

## **NAG Library Sub-chapter Introduction**

### **d02m–n – Integrators for Stiff Ordinary Differential Systems**

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## 1 Introduction

This sub-chapter contains the specifications of the integrators from the DASSL package, Brenan *et al.* (1996).

The DASSL integrator `nag_dae_ivp_dassl_gen` (d02nec) is designed for solving systems of the form,  $F(t, y, y') = 0$ . These formulations permit solution of differential/algebraic systems (DAEs). The facilities provided are essentially those of the explicit solvers.

The DASSL integrator, `nag_dae_ivp_dassl_gen` (d02nec), has an associated setup function `nag_dae_ivp_dassl_setup` (d02mwc) which must be called first. On return from the integrator, if it is feasible to continue the integration, the associated continuation call function is `nag_dae_ivp_dassl_cont` (d02mcc) may be called to reset various integration parameters. The structure of the Jacobian is assumed to be full unless `nag_dae_ivp_dassl_linalg` (d02npc) is called following a call to the setup function to specify that the Jacobian is banded and to supply its bandwidths.

The DASSL integrator `nag_dae_ivp_dassl_gen` (d02nec) can solve DAEs of the fully implicit form  $F(t, y, y') = 0$  and therefore has increased functionality over the SPRINT integrators. Additionally `nag_dae_ivp_dassl_gen` (d02nec) can be used to solve difficult algebraic problems by continuation; for example, the nonlinear algebraic problem

$$f(x) = 0$$

can be solved by integrating solutions of

$$f(x) + (1 - t)g(x) = 0$$

where the solution to  $f(x) + g(x) = 0$  is known. The solution of this type of problem is illustrated in Section 10 in `nag_dae_ivp_dassl_gen` (d02nec).

## 2 References

Berzins M and Furzeland R M (1985) A user's manual for SPRINT – A versatile software package for solving systems of algebraic, ordinary and partial differential equations: Part 1 – Algebraic and ordinary differential equations *Report TNER.85.085* Shell Research Limited

Brenan K, Campbell S and Petzold L (1996) *Numerical Solution of Initial-Value Problems in Differential-Algebraic Equations* SIAM, Philadelphia

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