Min T transfer             [   /527]   =    0.000 ms
  C527 Rel: max T transfer             [526/523]   =   15.000 ms
  C516 Rel: Min T action               [   /517]   =    0.000 ms
  C517 Rel: max T action               [516/   ]   =   15.000 ms
  C518 Rel: Max T bounce                           =    3.750 ms
  C519 Rel: Max num bounces                        =    1000
RESULT SUMMARY
TOTALS THIS STEP 0% (0/0)
RESULT LIST
DATALOG True [Always]
PRINT   True [Always]
HANDLER BIN Fail: 0, Pass: 0
JUMP    False [Never], to step <End of program>
--------------------------------------------------------------------------
5[-] "V Functional"
CONDITION LIST
  C121  Device coil format                         = As monostable A+
  C101  Device contact format                      = 4PCO   (Sets 1..4)
  C102  Contacts to test                           = C,C,C,C,X,X
  C201   # Voltage default                         =   12.00   V
  C301   # Current default                         =    0.000 mA
  C401   # RCoil default                           =    0.000 kR
  C501   # TStable default                        =   15.000 ms
  C124  Device coil suppression                    = Network #0
  C510  Settling time                              =   15.000 ms
  C310  Current to apply                           =  100.000 mA
  C1011 Level mode 1                               = OxR (App OP, exp RL).
  C1012  V Applied Level 1                         =    2.40   V
  C1013  V Step to Level 1                         =    0.00   V
  C1014  T Step to Level 1                         =    0.000 ms
  C1021 Level mode 2                               = OxO (App OP, exp OP).
  C1022  V Applied Level 2                         =    9.60   V
  C1023  V Step to Level 2                         =    0.00   V
  C1024  T Step to Level 2                         =    0.000 ms
  C1031 Level mode 3                               = O   (App OP only).
  C1032  V Applied Level 3                         =   12.00   V
  C1033  V Step to Level 3                         =    0.00   V
  C1034  T Step to Level 3                         =    0.000 ms
  C1041 Level mode 4                               = RxO (App RL, exp OP).
  C1042  V Applied Level 4                         =    8.40   V
  C1043  V Step to Level 4                         =    0.00   V
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  C1044  T Step to Level 4                          =    0.000 ms
  C1051 Level mode 5                                = RxR (App RL, exp RL).
  C1052  V Applied Level 5                          =    1.80   V
  C1053  V Step to Level 5                          =    0.00   V
  C1054  T Step to Level 5                          =    0.000 ms
  C1061 Level mode 6                                = End.
  C1062  V Applied Level 6                          =    0.00   V
  C1063  V Step to Level 6                          =    0.00   V
  C1064  T Step to Level 6                          =    0.000 ms
  C1071 Level mode 7                                = End.
  C1072  V Applied Level 7                          =    0.00   V
  C1073  V Step to Level 7                          =    0.00   V
  C1074  T Step to Level 7                          =    0.000 ms
  C1081 Level mode 8                                = End.
  C1082  V Applied Level 8                          =    0.00   V
  C1083  V Step to Level 8                          =    0.00   V
  C1084  T Step to Level 8                          =    0.000 ms
  C1091 Level mode 9                                = End.
  C1092  V Applied Level 9                          =    0.00   V
  C1093  V Step to Level 9                          =    0.00   V
  C1094  T Step to Level 9                          =    0.000 ms
  C1101 Level mode 10                               = End.
  C1102  V Applied Level 10                         =    0.00   V
  C1103  V Step to Level 10                         =    0.00   V
  C1104  T Step to Level 10                         =    0.000 ms
RESULT SUMMARY
TOTALS THIS STEP 0% (0/0)
RESULT LIST
DATALOG True [Always]
PRINT   False [Never]
HANDLER BIN Fail: 0, Pass: 0
JUMP    False [Never], to step <End of program>
------------------------------------------------------------------------------
6[-] "CR stability"
CONDITION LIST
  C121 Device coil format                           = As monostable A+
  C101 Device contact format                        = 4PCO   (Sets 1..4)
  C102 Contacts to test                             = C,C,C,C,X,X
  C201  # Voltage default                           =    0.00   V
  C301  # Current default                           =    0.000 mA
  C402  # RContact default                         =   0.0000  R
  C401  # RCoil default                            =    0.000 kR
  C501  # TStable default                          =    0.000 ms
  C124 Device coil suppression                      = Network #0
  C103 Contact side to measure                      = Normally open
  C212 VClamp                                       =   50 mV
  C104 Contact load                                 = CA0 (as gen and clamp)
  C210 Voltage to apply                             =   12.00   V
  C310 Current to apply                             =  100.000 mA
  C510 Settling time                                =   15.000 ms
  C410 CR Measurement range                         = 1R,  AC, 10mV, 10mA
  C411 CR measurement precision                     = 4 (best speed)
  C700 Number of measurements                       =       1
  C420 RMin limit: Min RContact        [   /421]  =   0.0000  R
  C421 RMax limit: Min RContact        [420/   ]  =   0.1000  R
  C422 RMin limit: Max RContact        [   /423]  =   0.0000  R
  C423 RMax limit: Max RContact        [422/   ]  =   0.1000  R
  C428 RMin limit: Delta RContact      [   /429]  =   0.0000  R
  C429 RMax limit: Delta RContact      [428/   ]  =   0.0100  R
  C424 RMin limit: Mean RContact       [   /425]  =   0.0000  R
  C425 RMax limit: Mean RContact       [424/   ]  =   0.1000  R
  C426 RMin limit: StDev RContact      [   /427]  =   0.0000  R
  C427 RMax limit: StDev RContact      [426/   ]  =   0.0100  R
RESULT SUMMARY
TOTALS THIS STEP 0% (0/0)
RESULT LIST
DATALOG True [Always]
PRINT   False [Never]
HANDLER BIN Fail: 0, Pass: 0
JUMP    False [Never], to step <End of program>
------------------------------------------------------------------------------
```

End of listing.