

MATHEMATISCH CENTRUM

2e BOERHAAVESTRAAT 49

AMSTERDAM

REKENAFDELING

Programmering voor de ARMAC

Deel IV

Rm6: Interpretatief programma voor het werken met 6-voudige lengte getallen.

door

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Rm6

Rm6 bevat subroutines die geschikt zijn voor de bewerking van reële getallen die liggen tussen, of gelijk zijn aan  $10^{18-1}$  en  $1 \cdot 10^{-36}$ .

AANROEP EN WERKWIJZE

De subroutines maken gebruik van een vaste werkruimte R, bestaande uit 6 plaatsen n.l. 24 t/m 29 X 0.

De subroutines worden aangeroepen door een zogenaamd interpretatief programma; dus gaat men werken met 6.lengte getallen dan gebeurt dit via het interpretatieve programma.

De a a n r o e p van het interpretatieve programma luidt: 22 16 S 0 of 22 26 S 2. De aanroep 22 16 S 0 kan gebruikt worden als kanaal X 0 reeds de goede inhoud heeft. De aanroep 22 26 S 2 moet gebruikt worden als X 0 nog ingevuld moet worden. Het is dus raadzaam om bij ieder herstartpunt in het programma als eerste interpretatieve aanroep te gebruiken 22 26 S 2.

Na het uitvoeren van een der aanroepen worden de opdrachten op de volgende adressen geïnterpreteerd als aanroepen voor de respectievelijke subroutines van Rm6.

Wil men het interpretatief werken weer beëindigen dan moet dit gebeuren met een niet conditionele sprongopdracht.

INVOER

De getallen moeten geponst worden in 6 woorden, ieder van max. 9 cijfers. Ieder woord moet hetzelfde teken hebben.

Noem deze woorden resp.  $a_1, a_0, a_{-1}, a_{-2}, a_{-3}, a_{-4}$  dan geldt:  
 $G = a_1 \cdot 10^9 + a_0 + a_{-1} \cdot 10^{-9} + a_{-2} \cdot 10^{-18} + a_{-3} \cdot 10^{-27} + a_{-4} \cdot 10^{-36}$ .

G wordt door het invoerprogramma omgerekend tot een binair getal, dus dan geldt

$$G = \alpha_1 \cdot 2^{33} + \alpha_0 + \alpha_{-1} \cdot 2^{-33} + \alpha_{-2} \cdot 2^{-66} + \alpha_{-3} \cdot 2^{-99} + \alpha_{-4} \cdot 2^{-132}.$$

De getallen moeten zodanig ingevoerd worden dat het meest significante woord staat op de laagste plaats van de beschikbare geheugenruimte. De soortspecificatie is: RJ6 1 S 1.

Noem het adres van het minst significante woord  $\alpha$ , dan geldt na de invoer van G:  $(\alpha) = \alpha - 4$



UITVOER

Rm6 levert elk resultaat zo af dat alle woorden hetzelfde teken hebben en wel gelijk aan het teken van het meest significante woord.

Met behulp van de interpretatieve typ-aanroep wordt de inhoud van R getypt en wel in de vorm  $a_1 a_0 a_{-1} a_{-2} a_{-3} a_{-4}$  waarbij weer geldt  $G = a_1 \cdot 10^9 + a_0 + a_{-1} \cdot 10^{-9} + a_{-2} \cdot 10^{-18} + a_{-3} \cdot 10^{-27} + a_{-4} \cdot 10^{-36}$ .

G bestaat uit 6 woorden, hier dient dus rekening mee gehouden te worden met de waarde van n de constante voor de regelindeling.

## N.B.

1. Op de plaatsen 13 en 14 X 0 staan constanten nodig voor de subroutines van Rm6. Geen der subroutines verknoeit deze werkruimten.

De vaste inhoud van 13 en 14 X 0 staat op 29 en 30 S 2  
Verder worden alle plaatsen van X 0 gebruikt als werkruimten voor de subroutines.

De plaatsen 7 t/m 11 X 0 worden alleen gebruikt door de deelsubroutine van Rm6, dus deze plaatsen kunnen eventueel door het hoofdprogramma gebruikt worden als werkruimten.

2. De in- en uitloop van het interpretatieve programma laten de inhoud van R ongewijzigd.
3. De typconstanten nodig voor het uittypen van G zijn:

RA 4080 X 0

RT

S G9 F9 X K

T S G9 F9 X K

S G 9 J9 X K

S G9 J9 X T

Alleen de inhoud van R kan uitgetypt worden.

Na het typen is de inhoud van R verknoeid.



Subroutineopdrachten

|    |           |                                        |                               |
|----|-----------|----------------------------------------|-------------------------------|
| 0  | $\alpha$  | $\frac{1}{2} G \neq (R)$               |                               |
| 2  | $\alpha$  | $\sqrt{G} \neq (R)$                    |                               |
| 6  | p         | sprong naar ap                         | } beeindig interpr.<br>werken |
| 7  | p         | sprong naar bp                         |                               |
| 8  | $\alpha$  | $(R) + G \neq (R)$                     |                               |
| 9  | $\alpha$  | $(R) - G \neq (R)$                     |                               |
| 10 | $\alpha$  | $+ G \neq (R)$                         |                               |
| 11 | $\alpha$  | $- G \neq (R)$                         |                               |
| 12 | $\alpha$  | $+ (R) \neq G$                         |                               |
| 13 | $\alpha$  | $- (R) \neq G$                         |                               |
| 14 | . . . . . | typ (R). na het typen is (R) verknoeid |                               |
| 18 | $\alpha$  | $+ (R).G \neq (R)$                     |                               |
| 19 | $\alpha$  | $- (R).G \neq (R)$                     |                               |
| 20 | $\alpha$  | } $\frac{+ (R)}{G} \neq (R)$           |                               |
| 21 | $\alpha$  |                                        |                               |
| 22 | . . . . . | } skip                                 |                               |
| 23 | . . . . . |                                        |                               |
| 24 | . . . . . | } normeer (R) op goede teken           |                               |
| 25 | . . . . . |                                        |                               |

N.B. 1) ../..... zijn adresloze opdrachten, d.w.z. voor het adres mag alles ingevuld worden. Kies normaal 0 X 0

- 2)
- 22 16 S 0 en 22 26 S 2 hebben dus als opdr. twee functies n.l.:
- a) ga interpretatief werken
  - b) als men al interpretatief werkt: skip.

Interpretatief programma  
Kanaal SO

|                      |    | RA<br>RD | 0  | S | 0  |   |
|----------------------|----|----------|----|---|----|---|
| 0/0 halveren0        |    | 7        | 0  | S | 15 | ⇒ |
|                      |    | 8        | 8  | X | 8  |   |
| 2/2 V                | 1  | 6        | 0  | S | 13 | ⇒ |
|                      |    | 8        | 8  | X | 8  |   |
| 4/5                  | 2  | RX       | 1  |   |    |   |
| 6/7 eind int.        | 3  | 24       | 34 | X | 22 |   |
|                      |    | 6        | 15 | S | 0  | ⇒ |
| 8/9 ± add            | 4  | 22       | 30 | S | 7  | ⇒ |
|                      |    | 6        | 25 | S | 0  | ⇒ |
| 10/11<br>± schoon in | 5  | 6        | 24 | S | 1  | ⇒ |
|                      |    | 8        | 8  | X | 8  |   |
| 12/13<br>± vuil uit  | 6  | 7        | 20 | S | 4  | ⇒ |
|                      |    | 8        | 8  | X | 8  |   |
| 14/14 typ            | 7  | 7        | 0  | S | 3  | ⇒ |
|                      |    | 8        | 8  | X | 8  |   |
| 16/17                | 8  | RX       | 1  |   |    |   |
| 18/19 ±verm.         | 9  | 7        | 2  | S | 5  | ⇒ |
|                      |    | 8        | 8  | X | 8  |   |
| 20/21<br>± deling    | 10 | 22       | 25 | S | 8  | ⇒ |
|                      |    | 6        | 25 | S | 0  | ⇒ |
| 22/23 skip           | 11 | 6        | 25 | S | 0  | ⇒ |
|                      |    | 8        | 8  | X | 8  |   |
| 24/25<br>norm. R     | 12 | 22       | 17 | S | 4  | ⇒ |
|                      |    | 6        | 25 | S | 0  | ⇒ |
| 26/27                | 13 | RX       | 2  |   |    |   |
|                      | 14 |          |    |   |    |   |
| b3 ⇒                 | 15 | 0        | 19 | S | 0  |   |
|                      |    | 7        | 27 | S | 0  | ⇒ |

Interpretatief programma  
Kanaal SO

|       |    |         |       |   |    |           |
|-------|----|---------|-------|---|----|-----------|
| ⇒     | 16 | 26      | 0     | X | 12 |           |
|       |    | 26      | 12    | X | 28 |           |
|       | 17 | 26      | 21    | X | 30 |           |
|       |    | 8       | 20    | S | 0  |           |
|       | 18 | 24      | 34    | X | 22 |           |
|       |    | 6       | 26    | S | 0  | ⇒         |
|       | 19 | 6       | 0     | X | 0  |           |
|       |    | 0       | 0     | X | 0  |           |
|       | 20 | 2       | 0     | X | 0  |           |
|       |    | 4       | 31    | X | 0  |           |
| a27 → | 21 | 2       | 31    | X | 0  |           |
|       |    | 7       | 29    | S | 0  | ⇒         |
|       | 22 | 22      | 0     | S | 0  |           |
|       |    | 6       | 25    | S | 0  |           |
|       | 23 | RG      |       |   |    |           |
|       |    | + 85899 | 34591 |   |    |           |
| b31 ⇒ | 24 | RX      | 1     |   |    | 22 ... SQ |
|       |    | RD      |       |   |    | 6 25 SO   |
| ⇒     | 25 | 3       | 30    | X | 0  |           |
|       |    | 1       | 23    | S | 0  |           |
| b18 ⇒ | 26 | 5       | 30    | X | 0  |           |
|       |    | 26      | 0     | X | 12 |           |
|       | 27 | 14      | 21    | S | 0  | →         |
| b15 ⇒ |    | 28      | 28    | X | 2  |           |
|       | 28 | RX      | 1     |   |    | 2         |
|       |    |         |       |   |    | 4 31 X 0  |
|       | 29 | 24      | 17    | X | 20 |           |
| b21 ⇒ |    | 24      | 30    | X | 28 |           |
|       | 30 | 26      | 20    | X | 30 |           |
|       |    | 0       | 22    | S | 0  |           |
|       | 31 | 28      | 24    | X | 2  |           |
|       |    | 6       | 24    | S | 0  | ⇒         |
|       |    | RC      |       |   |    |           |

Invoer 6 lengte getallen - ,----  
Kanaal S1

|    | RA<br>RD | 0  | S | 1  |                              |
|----|----------|----|---|----|------------------------------|
| 0  | 4        | 31 | X | 0  |                              |
|    | 23       | 2  | S | 1  |                              |
| 1  | 2        | 0  | S | 1  |                              |
|    | 4        | 30 | X | 0  |                              |
| 2  | 6        | 8  | X | 0  | ⇒ pl.31 ≠ X0 en ga door      |
|    | 4        | 29 | X | 0  | berg.kop.opdr. van subr. S1  |
| 3  | 22       | 13 | X | 17 | =) lees getal $10^9$ -voud   |
|    | 12       | 5  | X | 0  | schrijf kop getal            |
| 4  | 22       | 13 | X | 17 | =) lees eenheden             |
|    | 24       | 34 | X | 22 |                              |
| 5  | 10       | 5  | X | 0  |                              |
|    | 16       | 31 | S | 1  | $\cdot 10^9$                 |
| 6  | 4        | 5  | X | 0  |                              |
|    | 2        | 25 | X | 0  |                              |
| 7  | 24       | 1  | X | 4  |                              |
|    | 28       | 8  | X | 2  |                              |
| 8  | RX       | 1  |   |    | berg eenh.                   |
| 9  | 26       | 16 | X | 0  |                              |
|    | 10       | 5  | X | 0  |                              |
| 10 | 2        | 25 | X | 0  |                              |
|    | 28       | 11 | X | 2  |                              |
| 11 | RX       | 1  |   |    | berg $2^{33}$ vouden         |
| 12 | 26       | 16 | X | 0  |                              |
|    | 22       | 13 | X | 17 | =)                           |
| 13 | 12       | 5  | X | 0  | $10^{-9}$ vouden $\beta -1$  |
|    | 22       | 13 | X | 17 | =)                           |
| 14 | 12       | 6  | X | 0  | $10^{-18}$ vouden $\beta -2$ |
|    | 22       | 13 | X | 17 | =)                           |
| 15 | 12       | 7  | X | 0  | $10^{-27}$ vouden $\beta -3$ |
|    | 22       | 13 | X | 17 | =)                           |

Invoer 6.lengte getallen --,----  
Kanaal S1

|    |     |     |     |     |                             |
|----|-----|-----|-----|-----|-----------------------------|
| 16 | 2   | 0   | X   | 0   | } redt teken                |
|    | 4   | 2   | X   | 0   |                             |
| 17 | 12  | 0   | X   | 0   | $\beta - 4 \neq 0 \times 0$ |
|    | 10  | 31  | S   | 1   | $10^9 \neq S$               |
| 18 | 22  | 0   | X   | 31  | =)                          |
|    | 2   | 7   | X   | 0   |                             |
| 19 | 4   | 0   | X   | 0   |                             |
|    | 12  | 1   | X   | 0   |                             |
| 20 | 10  | 31  | S   | 1   |                             |
|    | 22  | 0   | X   | 30  | =)                          |
| 21 | 4   | 0   | X   | 0   |                             |
|    | 12  | 7   | X   | 0   | $\alpha_3$                  |
| 22 | 10  | 31  | S   | 1   |                             |
|    | 22  | 0   | X   | 31  | =)                          |
| 23 | 2   | 6   | X   | 0   |                             |
|    | 4   | 0   | X   | 0   |                             |
| 24 | 2   | 7   | X   | 0   |                             |
|    | 4   | 1   | X   | 0   |                             |
| 25 | 12  | 7   | X   | 0   |                             |
|    | 10  | 31  | S   | 1   |                             |
| 26 | 22  | 0   | X   | 30  | =)                          |
|    | 12  | 6   | X   | 0   | $\alpha_2'$                 |
| 27 | 4   | 0   | X   | 0   |                             |
|    | 2   | 7   | X   | 0   |                             |
| 28 | 4   | 1   | X   | 0   |                             |
|    | 10  | 31  | S   | 1   |                             |
| 29 | 2   | 30  | S   | 1   |                             |
|    | 6   | 0   | X   | 30  |                             |
| 30 | 6   | 1   | S   | 2   |                             |
|    | 0   | 0   | X   | 0   |                             |
| 31 | RG  |     |     |     |                             |
|    | + 1 | 000 | 000 | 000 |                             |
|    | RC  |     |     |     |                             |

Invoer 6.lengte getallen  
2e aanroep Int. programma  
Kanaal S2

|    | RA             | 0 | S | 2 |                     |
|----|----------------|---|---|---|---------------------|
|    | RG             |   |   |   |                     |
| 0  | +1 000 000 000 |   |   |   |                     |
|    | RD             |   |   |   |                     |
| 1  | 12 7 X 0       |   |   |   |                     |
|    | 4 0 X 0        |   |   |   |                     |
| 2  | 10 0 S 2       |   |   |   | $10^9$              |
|    | 22 0 X 31      |   |   |   | =)                  |
| 3  | 2 5 X 0        |   |   |   |                     |
|    | 4 0 X 0        |   |   |   |                     |
| 4  | 12 5 X 0       |   |   |   |                     |
|    | 2 6 X 0        |   |   |   |                     |
| 5  | 4 1 X 0        |   |   |   |                     |
|    | 10 0 S 2       |   |   |   |                     |
| 6  | 22 0 X 30      |   |   |   | =)                  |
|    | 4 0 X 0        |   |   |   |                     |
| 7  | 2 7 X 0        |   |   |   |                     |
|    | 4 1 X 0        |   |   |   |                     |
| 8  | 24 0 X 4       |   |   |   |                     |
|    | 2 25 X 0       |   |   |   |                     |
| 9  | 24 2 X 4       |   |   |   |                     |
|    | 28 10 X 2      |   |   |   |                     |
| 10 | RX 1           |   |   |   | berg $2^{-33}$ voud |
| 11 | 26 16 X 0      |   |   |   | stop als fout       |
|    | 10 0 S 2       |   |   |   |                     |
| 12 | 22 0 X 30      |   |   |   | =)                  |
|    | 4 0 X 0        |   |   |   |                     |
| 13 | 2 5 X 0        |   |   |   |                     |
|    | 4 1 X 0        |   |   |   |                     |
| 14 | 24 0 X 4       |   |   |   |                     |
|    | 2 25 X 0       |   |   |   |                     |
| 15 | 24 3 X 4       |   |   |   |                     |
|    | 28 16 X 2      |   |   |   |                     |

Invoer 6.lengte getallen  
 2e aanroep Int. programma.  
 Kanaal S2

|                            |    |    |    |    |                               |                |
|----------------------------|----|----|----|----|-------------------------------|----------------|
| 16                         | RX | 1  |    |    |                               | $2^{-66}$ voud |
| 17                         | 26 | 16 | X  | 0  |                               |                |
|                            | 10 | 0  | S  | 2  |                               |                |
| 18                         | 22 | 0  | X  | 30 | =)                            |                |
|                            | 4  | 0  | X  | 0  |                               |                |
| 19                         | 2  | 25 | X  | 0  |                               |                |
|                            | 24 | 4  | X  | 4  |                               |                |
| 20                         | 28 | 22 | X  | 2  |                               |                |
|                            | 24 | 1  | X  | 4  |                               |                |
| 21                         | 4  | 25 | X  | 0  |                               |                |
|                            | 24 | 0  | X  | 4  |                               |                |
| 22                         | RX | 1  |    |    |                               |                |
| 23                         | 26 | 16 | X  | 0  |                               |                |
|                            | 10 | 0  | S  | 2  |                               |                |
| 24                         | 22 | 0  | X  | 31 | =)                            |                |
|                            | 2  | 2  | X  | 0  | } geredde teken terug         |                |
| 25                         | 4  | 0  | X  | 0  |                               |                |
|                            | 6  | 25 | X  | 0  | ⇒ met laatste getal naar link |                |
| 2e aanroep ⇒<br>int.progr. | 26 | 10 | 29 | S  | 2                             |                |
|                            |    | 12 | 13 | X  | 0                             |                |
| 27                         | 10 | 30 | S  | 2  |                               |                |
|                            | 12 | 14 | X  | 0  |                               |                |
| 28                         | 6  | 16 | S  | 0  | ⇒                             |                |
|                            | 8  | 8  | X  | 8  |                               |                |
| 29                         | 0  | 1  | X  | 0  |                               |                |
|                            | 0  | 1  | X  | 0  |                               |                |
| 30                         | 12 | 19 | X  | 0  |                               |                |
|                            | 6  | 28 | S  | 6  |                               |                |
| 31                         | RC |    |    |    |                               |                |

Uitvoer 6. lengte getallen --,----  
Kanaal S3

|       |   | RA | 0  | S | 3  |
|-------|---|----|----|---|----|
|       |   | RD |    |   |    |
| a7S0⇒ | 0 | 8  | 8  | X | 8  |
|       |   | 10 | 24 | X | 0  |
| 1     |   | 12 | 0  | X | 0  |
|       |   | 10 | 25 | X | 0  |
| 2     |   | 12 | 1  | X | 0  |
|       |   | 10 | 31 | S | 3  |
| 3     |   | 22 | 0  | X | 30 |
|       |   | 12 | 24 | X | 0  |
| 4     |   | 4  | 25 | X | 0  |
|       |   | 10 | 29 | X | 0  |
| 5     |   | 18 | 31 | S | 3  |
|       |   | 10 | 28 | X | 0  |
| 6     |   | 16 | 31 | S | 3  |
|       |   | 12 | 29 | X | 0  |
| 7     |   | 10 | 27 | X | 0  |
|       |   | 16 | 31 | S | 3  |
| 8     |   | 12 | 28 | X | 0  |
|       |   | 10 | 26 | X | 0  |
| 9     |   | 16 | 31 | S | 3  |
|       |   | 12 | 27 | X | 0  |
| 10    |   | 4  | 26 | X | 0  |
|       |   | 10 | 29 | X | 0  |
| 11    |   | 18 | 31 | S | 3  |
|       |   | 10 | 28 | X | 0  |
| 12    |   | 16 | 31 | S | 3  |
|       |   | 12 | 29 | X | 0  |
| 13    |   | 10 | 27 | X | 0  |
|       |   | 16 | 31 | S | 3  |
| 14    |   | 12 | 28 | X | 0  |
|       |   | 4  | 27 | X | 0  |
| 15    |   | 10 | 29 | X | 0  |
|       |   | 18 | 31 | S | 3  |

=)

 $a-4.10^9$

Uitvoer 6. lengte getallen ---,----  
Kanaal S3

|       |    |    |     |     |     |                          |
|-------|----|----|-----|-----|-----|--------------------------|
|       | 16 | 10 | 28  | X   | 0   |                          |
|       |    | 16 | 31  | S   | 3   |                          |
|       | 17 | 4  | 28  | X   | 0   |                          |
|       |    | 18 | 31  | S   | 3   |                          |
|       | 18 | 4  | 29  | X   | 0   |                          |
|       |    | 10 | 24  | X   | 0   |                          |
|       | 19 | 28 | 0   | X   | 8   |                          |
|       |    | 15 | 24  | S   | 3   | →                        |
|       | 20 | 28 | 0   | X   | 10  |                          |
|       |    | 15 | 21  | S   | 3   | →                        |
|       | 21 | 27 | 1   | X   | 12  |                          |
| b20 → |    | 24 | 13  | X   | 12  |                          |
|       | 22 | 28 | 8   | X   | 8   | typ teken                |
|       |    | 22 | 6   | X   | 26  | =) a.g.g.g.              |
|       | 23 | 10 | 25  | X   | 0   |                          |
|       |    | 22 | 0   | X   | 28  | =) typ a0 fac.           |
|       | 24 | 7  | 26  | S   | 3   | ⇒                        |
| b19 → |    | 10 | 24  | X   | 0   |                          |
|       | 25 | 22 | 1   | X   | 28  | =) typ a1 fac. met teken |
|       |    | 10 | 25  | X   | 0   |                          |
|       | 26 | 22 | 2   | X   | 28  | =) typ a0 imp.z.t.       |
| a24 ⇒ |    | 26 | 15  | X   | 12  |                          |
|       | 27 | 28 | 8   | X   | 8   | typ komma                |
|       |    | 10 | 26  | X   | 0   |                          |
|       | 28 | 22 | 2   | X   | 28  | =)                       |
|       |    | 10 | 27  | X   | 0   |                          |
|       | 29 | 22 | 2   | X   | 28  | =)                       |
|       |    | 10 | 28  | X   | 0   |                          |
|       | 30 | 22 | 2   | X   | 28  | =)                       |
|       |    | 6  | 30  | S   | 4   | ⇒                        |
|       | 31 | RG |     |     |     |                          |
|       |    | +1 | 000 | 000 | 000 |                          |
|       |    | RC |     |     |     |                          |

Normering, vuil uit, vervolg uitvoer  
Kanaal S4.

|           |    | RA<br>RD | 0  | S | 4  |                |
|-----------|----|----------|----|---|----|----------------|
|           | 0  | (10      | 29 | X | 0  |                |
|           |    | 29       | 0  | X | 8) | S = 0?         |
|           | 1  | 14       | 2  | S | 4  | →              |
|           |    | 28       | 27 | X | 10 |                |
| a1 →      | 2  | 2        | 0  | S | 4  |                |
|           |    | 25       | 1  | X | 4  |                |
|           | 3  | 28       | 0  | X | 2  |                |
|           |    | 29       | 4  | X | 20 |                |
|           | 4  | 14       | 0  | S | 4  | → niet klaar   |
|           |    | 10       | 27 | S | 4  |                |
| a23 S7 ⇒  | 5  | 29       | 34 | X | 30 | S ≤ -0?        |
|           |    | 15       | 8  | S | 4  | → O.K.         |
|           | 6  | 2        | 8  | S | 4  |                |
|           |    | 0        | 15 | S | 4  |                |
|           | 7  | 28       | 8  | X | 2  |                |
|           |    | 7        | 8  | S | 4  | ⇒              |
|           | 8  | (12      | 30 | X | 0  | 12/13 30-n X 0 |
| b13 → b7⇒ |    | 2        | 29 | X | 0) | 2/3 29-n X 0   |
|           | 9  | 27       | 0  | X | 12 | -0 ≠ S         |
|           |    | 1        | 19 | S | 4  |                |
|           | 10 | 0        | 18 | S | 4  | + carry        |
|           |    | 24       | 33 | X | 28 |                |
|           | 11 | 28       | 18 | X | 2  |                |
|           |    | 2        | 8  | S | 4  |                |
|           | 12 | 1        | 13 | X | 0  |                |
|           |    | 28       | 8  | X | 2  |                |
|           | 13 | 29       | 21 | X | 20 |                |
|           |    | 14       | 8  | S | 4  | → niet klaar   |
|           | 14 | 2        | 8  | S | 4  |                |
|           |    | 28       | 15 | X | 2  |                |
|           | 15 | ( 1      | 0  | X | 0  |                |
|           |    | 1        | 0  | X | 0) |                |

Norm line uit vervolg uitvoer  
Kanaal S4

|                      |    |               |    |   |    |                       |
|----------------------|----|---------------|----|---|----|-----------------------|
|                      | 16 | RX            | 1  |   |    | koppelopdr.           |
| a12S0 ⇒<br>normering | 17 | 28            | 16 | X | 2  |                       |
|                      |    | 6             | 0  | S | 4  | ⇒                     |
|                      | 18 | RG            |    |   |    |                       |
|                      |    | -             |    |   | 1  |                       |
|                      | 19 | + 85890 01591 |    |   |    |                       |
|                      |    | RD            |    |   |    |                       |
| vull uit ⇒<br>a6S0 ⇒ | 20 | 28            | 26 | X | 2  | kop. opdr.            |
|                      |    | 26            | 17 | X | 22 |                       |
|                      | 21 | 0             | 22 | S | 4  |                       |
|                      |    | 28            | 22 | X | 2  |                       |
| a25 →                | 22 | (2            | 29 | X | 0  | 2 29 t/m 01 x 0       |
|                      |    | 4             | 0  | X | 0) | 4/5                   |
|                      | 23 | 2             | 22 | S | 4  |                       |
|                      |    | 1             | 13 | X | 0  |                       |
|                      | 24 | 28            | 22 | X | 2  |                       |
|                      |    | 29            | 4  | X | 20 |                       |
|                      | 25 | 14            | 22 | S | 4  | →                     |
|                      |    | 24            | 0  | X | 4  |                       |
|                      | 26 | (6            | 25 | S | 0  |                       |
|                      |    | 8             | 8  | X | 8) |                       |
|                      | 27 | RA            | 30 | S | 4  | vr.                   |
|                      | 28 | 12            | 0  | X | 0  | const. voor R 358 A   |
|                      |    | 6             | 25 | B | 1  |                       |
|                      | 29 |               |    |   |    |                       |
| vervolg uitvoer      |    |               |    |   |    |                       |
| b30S3 ⇒              | 30 | 10            | 29 | X | 0  | benodigde typeconst . |
|                      |    | 22            | 3  | X | 28 | =) RA 4080 X 0        |
|                      | 31 | 6             | 25 | S | 0  | ⇒ RT                  |
|                      |    | 8             | 8  | X | 8  | S Gg Fg X K           |
|                      |    | RC            |    |   |    | T S Gg Fg X K         |
|                      |    |               |    |   |    | S Gg Jg X K           |
|                      |    |               |    |   |    | S Gg Jg X T           |

Vermenigvuldiging  
Kanaal S5

|                      |    | RA<br>RG       | 0  | S | 5  |                        |
|----------------------|----|----------------|----|---|----|------------------------|
|                      | 0  | + 524287<br>RD |    |   |    | = 0 - 1 X 0<br>0 4 X 0 |
|                      | 1  | 18             | 30 | X | 0  |                        |
|                      |    | 7              | 3  | S | 5  |                        |
| vermenigv.<br>a9S0 ⇒ | 2  | 8              | 8  | X | 8  |                        |
|                      |    | 26             | 0  | X | 4  |                        |
|                      | 3  | 4              | 17 | X | 0  |                        |
|                      |    | 4              | 18 | X | 0  |                        |
|                      | 4  | 8              | 5  | S | 5  |                        |
| b31 →                |    | 28             | 5  | X | 10 |                        |
|                      | 5  | (10            | 0  | X | 0  | 10/11 α -n             |
|                      |    | 12             | 16 | X | 0) | 12 16 X 0              |
|                      | 6  | (18            | 26 | X | 0  | 18 R-n                 |
|                      |    | 7              | 19 | S | 5) | 7 19-4n                |
|                      | 7  | 8              | 8  | X | 8  |                        |
| b* = b-1 ⇒           |    | 10             | 16 | X | 0  |                        |
|                      | 8  | 16             | 28 | X | 0  | R - 3                  |
|                      |    | 28             | 2  | X | 2  |                        |
|                      | 9  | 26             | 34 | X | 22 |                        |
|                      |    | 0              | 21 | X | 0  | + ε                    |
|                      | 10 | 24             | 33 | X | 28 |                        |
|                      |    | 12             | 22 | X | 0  |                        |
|                      | 11 | 0              | 2  | S | 5  |                        |
| b* = b-2 ⇒           |    | 10             | 16 | X | 0  | R-2                    |
|                      | 12 | 16             | 27 | X | 0  |                        |
|                      |    | 28             | 2  | X | 2  |                        |
|                      | 13 | 26             | 34 | X | 22 |                        |
|                      |    | 0              | 20 | X | 0  | + δ                    |
|                      | 14 | 24             | 33 | X | 28 |                        |
|                      |    | 12             | 21 | X | 0  | ε                      |
|                      | 15 | 0              | 2  | S | 5  |                        |
| b* = b-3 ⇒           |    | 10             | 16 | X | 0  |                        |

Vermenigvuldiging  
Kanaal S5

$b^* b-4 =$

|    |    |    |   |    |               |
|----|----|----|---|----|---------------|
| 16 | 16 | 26 | X | 0  |               |
|    | 28 | 2  | X | 2  |               |
| 17 | 26 | 34 | X | 22 |               |
|    | 0  | 19 | X | 0  | $+\delta$     |
| 18 | 24 | 33 | X | 28 |               |
|    | 12 | 20 | X | 0  | $\delta$      |
| 19 | 0  | 2  | S | 5  |               |
|    | 10 | 16 | X | 0  |               |
| 20 | 16 | 25 | X | 0  | RO            |
|    | 28 | 2  | X | 2  |               |
| 21 | 26 | 34 | X | 22 |               |
|    | 0  | 18 | X | 0  | $+\beta$      |
| 22 | 24 | 33 | X | 28 |               |
|    | 12 | 19 | X | 0  | $\gamma$      |
| 23 | 0  | 2  | S | 5  |               |
|    | 10 | 16 | X | 0  |               |
| 24 | 16 | 24 | X | 0  | R1            |
|    | 28 | 2  | X | 2  |               |
| 25 | 26 | 34 | X | 22 |               |
|    | 0  | 17 | X | 0  | $+\alpha$     |
| 26 | 24 | 33 | X | 28 |               |
|    | 12 | 18 | X | 0  | $\beta$       |
| 27 | 0  | 2  | S | 5  |               |
|    | 4  | 17 | X | 0  |               |
| 28 | 10 | 5  | S | 5  |               |
|    | 25 | 1  | X | 12 |               |
| 29 | 2  | 6  | S | 5  |               |
|    | 1  | 0  | S | 5  |               |
| 30 | 28 | 6  | X | 2  |               |
|    | 1  | 1  | S | 5  |               |
| 31 | 28 | 0  | X | 0  | $A \neq 0?$   |
|    | 15 | 4  | S | 5  | $\rightarrow$ |
|    | RC |    |   |    |               |

Vervolg vermenigvuldiging  
Kanaal S6

|                 | RA | 0  | S  | 6  |           |
|-----------------|----|----|----|----|-----------|
|                 | RD |    |    |    |           |
| vervolg verm. 0 | 28 | 2  | X  | 10 |           |
|                 | 25 | 1  | X  | 12 |           |
| 1               | 28 | 24 | X  | 10 |           |
|                 | 2  | 22 | X  | 0  |           |
| 2               | RX | 1  |    |    | 10/11     |
| $b^* = b^0$     |    |    |    |    | 12 16 X 0 |
| a26 →           | 3  | 16 | 29 | X  | 0         |
|                 |    | 12 | 23 | X  | 0         |
|                 | 4  | 10 | 16 | X  | 0         |
|                 |    | 16 | 28 | X  | 0         |
|                 | 5  | 28 | 0  | X  | 2         |
|                 |    | 26 | 34 | X  | 22        |
|                 | 6  | 0  | 21 | X  | 0         |
|                 |    | 24 | 33 | X  | 28        |
|                 | 7  | 12 | 22 | X  | 0         |
|                 |    | 0  | 0  | S  | 6         |
|                 | 8  | 10 | 16 | X  | 0         |
|                 |    | 16 | 27 | X  | 0         |
|                 | 9  | 28 | 0  | X  | 2         |
|                 |    | 26 | 34 | X  | 22        |
| 10              |    | 0  | 20 | X  | 0         |
|                 |    | 24 | 33 | X  | 28        |
| 11              |    | 12 | 21 | X  | 0         |
|                 |    | 0  | 0  | S  | 6         |
| 12              |    | 10 | 16 | X  | 0         |
|                 |    | 16 | 26 | X  | 0         |
| 13              |    | 28 | 0  | X  | 2         |
|                 |    | 26 | 34 | X  | 22        |
| 14              |    | 0  | 19 | X  | 0         |
|                 |    | 24 | 33 | X  | 28        |
| 15              |    | 12 | 20 | X  | 0         |
|                 |    | 0  | 0  | S  | 6         |

10/11

12 16 X 0

.R-4

7

R-3

+8

2

R-2

+8

8

Vervolg vermenigvuldiging  
Kanaal S6

b\* = b1

b19a31 →

a27 ⇒

|    |     |    |   |    |                       |  |  |  |  |
|----|-----|----|---|----|-----------------------|--|--|--|--|
| 16 | 10  | 16 | X | 0  | R0                    |  |  |  |  |
|    | 16  | 25 | X | 0  |                       |  |  |  |  |
| 17 | 28  | 0  | X | 2  |                       |  |  |  |  |
|    | 26  | 34 | X | 22 |                       |  |  |  |  |
| 18 | 0   | 18 | X | 0  |                       |  |  |  |  |
|    | 24  | 33 | X | 28 |                       |  |  |  |  |
| 19 | (12 | 19 | X | 0  | 12 19 X 0<br>6 28 S 6 |  |  |  |  |
|    | 0   | 0  | S | 6) |                       |  |  |  |  |
| 20 | 10  | 16 | X | 0  | R1                    |  |  |  |  |
|    | 16  | 24 | X | 0  |                       |  |  |  |  |
| 21 | 8   | 17 | X | 0  | β                     |  |  |  |  |
|    | 12  | 18 | X | 0  |                       |  |  |  |  |
| 22 | 2   | 14 | X | 0  |                       |  |  |  |  |
|    | 28  | 19 | X | 2  |                       |  |  |  |  |
| 23 | 2   | 23 | X | 0  |                       |  |  |  |  |
|    | 4   | 24 | X | 0  |                       |  |  |  |  |
| 24 | RX  | 1  |   |    | 10/11<br>12 16 X 0    |  |  |  |  |
| 25 | 2   | 22 | X | 0  |                       |  |  |  |  |
|    | 28  | 0  | X | 8  |                       |  |  |  |  |
| 26 | 14  | 3  | S | 6  | →                     |  |  |  |  |
|    | 27  | 1  | X | 12 | ⇒                     |  |  |  |  |
| 27 | 7   | 29 | S | 6  |                       |  |  |  |  |
|    | 8   | 8  | X | 8  |                       |  |  |  |  |
| 28 | ( 2 | 24 | X | 0  |                       |  |  |  |  |
|    | 4   | 29 | X | 0) |                       |  |  |  |  |
| 29 | 11  | 13 | X | 0  |                       |  |  |  |  |
|    | 8   | 28 | S | 6  |                       |  |  |  |  |
| 30 | 28  | 28 | X | 10 |                       |  |  |  |  |
|    | 29  | 21 | X | 30 | →<br>⇒                |  |  |  |  |
| 31 | 14  | 28 | S | 6  |                       |  |  |  |  |
|    | 6   | 25 | S | 0  |                       |  |  |  |  |
|    | RC  |    |   |    |                       |  |  |  |  |

vervolg + add; schoon in; + add  
Kanaal S7

|               |    | RA  | 0    | S | 7   |                       |
|---------------|----|-----|------|---|-----|-----------------------|
|               |    | RD  |      |   |     |                       |
| b30 S7 ⇒ ,    | 0  | 8   | 1    | S | 7   |                       |
| vervolg ± add |    | 28  | 1    | X | 10  |                       |
|               | 1  | (2  | 0    | X | 0   | 2/3 α -n              |
|               |    | 10  | 29   | X | 0   | 10 R-n                |
|               | 2  | 26  | 34   | X | 28  |                       |
|               |    | 26  | 32   | X | 30  |                       |
|               | 3  | 28  | 0    | X | 8   | S ≠ 0?                |
|               |    | 15  | 14   | S | 7   | → ongelijk teken      |
|               | 4  | 2   | 1    | S | 7   |                       |
|               |    | 0   | 7    | S | 7   |                       |
|               | 5  | 28  | 7    | X | 2   |                       |
|               |    | 7   | 6    | S | 7   | ⇒                     |
|               | 6  | (12 | 30   | X | 0   | 12 R-n                |
| a13 → b5 ⇒    |    | 2   | 29   | X | 0)  | 2 R-n-1               |
|               | 7  | (29 | 4096 | X | 0   | 0/1 α -n              |
|               |    | 16  | 3    | X | 30) | 26 33 X 30            |
|               | 8  | 0   | 31   | S | 7   |                       |
|               |    | 24  | 33   | X | 28  |                       |
|               | 9  | 28  | 31   | X | 2   | carry weg             |
|               |    | 27  | 1    | X | 4   |                       |
|               | 10 | 0   | 7    | S | 7   |                       |
|               |    | 28  | 7    | X | 2   |                       |
|               | 11 | 3   | 13   | X | 0   |                       |
|               |    | 0   | 6    | S | 7   |                       |
|               | 12 | (28 | 6    | X | 2   |                       |
|               |    | 29  | 21   | X | 20) |                       |
|               | 13 | 14  | 6    | S | 7   | →                     |
|               |    | 12  | 24   | X | 0   |                       |
|               | 14 | 6   | 16   | S | 4   | ⇒ naar koppelopdracht |
| b3 →          |    | 2   | 1    | S | 7   |                       |
|               | 15 | 1   | 16   | S | 7   |                       |
| a22 →         |    | 28  | 16   | X | 2   |                       |

vervolg + add; schoon in; + add  
Kanaal S7

|             |    |    |    |   |    |                  |
|-------------|----|----|----|---|----|------------------|
|             | 16 | (0 | 0  | X | 0  | 2/3 α -n         |
|             |    | 10 | 0  | X | 0) | 0 R-n            |
|             | 17 | (4 | 29 | X | 0  |                  |
|             |    | 29 | 0  | X | 0) | A = 0?           |
|             | 18 | 14 | 19 | S | 7  | →                |
|             |    | 28 | 12 | X | 2  | laatste blok ≠ 0 |
| a18 →       | 19 | 27 | 1  | X | 4  |                  |
|             |    | 0  | 17 | S | 7  |                  |
|             | 20 | 28 | 17 | X | 2  |                  |
|             |    | 29 | 4  | X | 20 |                  |
|             | 21 | 3  | 13 | X | 0  |                  |
|             |    | 0  | 16 | S | 7  |                  |
|             | 22 | 15 | 15 | S | 7  | → nog niet klaar |
|             |    | 10 | 12 | S | 7  |                  |
|             | 23 | 6  | 5  | S | 4  | ⇒ ga normeren    |
| schoon in ⇒ |    | 28 | 29 | X | 2  | kopp. opdr.      |
| a530 ⇒      | 24 | 8  | 25 | S | 7  |                  |
|             |    | 28 | 25 | X | 10 |                  |
| a28 →       | 25 | (2 | 0  | X | 0  | 2/3 α            |
|             |    | 4  | 29 | X | 0) | 4 29 t/m 24 X 0  |
|             | 26 | 2  | 25 | S | 7  |                  |
|             |    | 1  | 13 | X | 0  |                  |
|             | 27 | 28 | 25 | X | 2  |                  |
|             |    | 29 | 21 | X | 20 |                  |
|             | 28 | 14 | 25 | S | 7  | → niet klaar     |
|             |    | 24 | 0  | X | 4  |                  |
|             | 29 | (6 | 25 | S | 0  | koppelopdracht.  |
|             |    | 8  | 8  | X | 8) |                  |
| 4a50 +add ⇒ | 30 | 4  | 16 | S | 4  | koppel-opdracht  |
|             |    | 6  | 0  | S | 7  | ⇒                |
|             | 31 | RG |    |   |    |                  |
|             |    | +  |    |   | 0  |                  |
|             |    | RC |    |   |    |                  |

deling; const. worteltrekking

|                |    | RA  | 0  | S | 8   |                  |
|----------------|----|-----|----|---|-----|------------------|
|                |    | RD  |    |   |     |                  |
| b25 s8 →       | 0  | 12  | 2  | X | 0   |                  |
| vervolg deling |    | 8   | 3  | S | 8   |                  |
|                | 1  | 28  | 3  | X | 10  |                  |
|                |    | 10  | 2  | X | 0   |                  |
|                | 2  | 8   | 11 | S | 8   |                  |
|                |    | 28  | 11 | X | 10  |                  |
|                | 3  | (10 | 0  | X | 0   | 10/11 α          |
|                |    | 28  | 34 | X | 30) | 28 34 X 30       |
|                | 4  | 14  | 11 | S | 8   | → geen R wissel; |
|                |    | 26  | 1  | X | 4   |                  |
|                | 5  | 24  | 5  | X | 20  |                  |
|                |    | 0   | 11 | S | 8   |                  |
|                | 6  | 28  | 11 | X | 2   |                  |
|                |    | 24  | 0  | X | 4   |                  |
| a10 →          | 7  | (2  | 29 | X | 0   |                  |
|                |    | 5   | 29 | X | 0)  |                  |
|                | 8  | 2   | 7  | S | 8   |                  |
|                |    | 1   | 13 | X | 0   |                  |
|                | 9  | 28  | 7  | X | 2   |                  |
|                |    | 29  | 4  | X | 20  |                  |
|                | 10 | 14  | 7  | S | 8   | →                |
|                |    | 24  | 0  | X | 4   |                  |
| a15 a14 a4 →   | 11 | (10 | 0  | X | 0   | 10/11 α          |
|                |    | 12  | 12 | X | 0   | 12/13 12 X 0     |
|                | 12 | 2   | 11 | S | 8   |                  |
|                |    | 1   | 13 | X | 0   |                  |
|                | 13 | 28  | 11 | X | 2   |                  |
|                |    | 29  | 18 | X | 20  |                  |
|                | 14 | 14  | 11 | S | 8   | →                |
|                |    | 29  | 3  | X | 20  |                  |
|                | 15 | 14  | 11 | S | 8   | →                |
|                |    | 26  | 6  | X | 4   | (A) : 6          |

deling; const. worteltrekking  
Kanaal S8

|                |    |     |    |   |    |                             |
|----------------|----|-----|----|---|----|-----------------------------|
| b20 →          | 16 | (10 | 7  | X | 0  |                             |
|                |    | 28  | 0  | X | 8) |                             |
|                | 17 | 14  | 21 | S | 8  | →                           |
|                |    | 25  | 1  | X | 4  |                             |
|                | 18 | 29  | 0  | X | 0  | A = 0?                      |
|                |    | 26  | 16 | X | 0  | stop deler = 0              |
|                | 19 | 10  | 16 | S | 8  |                             |
|                |    | 24  | 1  | X | 12 |                             |
|                | 20 | 28  | 16 | X | 10 |                             |
|                |    | 6   | 16 | S | 8  | ⇒                           |
| a17 →          | 21 | 4   | 3  | X | 0  | (X0 + 3)=n = aantal bl. ≠ 0 |
|                |    | 27  | 1  | X | 4  |                             |
| a23 →          | 22 | 28  | 33 | X | 30 |                             |
|                |    | 24  | 1  | X | 4  |                             |
|                | 23 | 14  | 22 | S | 8  | → kop < 1/2 (A) = m         |
|                |    | 24  | 17 | X | 20 |                             |
|                | 24 | 6   | 0  | S | 9  | ⇒                           |
|                |    | 8   | 8  | X | 8  |                             |
| deling a10S0 ⇒ | 25 | 4   | 30 | S | 12 |                             |
|                |    | 6   | 0  | S | 8  | ⇒                           |
|                | 26 | RX  | 2  |   |    |                             |
|                | 27 |     |    |   |    |                             |
|                | 28 | 1   | 31 | S | 14 |                             |
|                |    | 0   | 0  | X | 0  |                             |
|                | 29 | 1   | 31 | S | 15 |                             |
|                |    | 0   | 0  | X | 0  |                             |
|                | 30 | 0   | 31 | S | 15 |                             |
|                |    | 0   | 0  | X | 0  |                             |
|                | 31 | 0   | 25 | S | 15 |                             |
|                |    | 0   | 0  | X | 0  |                             |
|                |    | RC  |    |   |    |                             |

vervolg deling  
Kanaal S9

|                             |    | RA  | 0  | S | 9   |                |
|-----------------------------|----|-----|----|---|-----|----------------|
|                             |    | RD  |    |   |     |                |
| a 24 S8 ⇒<br>vervolg deling | 0  | 1   | 3  | S | 9   |                |
|                             |    | 29  | 3  | X | 2   |                |
|                             | 1  | 25  | 17 | X | 4   |                |
| b15 →                       |    | 29  | 7  | X | 2   |                |
|                             | 2  | 26  | 0  | X | 12  |                |
|                             |    | 24  | 0  | X | 4   |                |
|                             | 3  | (2  | 12 | X | 0   | 2 12 t/m 7 X 0 |
|                             |    | 26  | 33 | X | 28) | 26 33-m X 28   |
|                             | 4  | 8   | 30 | S | 9   |                |
|                             |    | 28  | 30 | X | 2   | carry          |
|                             | 5  | (12 | 12 | X | 0   |                |
|                             |    | 10  | 24 | X | 0)  |                |
|                             | 6  | 26  | 33 | X | 30  | teken S O.K.   |
|                             |    | 24  | 0  | X | 4   |                |
|                             | 7  | RX  | 1  |   |     | 2 29 X 0       |
|                             |    |     |    |   |     | 26 33-m X 28   |
|                             | 8  | 8   | 31 | S | 9   |                |
|                             |    | 28  | 31 | X | 2   |                |
|                             | 9  | (12 | 29 | X | 0   |                |
|                             |    | 2   | 3  | S | 9)  |                |
|                             | 10 | 25  | 1  | X | 4   |                |
|                             |    | 28  | 3  | X | 2   |                |
|                             | 11 | 2   | 5  | S | 9   |                |
|                             |    | 25  | 1  | X | 4   |                |
|                             | 12 | 28  | 5  | X | 2   |                |
|                             |    | 2   | 9  | S | 9   |                |
|                             | 13 | 25  | 1  | X | 4   |                |
|                             |    | 28  | 9  | X | 2   |                |
|                             | 14 | 29  | 4  | X | 20  |                |
|                             |    | 3   | 7  | S | 9   |                |
|                             | 15 | 24  | 1  | X | 4   |                |
|                             |    | 15  | 1  | S | 9   | →              |

vervolg deling  
Kanaal S9

|    |             |    |   |    |
|----|-------------|----|---|----|
| 16 | 2           | 31 | S | 9  |
|    | 4           | 23 | X | 0  |
| 17 | 3           | 3  | X | 0  |
|    | 0           | 19 | S | 9  |
| 18 | 28          | 19 | X | 2  |
|    | 24          | 0  | X | 4  |
| 19 | (10         | 13 | X | 0  |
|    | 9           | 29 | S | 9) |
| 20 | 13          | 0  | X | 0  |
|    | 29          | 0  | X | 8  |
| 21 | 3           | 3  | X | 0  |
|    | 24          | 1  | X | 4  |
| 22 | 15          | 4  | S | 12 |
|    | 4           | 2  | X | 0  |
| 23 | 9           | 29 | S | 9  |
|    | 26          | 0  | X | 4  |
| 24 | 4           | 1  | X | 0  |
|    | 2           | 26 | S | 9  |
| 25 | 6           | 0  | X | 30 |
|    | 8           | 8  | X | 8  |
| 26 | 12          | 4  | X | 0  |
|    | 6           | 0  | S | 10 |
| 27 |             |    |   |    |
| 28 | RA          | 29 | S | 9  |
|    | RG          |    |   |    |
| 29 | +8589934591 |    |   |    |
| 30 | +           |    |   | 0  |
| 31 | +           |    |   | 0  |
|    | RC          |    |   |    |

T en N genormeerd

(S) =0?

(A) = -n+1 fact.telling  
→ naar f-n-1

⇒ deel subr: komt terug  
op a0 S10

vervolg deling  
Kanaal S10

|                              | RA  | O  | S | 10  |                   |
|------------------------------|-----|----|---|-----|-------------------|
|                              | RD  |    |   |     |                   |
| b26 S9 → 0<br>vervolg deling | 26  | 0  | X | 4   |                   |
|                              | 4   | 31 | S | 10  |                   |
| 1                            | 4   | 31 | S | 11  |                   |
|                              | 26  | 0  | X | 4   |                   |
| 2                            | 4   | 16 | X | 0   |                   |
|                              | 4   | 17 | X | 0   |                   |
| 3                            | 4   | 18 | X | 0   |                   |
|                              | 4   | 19 | X | 0   |                   |
| 4                            | 4   | 20 | X | 0   |                   |
|                              | 26  | 1  | X | 4   |                   |
| 5                            | 24  | 2  | X | 20  |                   |
|                              | 10  | 9  | S | 10  |                   |
| 6                            | 9   | 31 | S | 10  |                   |
|                              | 28  | 9  | X | 10  |                   |
| 7                            | 10  | 16 | S | 10  |                   |
|                              | 8   | 31 | S | 10  |                   |
| 8                            | 28  | 16 | X | 10  |                   |
|                              | 24  | 0  | X | 4   |                   |
| 14a, 15a → 9                 | (10 | 12 | X | 0   | 10 12 t/m 7 X 0   |
|                              | 16  | 4  | X | 0)  | 16 4 X 0          |
| 10                           | (12 | 22 | X | 0   | 12 22 t/m 17 X 0  |
|                              | 10  | 10 | S | 10) | 10 10 S 10        |
| 11                           | 25  | 1  | X | 12  |                   |
|                              | 28  | 10 | X | 10  | verlaag bergopdr. |
| 12                           | 10  | 9  | S | 10  |                   |
|                              | 25  | 1  | X | 12  |                   |
| 13                           | 28  | 9  | X | 10  | verlaag verm.     |
|                              | 29  | 1  | X | 30  |                   |
| 14                           | 14  | 9  | S | 10  | →                 |
|                              | 29  | 3  | X | 30  |                   |
| 15                           | 14  | 9  | S | 10  | →                 |
|                              | 26  | 0  | X | 12  | (S) = +0          |

vervolg deling  
Koppel S10

a24 →

|    |     |    |   |     |                     |
|----|-----|----|---|-----|---------------------|
| 16 | (4  | 16 | X | 0   | 4 16 t/m 21 X 0     |
|    | 24  | 0  | X | 4)  |                     |
| 17 | (2  | 12 | X | 0   |                     |
|    | 0   | 21 | X | 0)  |                     |
| 18 | 26  | 33 | X | 30  |                     |
|    | 0   | 30 | S | 10  | + carry             |
| 19 | 24  | 33 | X | 28  |                     |
|    | 28  | 30 | X | 2   |                     |
| 20 | (12 | 12 | X | 0   |                     |
|    | 2   | 20 | S | 10) |                     |
| 21 | 25  | 1  | X | 4   |                     |
|    | 28  | 20 | X | 2   |                     |
| 22 | 2   | 17 | S | 10  |                     |
|    | 1   | 13 | X | 0   |                     |
| 23 | 28  | 17 | X | 2   |                     |
|    | 28  | 21 | X | 20  |                     |
| 24 | 14  | 17 | S | 10  | →                   |
|    | 26  | 0  | X | 4   |                     |
| 25 | 6   | 0  | S | 11  | ⇒                   |
|    | 8   | 8  | X | 8   |                     |
| 26 | 8   | 9  | K | 3   | const. voor R 358 A |
|    | 12  | 9  | K | 3   |                     |
| 27 | 10  | 21 | J | 1   |                     |
|    | 8   | 21 | J | 1   |                     |
| 28 | 19  | 0  | X | 0   |                     |
|    | 8   | 0  | X | 0   |                     |
| 29 | 12  | 24 | X | 0   |                     |
|    | 6   | 24 | B | 3   |                     |
| 30 | RG  |    |   |     |                     |
|    | +   |    |   | 0   |                     |
| 31 | RC  |    |   |     | ur                  |

vervolg deling  
Kanaal S11

|                | RA  | 0  | S  | 11  |                     |
|----------------|-----|----|----|-----|---------------------|
|                | RD  |    |    |     |                     |
| a25 S10 ⇒ 0    | 10  | 24 | X  | 0   |                     |
| vervolg deling | 26  | 33 | X  | 30  | S schoon teken O.K. |
| 1              | 12  | 15 | X  | 0   |                     |
|                | 12  | 16 | X  | 0   |                     |
| 2              | 12  | 17 | X  | 0   |                     |
|                | 12  | 18 | X  | 0   |                     |
| 3              | 12  | 19 | X  | 0   |                     |
|                | 12  | 20 | X  | 0   | wr. schoon          |
| 4              | 10  | 13 | S  | 11  |                     |
|                | 8   | 31 | S  | 11  |                     |
| 5              | 28  | 13 | X  | 10  |                     |
|                | 10  | 7  | S  | 11  |                     |
| 6              | 9   | 31 | S  | 11  |                     |
| b12 ⇒          | 28  | 7  | X  | 10  |                     |
| 7              | (10 | 29 | X  | 0   | 10 29 t/m 24 X 0    |
|                | 16  | 4  | X  | 0)  | 16 4 X 0            |
| 8              | (12 | 22 | X  | 0   | 12 22 t/m 17 X 0    |
|                | 10  | 7  | S  | 11) | 10 7 S 11           |
| 9              | 28  | 4  | X  | 30  |                     |
|                | 14  | 13 | S  | 11  | → naar opt.         |
| 10             | 10  | 8  | S  | 11  |                     |
|                | 25  | 1  | X  | 12  |                     |
| 11             | 28  | 8  | X  | 10  |                     |
|                | 10  | 7  | S  | 11  |                     |
| 12             | 25  | 1  | X  | 12  |                     |
|                | 7   | 6  | S  | 11  | ⇒                   |
| b9 →           | 13  | (4 | 15 | X   | 0                   |
| a22 ⇒          | 10  | 24 | X  | 0)  | teken S in orde     |
| 14             | (2  | 29 | X  | 0   |                     |
|                | 0   | 21 | X  | 0)  |                     |
| 15             | 26  | 33 | X  | 30  |                     |
|                | 0   | 30 | S  | 11  |                     |

vervolg deling  
Kanaal S11

|          |    |     |    |   |     |                      |
|----------|----|-----|----|---|-----|----------------------|
|          | 16 | 24  | 33 | X | 28  |                      |
|          |    | 28  | 30 | X | 2   |                      |
|          | 17 | (12 | 29 | X | 0   |                      |
|          |    | 2   | 14 | S | 11) |                      |
|          | 18 | 28  | 4  | X | 20  |                      |
|          |    | 15  | 22 | S | 11  | → klaar met optellen |
|          | 19 | 2   | 14 | S | 11  |                      |
|          |    | 1   | 13 | X | 0   |                      |
|          | 20 | 28  | 14 | X | 2   |                      |
|          |    | 2   | 17 | S | 11  |                      |
|          | 21 | 25  | 1  | X | 4   |                      |
|          |    | 28  | 17 | X | 2   |                      |
|          | 22 | 7   | 13 | S | 11  | ⇒                    |
| b18 →    |    | 3   | 3  | X | 0   |                      |
|          | 23 | 0   | 31 | S | 11  |                      |
|          |    | 6   | 0  | S | 12  | ⇒                    |
| b10S12 ⇒ | 24 | 6   | 2  | S | 12  | ⇒                    |
|          |    | 8   | 8  | X | 8   |                      |
|          | 25 |     |    |   |     |                      |
|          | 26 |     |    |   |     |                      |
|          | 27 |     |    |   |     |                      |
|          | 28 |     |    |   |     |                      |
|          | 29 | RA  | 30 | S | 11  |                      |
|          |    | RG  |    |   |     |                      |
|          | 30 | +   |    |   | 0   |                      |
|          |    | RC  |    |   |     |                      |
|          | 31 |     |    |   |     |                      |

vervolg deling  
Kanaal S12

|                |    | RA<br>RD | 0  | S | 12  |                  |
|----------------|----|----------|----|---|-----|------------------|
| b23 S11 ⇒      | 0  | 0        | 1  | S | 12  |                  |
| vervolg deling |    | 28       | 1  | X | 2   |                  |
|                | 1  | (2       | 13 | X | 0   | 2 kop            |
|                |    | 1        | 31 | S | 12) |                  |
| a24 S11 ⇒      | 2  | 29       | 0  | X | 0   | A = 0?           |
|                |    | 14       | 4  | S | 12  | → vorm f-n-1     |
|                | 3  | 5        | 4  | X | 0   |                  |
|                |    | 7        | 1  | S | 10  | ⇒ cyclus opnieuw |
| b2 →           | 4  | 2        | 2  | X | 0   |                  |
| a22s9 →        |    | 24       | 1  | X | 4   |                  |
|                | 5  | 4        | 2  | X | 0   |                  |
|                |    | 14       | 11 | S | 12  | → klaar transp.  |
|                | 6  | 26       | 1  | X | 4   |                  |
|                |    | 0        | 31 | S | 11  |                  |
|                | 7  | 4        | 31 | S | 11  |                  |
|                |    | 4        | 31 | S | 10  |                  |
|                | 8  | 1        | 3  | X | 0   |                  |
|                |    | 0        | 10 | S | 12  |                  |
|                | 9  | 28       | 10 | X | 2   |                  |
|                |    | 3        | 31 | S | 12  |                  |
|                | 10 | (0       | 13 | X | 0   |                  |
|                |    | 6        | 24 | S | 11) | ⇒                |
| b5 →           | 11 | 2        | 3  | X | 0   |                  |
|                |    | 25       | 4  | X | 4   |                  |
|                | 12 | 4        | 3  | X | 0   | m = n-4          |
|                |    | 15       | 19 | S | 12  | → m pos.         |
|                | 13 | 1        | 14 | S | 12  |                  |
|                |    | 29       | 14 | X | 2   |                  |
|                | 14 | (2       | 24 | X | 0   |                  |
|                |    | 4        | 24 | X | 0)  |                  |
|                | 15 | 2        | 14 | S | 12  |                  |
|                |    | 28       | 1  | X | 20  |                  |

vervolg deling  
Kanaal S12

|       |    |         |       |   |     |              |
|-------|----|---------|-------|---|-----|--------------|
|       | 16 | 14      | 18    | S | 12  | → niet klaar |
|       |    | 28      | 2     | X | 20  |              |
|       | 17 | 14      | 18    | S | 12  | → niet klaar |
|       |    | 6       | 30    | S | 12  | ⇒            |
| a16 → | 18 | 3       | 14    | S | 12  |              |
|       |    | 1       | 13    | X | 0   |              |
|       | 19 | 7       | 13    | S | 12  | ⇒            |
| b12 → |    | 10      | 24    | X | 0   |              |
|       | 20 | 26      | 33    | X | 30  | S=0          |
|       |    | 25      | 2     | X | 4   |              |
|       | 21 | 29      | 0     | X | 0   |              |
|       |    | 15      | 26    | S | 12  | → m=2        |
| a28 ⇒ | 22 | (2      | 28    | X | 0   |              |
|       |    | 12      | 28    | X | 0)  |              |
|       | 23 | (4      | 29    | X | 0   |              |
|       |    | 2       | 22    | S | 12) |              |
|       | 24 | 28      | 4     | X | 20  |              |
|       |    | 14      | 30    | S | 12  | →            |
|       | 25 | 2       | 23    | S | 12  |              |
|       |    | 25      | 1     | X | 4   |              |
|       | 26 | 28      | 23    | X | 2   |              |
|       |    | 2       | 22    | S | 12  |              |
|       | 27 | 1       | 13    | X | 0   |              |
|       |    | 28      | 22    | X | 2   |              |
|       | 28 | 6       | 22    | S | 12  | ⇒            |
|       |    | 8       | 8     | X | 8   |              |
|       | 29 | RX      | 2     |   |     |              |
| b24 → | 30 |         |       |   |     | kop.opdr.    |
|       |    | RG      |       |   |     |              |
|       | 31 | + 85899 | 34591 |   |     |              |
|       |    | RC      |       |   |     |              |

Worteltrekking  
Kanaal S13

|                      |    | RA<br>RD | 0  | S | 13  |                           |
|----------------------|----|----------|----|---|-----|---------------------------|
| a1 S0 ⇒<br>worteltr. | 0  | 12       | 2  | X | 0   |                           |
|                      |    | 8        | 2  | S | 13  |                           |
|                      | 1  | 28       | 2  | X | 10  |                           |
|                      |    | 26       | 0  | X | 12  |                           |
|                      | 2  | (2       | 0  | X | 0   |                           |
|                      |    | 28       | 34 | X | 20) |                           |
|                      | 3  | 15       | 4  | S | 13  | → pos.                    |
|                      |    | 26       | 1  | X | 12  |                           |
|                      | 4  | 24       | 22 | X | 30  |                           |
| a3 →                 |    | 8        | 2  | X | 0   |                           |
|                      | 5  | 23       | 23 | S | 7   | ⇒  α  in R                |
| ⇒                    |    | 10       | 31 | S | 8   |                           |
|                      | 6  | 22       | 20 | S | 4   | ⇒                         |
| ⇒                    |    | 26       | 0  | X | 12  |                           |
|                      | 7  | 12       | 26 | S | 14  |                           |
|                      |    | 12       | 27 | S | 14  |                           |
|                      | 8  | 12       | 28 | S | 14  |                           |
|                      |    | 12       | 29 | S | 14  |                           |
|                      | 9  | 12       | 30 | S | 14  |                           |
|                      |    | 12       | 31 | S | 14  | 26 t/m 31 S 14 schoon: +0 |
|                      | 10 | 2        | 24 | X | 0   |                           |
|                      |    | 28       | 0  | X | 0   | A ≠ 0?                    |
|                      | 11 | 15       | 19 | S | 13  | → n=0                     |
|                      |    | 2        | 25 | X | 0   |                           |
|                      | 12 | 28       | 0  | X | 0   |                           |
|                      |    | 15       | 25 | S | 13  | → n= 1                    |
|                      | 13 | 2        | 26 | X | 0   |                           |
|                      |    | 28       | 0  | X | 0   |                           |
|                      | 14 | 14       | 0  | S | 14  | → n=2                     |
|                      |    | 2        | 27 | X | 0   |                           |
|                      | 15 | 28       | 0  | X | 0   |                           |
|                      |    | 14       | 2  | S | 14  | → n=3                     |

Worteltrekking  
Kanaal S13

|           |    |     |    |   |     |                  |
|-----------|----|-----|----|---|-----|------------------|
|           | 16 | 2   | 28 | X | 0   |                  |
|           |    | 28  | 0  | X | 0   |                  |
|           | 17 | 15  | 5  | S | 14  | → n=4            |
|           |    | 2   | 29 | X | 0   |                  |
|           | 18 | 28  | 0  | X | 0   |                  |
|           |    | 15  | 7  | S | 14  | → n=5            |
|           | 19 | 6   | 25 | S | 0   | ⇒ $\sqrt{0}=0$   |
| a21a11 →  |    | 26  | 1  | X | 20  |                  |
|           | 20 | 25  | 1  | X | 12  |                  |
|           |    | 28  | 0  | X | 0   |                  |
|           | 21 | 15  | 19 | S | 13  | →                |
|           |    | 26  | 1  | X | 30  |                  |
|           | 22 | 25  | 16 | X | 12  |                  |
|           |    | 8   | 24 | S | 13  |                  |
|           | 23 | 28  | 24 | X | 10  |                  |
|           |    | 26  | 1  | X | 4   |                  |
|           | 24 | (24 | 34 | X | 20  |                  |
|           |    | 4   | 27 | S | 14) |                  |
|           | 25 | 7   | 10 | S | 14  | ⇒ schatting 0.K. |
| a27 b12 → |    | 26  | 1  | X | 20  |                  |
|           | 26 | 25  | 1  | X | 12  |                  |
|           |    | 28  | 0  | X | 0   | A ≠ 0?           |
|           | 27 | 15  | 25 | S | 13  | →                |
|           |    | 26  | 1  | X | 30  |                  |
|           | 28 | 8   | 31 | S | 13  |                  |
|           |    | 28  | 31 | X | 10  |                  |
|           | 29 | 26  | 1  | X | 4   |                  |
|           |    | 24  | 0  | X | 4   |                  |
|           | 30 | (24 | 34 | X | 20  |                  |
|           |    | 4   | 27 | S | 14) |                  |
|           | 31 | 7   | 10 | S | 14  | ⇒ schatting 0.K. |
|           |    | 8   | 8  | X | 8   |                  |
|           |    | RC  |    |   |     |                  |

Vervolg worteltrekking  
Kanaal S14

|                        |    | RA<br>RD | 0  | S | 14 |                                                     |
|------------------------|----|----------|----|---|----|-----------------------------------------------------|
| a14 S13 →<br>vervoig V | 0  | 26       | 1  | X | 20 | + 2 <sup>32</sup>                                   |
|                        |    | 0        | 25 | S | 14 |                                                     |
|                        | 1  | 4        | 28 | S | 14 |                                                     |
|                        |    | 7        | 10 | S | 14 | ⇒ schatting O.K.                                    |
| b15S13 →               | 2  | 26       | 1  | X | 20 |                                                     |
|                        |    | 0        | 25 | S | 14 |                                                     |
|                        | 3  | 26       | 0  | X | 12 |                                                     |
|                        |    | 26       | 17 | X | 28 |                                                     |
|                        | 4  | 4        | 28 | S | 14 |                                                     |
|                        |    | 12       | 29 | S | 14 | ⇒ schatting O.K.                                    |
|                        | 5  | 7        | 10 | S | 14 |                                                     |
| a17S13 →               |    | 26       | 1  | X | 20 |                                                     |
|                        | 6  | 0        | 25 | S | 14 |                                                     |
|                        |    | 4        | 29 | S | 14 |                                                     |
|                        | 7  | 7        | 10 | S | 14 |                                                     |
| b18S13 →               |    | 26       | 1  | X | 20 | ⇒ schatting O.K.                                    |
|                        | 8  | 0        | 25 | S | 14 |                                                     |
|                        |    | 26       | 0  | X | 12 |                                                     |
|                        | 9  | 26       | 17 | X | 28 |                                                     |
|                        |    | 4        | 29 | S | 14 |                                                     |
|                        | 10 | 12       | 30 | S | 14 |                                                     |
| goede sch. ⇒           |    | 10       | 24 | S | 14 |                                                     |
|                        | 11 | 22       | 25 | S | 8  |                                                     |
|                        |    | 26       | 29 | X | 12 |                                                     |
|                        | 12 | 22       | 0  | S | 15 | ⇒) $R = \frac{1}{2} \frac{a}{x_n}$                  |
|                        |    | 10       | 30 | S | 8  | ⇒)                                                  |
|                        | 13 | 22       | 20 | S | 4  |                                                     |
|                        |    | 10       | 24 | S | 14 |                                                     |
|                        | 14 | 22       | 0  | S | 15 | ⇒) $R = \frac{1}{2} x_n$                            |
|                        |    | 10       | 29 | S | 8  | ⇒) $(R) = \frac{1}{2} (x_n - \frac{a}{x_n}) = -c_n$ |
|                        | 15 | 22       | 30 | S | 7  |                                                     |
|                        |    | 2        | 29 | X | 0  |                                                     |

vervolg worteltrekking  
Kanaal S14

|    |              |    |   |    |
|----|--------------|----|---|----|
| 16 | 26           | 34 | X | 20 |
|    | 0            | 28 | X | 0  |
| 17 | 0            | 27 | X | 0  |
|    | 0            | 26 | X | 0  |
| 18 | 0            | 25 | X | 0  |
|    | 0            | 24 | X | 0  |
| 19 | 29           | 0  | X | 0  |
|    | 14           | 16 | S | 15 |
| 20 | 10           | 28 | S | 8  |
|    | 22           | 30 | S | 7  |
| 21 | 10           | 28 | S | 8  |
|    | 22           | 20 | S | 4  |
| 22 | 10           | 31 | S | 8  |
|    | 23           | 23 | S | 7  |
| 23 | 7            | 10 | S | 14 |
|    | 8            | 8  | X | 8  |
| 24 | 0            | 31 | S | 14 |
|    | 0            | 0  | X | 0  |
| 25 | RG           |    |   |    |
|    | + 4294967296 |    |   |    |
| 26 | RC           |    |   |    |
| 27 |              |    |   |    |
| 28 |              |    |   |    |
| 29 |              |    |   |    |
| 30 |              |    |   |    |
| 31 |              |    |   |    |

A = 0?  
→ klaar

=)  $R = -x_n - c_n$

=) 26 t/m 31 S14 =  $x_n + 1$

=)  $R = |\alpha|$

⇒

}  $x_n$

halvering, vervolg worteltrekking  
Kanaal S15

|                      |    | RA<br>RD | 0  | S | 15  |             |
|----------------------|----|----------|----|---|-----|-------------|
| halvering ⇒<br>0a S0 | 0  | 28       | 13 | X | 2   | koppelopdr. |
|                      |    | 25       | 5  | X | 12  | (S) = α - 5 |
|                      | 1  | 12       | 2  | X | 0   |             |
|                      |    | 24       | 17 | X | 30  |             |
|                      | 2  | 8        | 2  | X | 0   |             |
|                      |    | 8        | 4  | S | 15  |             |
|                      | 3  | 28       | 4  | X | 10  |             |
|                      |    | 24       | 0  | X | 4   |             |
|                      | 4  | (10      | 0  | X | 0   | 10 α - n    |
|                      |    | 2        | 0  | X | 0)  | 2 α - n     |
|                      | 5  | 26       | 33 | X | 30  |             |
|                      |    | 26       | 1  | X | 28  |             |
|                      | 6  | 0        | 14 | S | 15  |             |
|                      |    | 28       | 14 | X | 10  |             |
|                      | 7  | (4       | 24 | X | 0   |             |
|                      |    | 2        | 4  | S | 15) |             |
|                      | 8  | • 13     | X  | 0 |     |             |
|                      |    | 28       | 4  | X | 2   |             |
|                      | 9  | 2        | 7  | S | 15  |             |
|                      |    | 24       | 1  | X | 4   |             |
|                      | 10 | 28       | 7  | X | 2   |             |
|                      |    | 28       | 2  | X | 20  |             |
|                      | 11 | 14       | 4  | S | 15  | →           |
|                      |    | 28       | 1  | X | 20  |             |
|                      | 12 | 14       | 4  | S | 15  | →           |
|                      |    | 24       | 0  | X | 4   |             |
|                      | 13 | (6       | 25 | S | 0   | ⇒           |
|                      |    | 8        | 8  | X | 8)  |             |
|                      | 14 | RG       |    |   |     |             |
|                      |    | +0       |    |   |     |             |
|                      | 15 | RX       | 1  |   |     |             |
|                      |    | RD       |    |   |     |             |

halvering vervolg worteltrekking  
Kanaal S15

b19 S14 →  
vervolg V

|    |    |    |   |    |
|----|----|----|---|----|
| 16 | 2  | 31 | S | 14 |
|    | 4  | 29 | X | 0  |
| 17 | 2  | 16 | S | 15 |
|    | 1  | 13 | X | 0  |
| 18 | 28 | 16 | X | 2  |
|    | 29 | 21 | X | 20 |
| 19 | 14 | 16 | S | 15 |
|    | 6  | 25 | S | 0  |
| 20 | RC |    |   |    |
| 21 |    |    |   |    |
| 22 |    |    |   |    |
| 23 |    |    |   |    |
| 24 |    |    |   |    |
| 25 |    |    |   |    |
| 26 |    |    |   |    |
| 27 |    |    |   |    |
| 28 |    |    |   |    |
| 29 |    |    |   |    |
| 30 |    |    |   |    |
| 31 |    |    |   |    |

→  
⇒

|α|

$\frac{1}{2} \frac{a}{x_n}$

