HEIDENHAIN

TNC 320 / TNC 620 / TNC 640

Solutions
Additional Exercises

HIT Learning Package
Milling – 3-Axis Machining

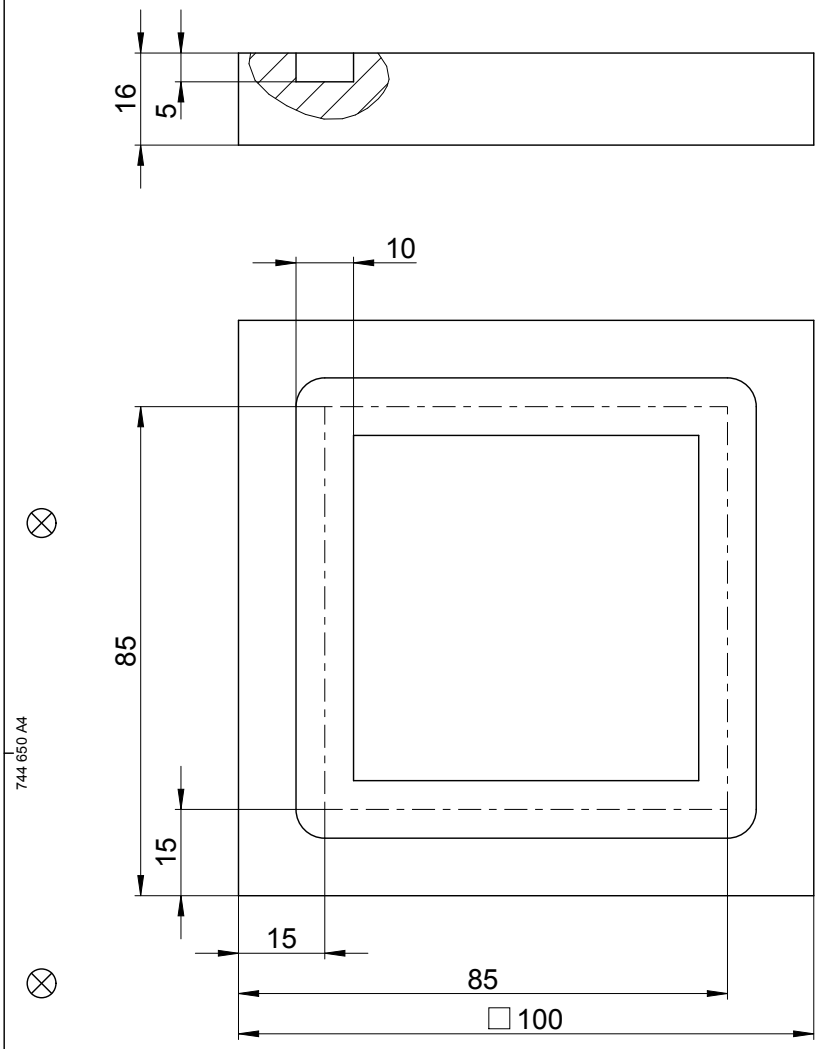
English (en)
6/2018

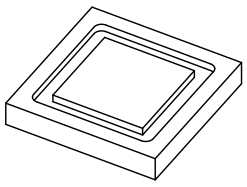
Contents

1

Contour programming

1.1 Slot milling – 1226650





3:10

				ID number
Text:				Change No. C000941-05 Phase: Nicht-Serie
	Original drawing Scale / Format	Platte Plate		Werkstoff: 3.1645 Material:
RoHS	1:1 / A4			
Maße in mm / Dimensions in mm		Einzelteilzeichnung / Component Drawing		●blanke Flächen/Blank surfaces
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715	Allgemeintoleranzen ISO 2768-mH ≦6mm: ±0,2 General tolerances ISO 2768-mH ≦6mm: ±0,2		Tolerierung nach ISO 8015 Tolerances as per ISO 8015	Oberflächen nach ISO 1302 Surfaces as per ISO 1302
			Oberflächenbehandlung: Surface treatment:	

HEIDENHAIN	Created	Responsible	Released	Version	Revision	Sheet	Page
DR. JOHANNES HEIDENHAIN GmbH 83301 Traunreut, Germany	M-TS 05.09.2017			D1226650-00-A-01 Document number			1 of 1

Program parameters

Milling of a slot	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
Pre-position		+50	+15	+100
Start/End point of the contour		+50	+15	-
Machining direction	Clockwise			

Tool parameters

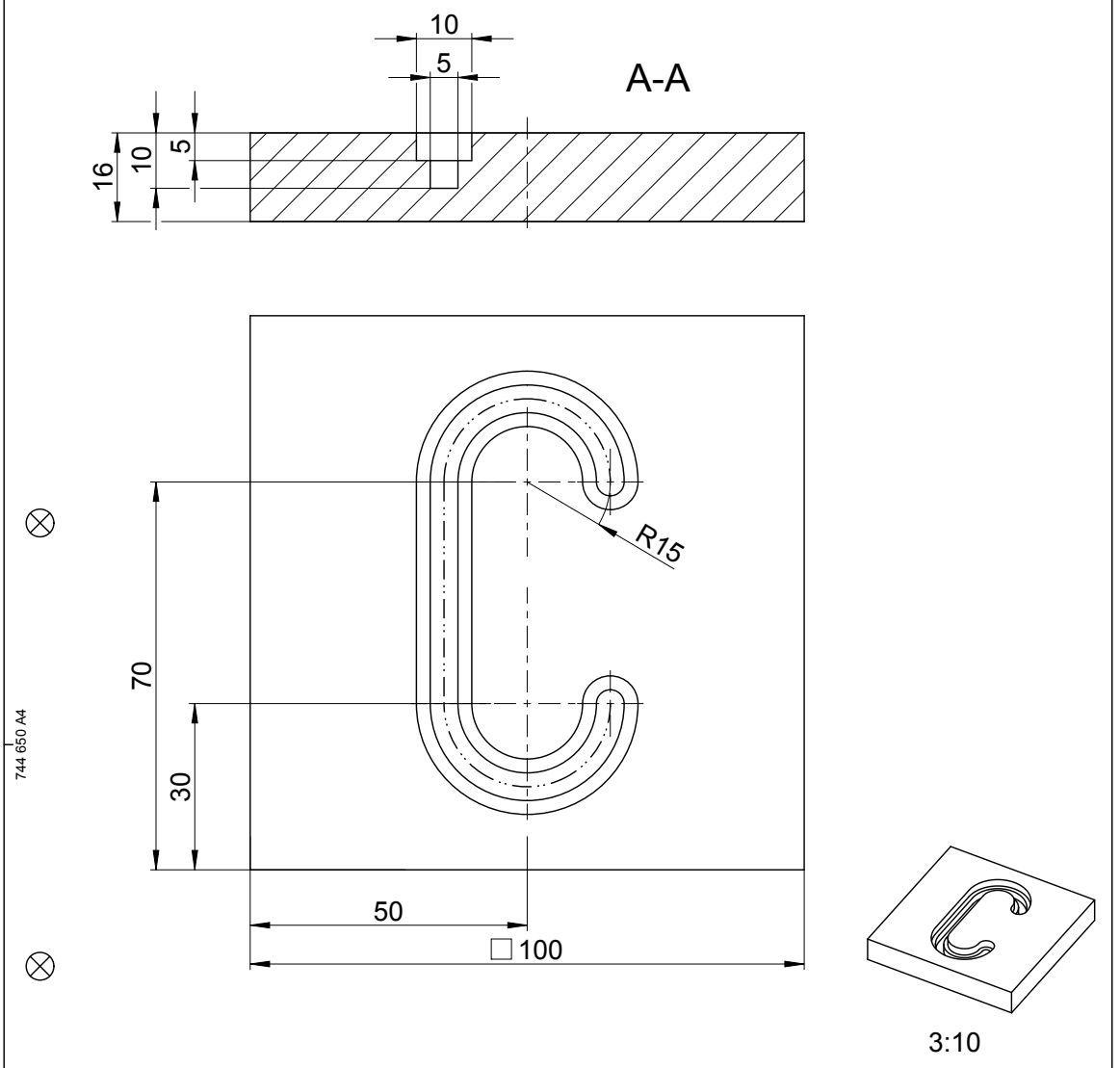
	Ø	T	S	F_1	F_2	DZ	IZ
	10	5	8900	1100	2000	-5	5

Ø) Diameter
T) Tool number
S) Speed
F_1) Machining feed
F_2) Retraction feed rate
DZ) Max. machining / drilling depth
IZ) Infeed

Solution

```
0  BEGIN PGM 1226650 MM
1  BLK FORM 0.1 Z X+0 Y+0 Z-16
2  BLK FORM 0.2  X+100  Y+100  Z+0
3  TOOL CALL 5 Z S8900 F1100
4  L  Z+100 R0 FMAX M3
5  L  X+50  Y+15  Z+5 R0 FMAX M8
6  L  Z-5 R0 F AUTO
7  L  X+15
8  L  Y+85
9  L  X+85
10 L  Y+15
11 L  X+50
12 L  Z+5 R0 F2000
13 L  X+150  Y+150  Z+100 R0 FMAX
14 M30
15 END PGM 1226650 MM
```

1.2 Slot milling – 1226682



				ID number
Text:				Change No. C000941-05 Phase: Nicht-Serie
	Original drawing Scale / Format	Platte Plate		Werkstoff: 3.1645 Material:
RoHS	1:1 / A4			
Maße in mm / Dimensions in mm		Einzelteilzeichnung / Component Drawing		●blanke Flächen/Blank surfaces
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715 -0.3 +0.3		Allgemeintoleranzen ISO 2768-mH ≦6mm: ±0,2 General tolerances ISO 2768-mH ≦6mm: ±0,2	Tolerierung nach ISO 8015 Tolerances as per ISO 8015	Oberflächen nach ISO 1302 Surfaces as per ISO 1302
			Oberflächenbehandlung: Surface treatment:	

HEIDENHAIN	Created	Responsible	Released	Version	Revision	Sheet	Page
DR. JOHANNES HEIDENHAIN GmbH 83301 Traunreut, Germany	M-TS 05.09.2017			D1226682-00-A-01 Document number			1 of 1

Program parameters

Milling of a slot	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
Pre-position		+65	+30	+100
Starting point of contour		+65	+30	-

Tool parameters

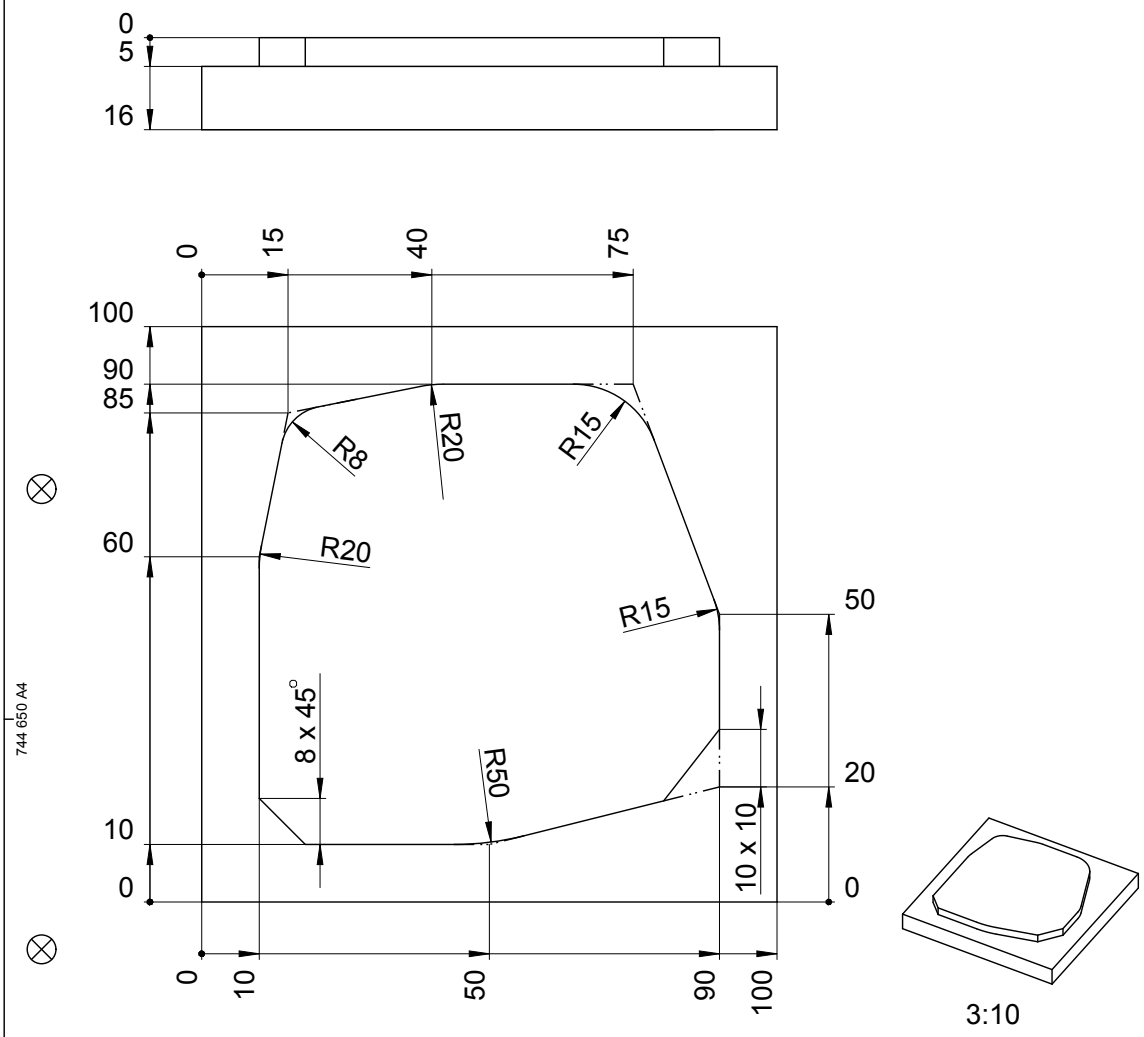
	Ø	T	S	F_1	F_2	DZ	IZ
	10	5	8900	1100	2000	-5	5
	6	3	6000	840	2000	-5	5

Ø) Diameter
T) Tool number
S) Speed
F_1) Machining feed
F_2) Retraction feed rate
DZ) Max. machining / drilling depth
IZ) Infeed

Solution

```
0  BEGIN PGM 1226682 MM
1  BLK FORM 0.1 Z X+0 Y+0 Z-16
2  BLK FORM 0.2  X+100  Y+100  Z+0
3  TOOL CALL 5 Z S8900 F1100
4  L  Z+100 R0 FMAX M3
5  L  X+65  Y+30  Z+5 R0 FMAX M8
6  L  Z-5 R0 F AUTO
7  CALL LBL 1
8  L  Z+5 R0 F2000
9  L  Z+100 R0 FMAX
10 TOOL CALL 3 Z S6000 F840
11 L  Z+100 R0 FMAX M3
12 L  X+65  Y+30  Z+5 R0 FMAX M8
13 L  Z-10 R0 F AUTO
14 CALL LBL 1
15 L  Z+5 R0 F2000
16 L  Z+100 R0 FMAX
17 L  X+150  Y+150  Z+100 R0 FMAX
18 M30
19 LBL 1
20 CR  X+35  Y+30 R+15 DR-
21 L  Y+70
22 CR  X+65  Y+70 R+15 DR-
23 LBL 0
24 END PGM 1226682 MM
```

1.3 Contour milling – 1226656



				ID number
Text: Access changed from Confidential to Standard				Change No. C000941-05 Phase: Nicht-Serie
	Original drawing Scale / Format	Platte Plate Einzelteilzeichnung / Component Drawing		Werkstoff: 3.1645 Material:
RoHS	1:1 / A4			●blanke Flächen/Blank surfaces
Maße in mm / Dimensions in mm				
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715	Allgemeintoleranzen ISO 2768-mH ≦6mm: ±0,2 General tolerances ISO 2768-mH ≦6mm: ±0,2		Tolerierung nach ISO 8015 Tolerances as per ISO 8015	Oberflächen nach ISO 1302 Surfaces as per ISO 1302
			Oberflächenbehandlung: Surface treatment:	

HEIDENHAIN	Created	Responsible	Released	Version	Revision	Sheet	Page
DR. JOHANNES HEIDENHAIN GmbH 83301 Traunreut, Germany	M-TS 05.09.2017			D1226656-00-A-01 Document number			1 of 1

Program parameters

Milling an external contour	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
Pre-position		-20	+40	+100
Start/End point of the contour		+10	+40	-
Approach/Departure strategy	Circular arc with tangential connection to the contour and a straight line			
Approach/Departure radius	5			
Machining direction	Climb milling			

Tool parameters

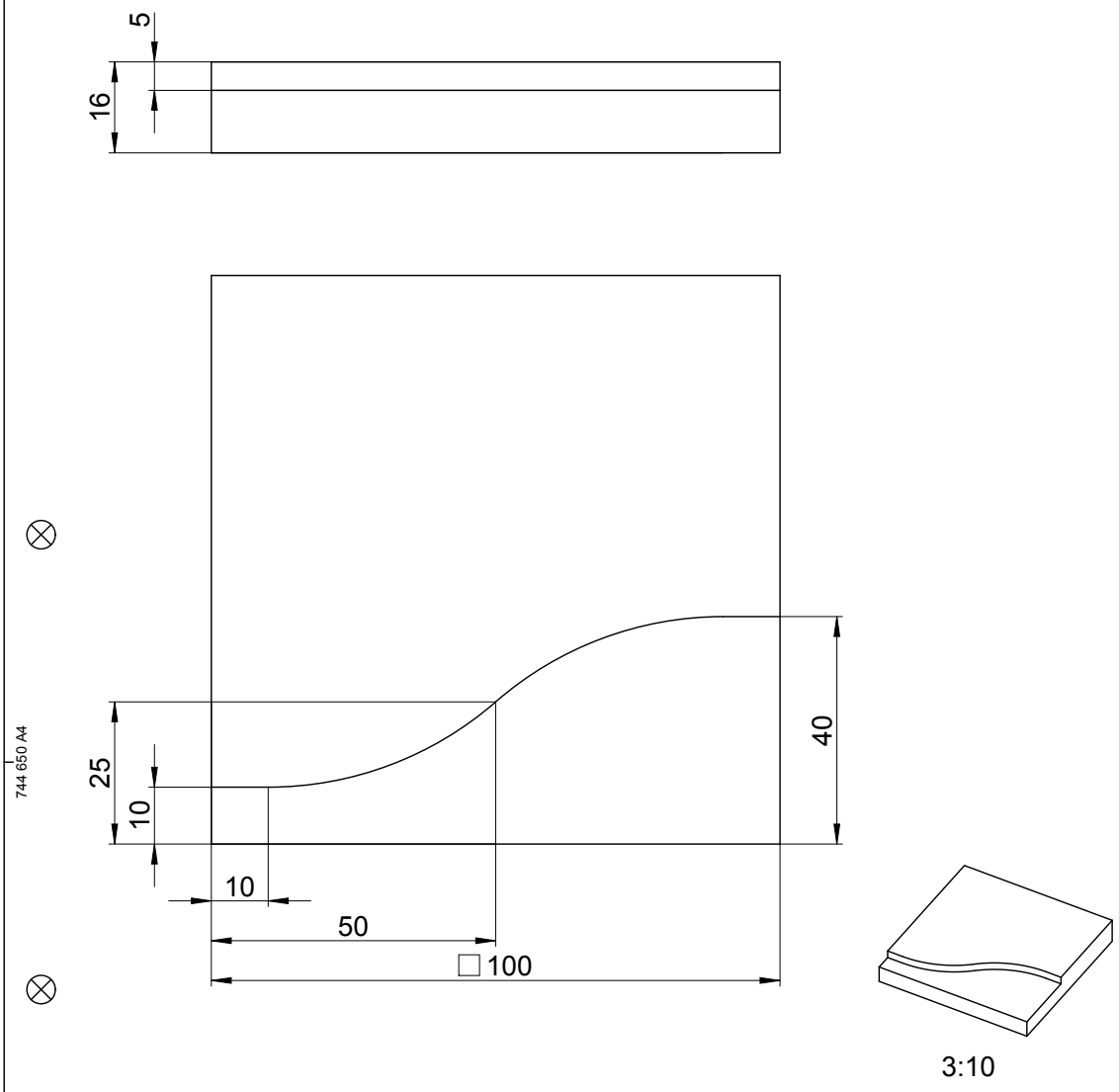
	Ø	T	S	F_1	F_2	DZ	IZ
	20	10	4500	1100	2000	-5	5

Ø) Diameter
T) Tool number
S) Speed
F_1) Machining feed
F_2) Retraction feed rate
DZ) Max. machining / drilling depth
IZ) Infeed

Solution

```
0  BEGIN PGM 1226656 MM
1  BLK FORM 0.1 Z X+0 Y+0 Z-16
2  BLK FORM 0.2  X+100  Y+100  Z+0
3  TOOL CALL 10 Z S4500 F1700
4  L  Z+100 R0 FMAX M3
5  L  X-20  Y+40  Z+5 R0 FMAX M8
6  L  Z-5 R0 F AUTO
7  APPR LCT  X+10  Y+40 R5 RL
8  L  Y+60
9 RND R20
10 L  X+15  Y+85
11 RND R8
12 L  X+40  Y+90
13 RND R20
14 L  X+75
15 RND R15
16 L  X+90  Y+50
17 RND R15
18 L  Y+20
19 CHF 10
20 L  X+50  Y+10
21 RND R50
22 L  X+10
23 CHF 8
24 L  Y+40
25 DEP LCT  X-20  Y+40 R5
26 L  Z+5 R0 F2000
27 L  X+150  Y+150  Z+100 R0 FMAX
28 M30
29 END PGM 1226656 MM
```

1.4 Contour milling – 1214128



				ID number
Text:				Change No. C000941-05 Phase: Nicht-Serie
	Original drawing Scale / Format	Platte Plate		Werkstoff: 3.1645 Material:
RoHS	1:1 / A4			
Maße in mm / Dimensions in mm		Einzelteilzeichnung / Component Drawing		●blanke Flächen/Blank surfaces
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715 -0.3 +0.3	Allgemeintoleranzen ISO 2768-mH ≦6mm: ±0,2 General tolerances ISO 2768-mH ≦6mm: ±0,2		Tolerierung nach ISO 8015 Tolerances as per ISO 8015	Oberflächen nach ISO 1302 Surfaces as per ISO 1302
			Oberflächenbehandlung: Surface treatment:	

HEIDENHAIN	Created	Responsible	Released	Version	Revision	Sheet	Page
DR. JOHANNES HEIDENHAIN GmbH 83301 Traunreut, Germany	M-TS 11.04.2017			D1214128-00-A-01 Document number			1 of 1

Program parameters

Milling a contour	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
Pre-position		+130	+20	+100
Starting point of contour		+100	+40	-
Approach/Departure path	LEN20			
Machining direction	Climb milling			

Tool parameters

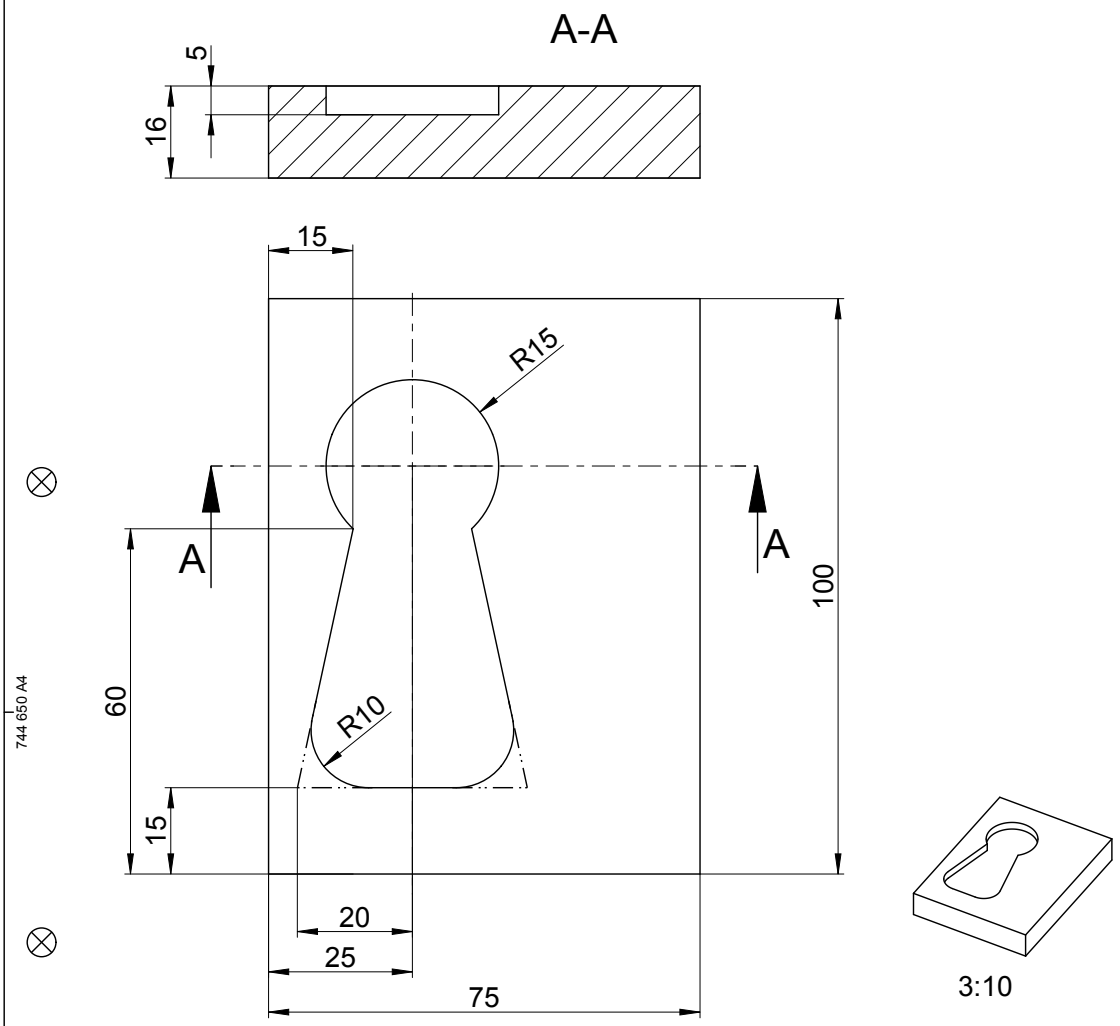
	Ø	T	S	F_1	F_2	DZ	IZ
	20	10	4500	1700	2000	-5	5

Ø) Diameter
T) Tool number
S) Speed
F_1) Machining feed
F_2) Retraction feed rate
DZ) Max. machining / drilling depth
IZ) Infeed

Solution

```
0  BEGIN PGM 1214128 MM
1  BLK FORM 0.1 Z X+0 Y+0 Z-16
2  BLK FORM 0.2  X+100  Y+100  Z+0
3  TOOL CALL 10 Z S4500 F1700
4  L  Z+100 R0 FMAX M3
5  L  X+130  Y+20  Z+5 R0 FMAX M8
6  L  Z-5 R0 F AUTO
7  APPR LT  X+100  Y+40 LEN20 RL
8  FL  AN+180
9  FCT  X+50  Y+25 DR+
10 FCT  X+10  Y+10 DR-
11 FLT  X+0  Y+10  AN+180
12 DEP LT LEN20
13 L  Z+5 R0 F2000
14 L  X+150  Y+150  Z+100 R0 FMAX
15 M30
16 END PGM 1214128 MM
```

1.5 Milling an inside contour – 1214109



				ID number
Text:				Change No. C000941-05 Phase: Nicht-Serie
	Original drawing Scale / Format	Platte Plate		Werkstoff: 3.1645 Material:
RoHS	1:1 / A4			
Maße in mm / Dimensions in mm		Einzelteilzeichnung / Component Drawing		●blanke Flächen/Blank surfaces
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715 -0.3 +0.3		Allgemeintoleranzen ISO 2768-mH ≦6mm: ±0,2 General tolerances ISO 2768-mH ≦6mm: ±0,2	Tolerierung nach ISO 8015 Tolerances as per ISO 8015	Oberflächen nach ISO 1302 Surfaces as per ISO 1302
			Oberflächenbehandlung: Surface treatment:	

HEIDENHAIN	Created	Responsible	Released	Version	Revision	Sheet	Page
DR. JOHANNES HEIDENHAIN GmbH 83301 Traunreut, Germany	M-TS 11.04.2017			D1214109-00-A-01 Document number			1 of 1

Program parameters

Milling an inside contour	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
Pre-position		+25	+40	+100
Start/End point of the contour		+25	+15	-
Approach/Departure strategy	Circular arc with tangential connection to the contour and a straight line			
Approach/Departure radius	R5			
Machining direction	Climb milling			

Tool parameters

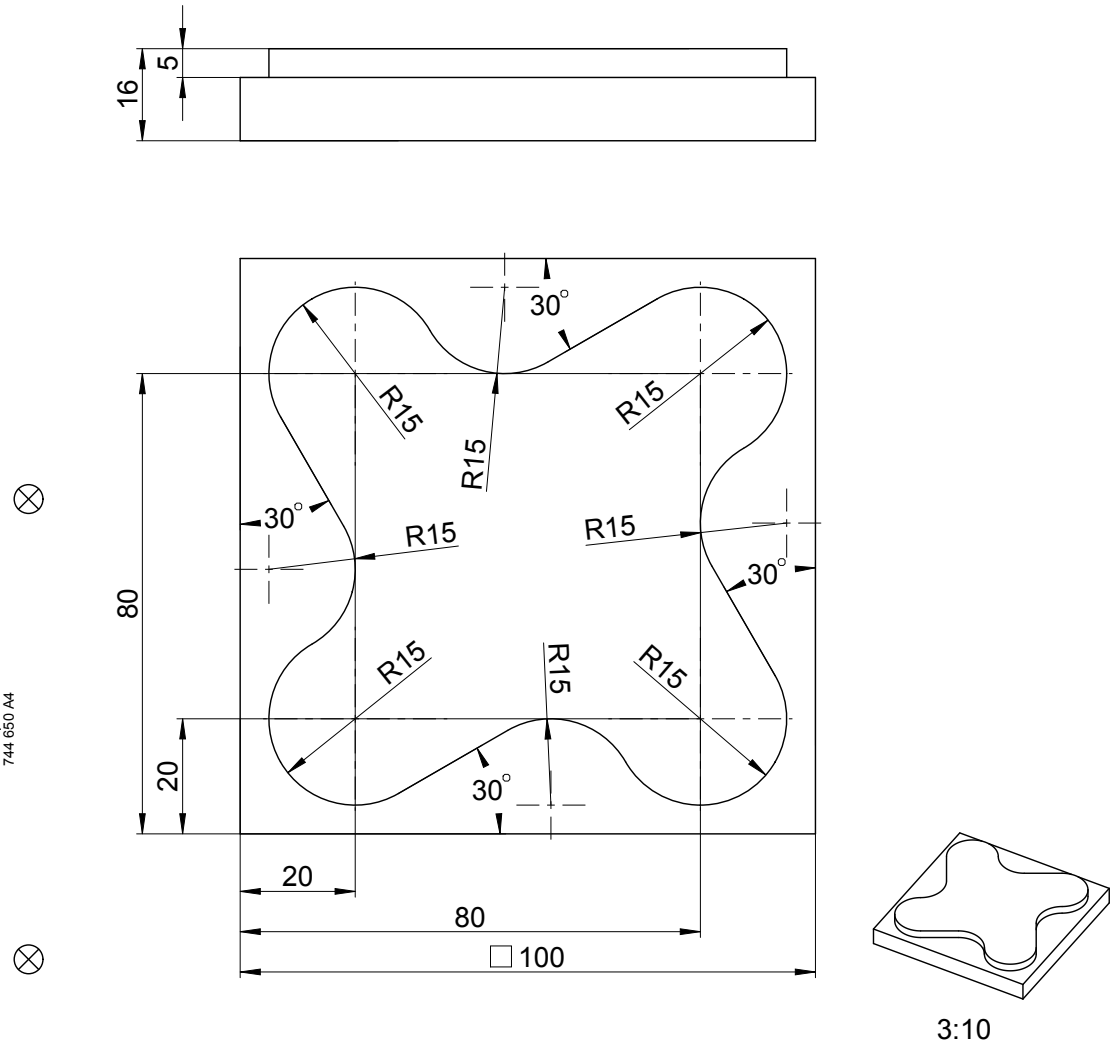
	Ø	T	S	F_1	F_2	DZ	IZ
	16	8	5600	1100	2000	-5	5

Ø) Diameter
T) Tool number
S) Speed
F_1) Machining feed
F_2) Retraction feed rate
DZ) Max. machining / drilling depth
IZ) Infeed

Solution

```
0  BEGIN PGM 1214109 MM
1  BLK FORM 0.1 Z X+0 Y+0 Z-16
2  BLK FORM 0.2  X+75  Y+100  Z+0
3  TOOL CALL 8 Z S5600 F1100
4  L  Z+100 R0 FMAX M3
5  L  X+25  Y+40  Z+5 R0 FMAX M8
6  L  Z-5 R0 F AUTO
7  APPR LCT  X+25  Y+15 R3 RL
8  FL LEN20  AN+0  Y+15
9  RND R10
10 FL  X+35  Y+60
11 FC  Y+60 DR+ R15  CCX+25
12 FSELECT2
13 FL  X+5  Y+15
14 RND R10
15 FL  X+25  Y+15  AN+0
16 DEP LCT  X+25  Y+40 R3
17 L  Z+5 R0 F2000
18 L  X+150  Y+150  Z+100 R0 FMAX
19 M30
20 END PGM 1214109 MM
```

1.6 Contour milling – 1226661



3:10

				ID number
Text:				Change No. C000941-05 Phase: Nicht-Serie
	Original drawing Scale / Format	Platte Plate		Werkstoff: 3.1645 Material:
RoHS	1:1 / A4			
Maße in mm / Dimensions in mm		Einzelteilzeichnung / Component Drawing		●blanke Flächen/Blank surfaces
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715 -0.3 +0.3		Allgemeintoleranzen ISO 2768-mH ≦6mm: ±0,2 General tolerances ISO 2768-mH ≦6mm: ±0,2	Tolerierung nach ISO 8015 Tolerances as per ISO 8015	Oberflächen nach ISO 1302 Surfaces as per ISO 1302
			Oberflächenbehandlung: Surface treatment:	

HEIDENHAIN	Created	Responsible	Released	Version	Revision	Sheet	Page
DR. JOHANNES HEIDENHAIN GmbH 83301 Traunreut, Germany	M-TS 05.09.2017			D1226661-00-A-01 Document number			1 of 1

Program parameters

Milling an external contour	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
Pre-position		-20	+20	+100
Start/End point of the contour		+5	+20	-
Approach/Departure strategy	Circular arc with tangential connection to the contour and a straight line			
Approach/Departure radius	R5			
Machining direction	Climb milling			

Tool parameters

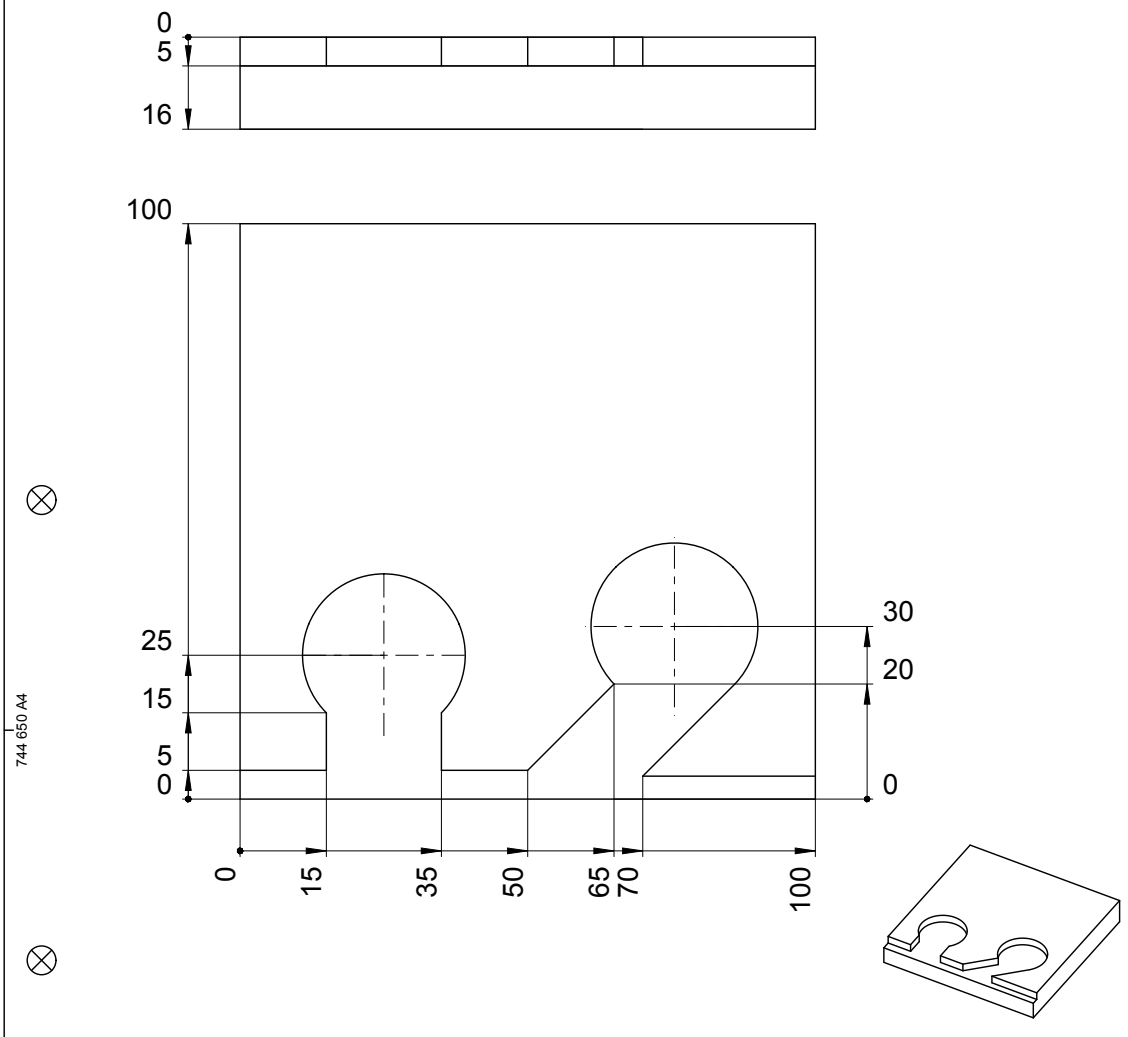
	Ø	T	S	F_1	F_2	DZ	IZ
	20	10	4500	1700	2000	-5	5

Ø) Diameter
T) Tool number
S) Speed
F_1) Machining feed
F_2) Retraction feed rate
DZ) Max. machining / drilling depth
IZ) Infeed

Solution

```
0  BEGIN PGM 1226661 MM
1  BLK FORM 0.1 Z X+0 Y+0 Z-16
2  BLK FORM 0.2  X+100  Y+100  Z+0
3  TOOL CALL 10 Z S4500 F1700
4  L  Z+100 R0 FMAX M3
5  L  X-20  Y+20  Z+5 R0 FMAX M8
6  L  Z-5 R0 F AUTO
7  APPR LCT  X+5  Y+20 R5 RL
8  FC DR- R15  CCX+20  CCY+20
9  FCT DR+ R15  CCX+5
10 FSELECT1
11 FLT  AN+120
12 FCT DR- R15  CCX+20  CCY+80
13 FCT DR+ R15  CCY+95
14 FSELECT1
15 FLT  AN+30
16 FCT DR- R15  CCX+80  CCY+80
17 FCT DR+ R15  CCX+95
18 FSELECT2
19 FLT  AN-60
20 FCT DR- R15  CCX+80  CCY+20
21 FCT DR+ R15  CCY+5
22 FSELECT2
23 FLT  AN-150
24 FCT  X+5  Y+20 DR- R15  CCX+20  CCY+20
25 DEP LCT  X-20  Y+20 R5
26 L  Z+5 R0 F2000
27 L  X+150  Y+150  Z+100 R0 FMAX
28 M30
29 END PGM 1226661 MM
```

1.7 Contour milling – 1226657



				ID number
Text:				Change No. C000941-05 Phase: Nicht-Serie
	Original drawing Scale: 1:1	Format: A4	Platte Plate	Werkstoff: 3.1645 Material:
RoHS				
Maße in mm / Dimensions in mm			Einzelteilzeichnung / Component Drawing	●blanke Flächen/Blank surfaces
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715	Allgemeintoleranzen ISO 2768-mH ≦6mm: ±0,2 General tolerances ISO 2768-mH ≦6mm: ±0,2		Tolerierung nach ISO 8015 Tolerances as per ISO 8015	Oberflächen nach ISO 1302 Surfaces as per ISO 1302
-0.3 +0.3			Oberflächenbehandlung: Surface treatment:	

HEIDENHAIN	Created	Responsible	Released	Version	Revision	Sheet	Page
DR. JOHANNES HEIDENHAIN GmbH 83301 Traunreut, Germany	M-TS 05.09.2017			D1226657-00-A-01 Document number			1 of 1

Program parameters

Milling a contour	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
Pre-position		+120	-20	+100
Starting point of contour		+100	+5	-
Approach/Departure path	LEN20			
Machining direction	Climb milling			

Tool parameters

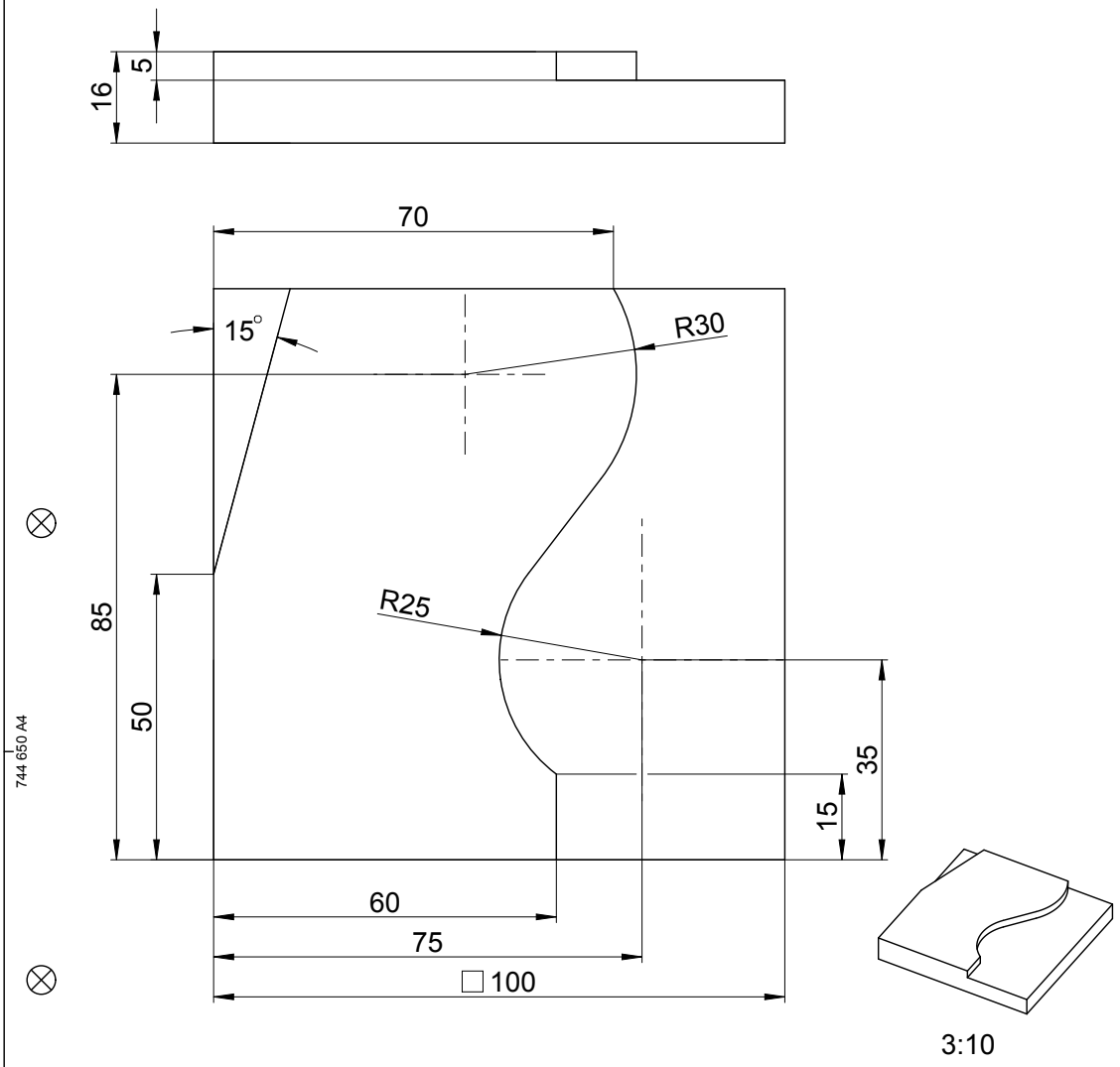
	Ø	T	S	F_1	F_2	DZ	IZ
	14	7	6800	1600	2000	-5	5

Ø) Diameter
T) Tool number
S) Speed
F_1) Machining feed
F_2) Retraction feed rate
DZ) Max. machining / drilling depth
IZ) Infeed

Solution

```
0  BEGIN PGM 1226657 MM
1  BLK FORM 0.1 Z X+0 Y+0 Z-16
2  BLK FORM 0.2  X+100  Y+100  Z+0
3  TOOL CALL 7 Z S6800 F1600
4  L  Z+100 R0 FMAX M3
5  L  X+120  Y-20  Z+5 R0 FMAX M8
6  L  Z-5 R0 F AUTO
7  APPR LT  X+100  Y+5 LEN20 RL
8  FL  X+70  Y+5  AN+180
9  FL  Y+20  AN+45
10 FCT  X+65  Y+20 DR+  CCY+30
11 FL  X+50  Y+5  AN-135
12 FL  X+35  Y+5  AN+180 LEN15
13 FL  X+35  Y+15
14 FC  X+15  Y+15 DR+  CCX+25  CCY+25
15 FL  X+15  Y+5  AN-90
16 FL  X+0  Y+5  AN+180
17 DEP LT LEN20
18 L  Z+5 R0 F2000
19 L  X+150  Y+150  Z+100 R0 FMAX
20 M30
21 END PGM 1226657 MM
```

1.8 Contour milling – 1226662



				ID number
Text:				Change No. C000941-05 Phase: Nicht-Serie
	Original drawing Scale / Format	Platte Plate		Werkstoff: 3.1645 Material:
RoHS	1:1 / A4			
Maße in mm / Dimensions in mm		Einzelteilzeichnung / Component Drawing		●blanke Flächen/Blank surfaces
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715 -0.3 +0.3		Allgemeintoleranzen ISO 2768-mH ≦6mm: ±0,2 General tolerances ISO 2768-mH ≦6mm: ±0,2	Tolerierung nach ISO 8015 Tolerances as per ISO 8015	Oberflächen nach ISO 1302 Surfaces as per ISO 1302
			Oberflächenbehandlung: Surface treatment:	

HEIDENHAIN	Created	Responsible	Released	Version	Revision	Sheet	Page
DR. JOHANNES HEIDENHAIN GmbH 83301 Traunreut, Germany	M-TS 05.09.2017			D1226662-00-A-01 Document number			1 of 1

Program parameters

Milling an external contour	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
Pre-position		-20	+30	+100
Start/End point of the contour		+0	+50	-
Approach strategy	Straight line with tangential connection to the contour			
Departure strategy	Circular arc with tangential connection to the contour and a straight line			
Approach/Departure path	LEN20			
Approach/Departure radius	R5			
Machining direction	Climb milling			

Tool parameters

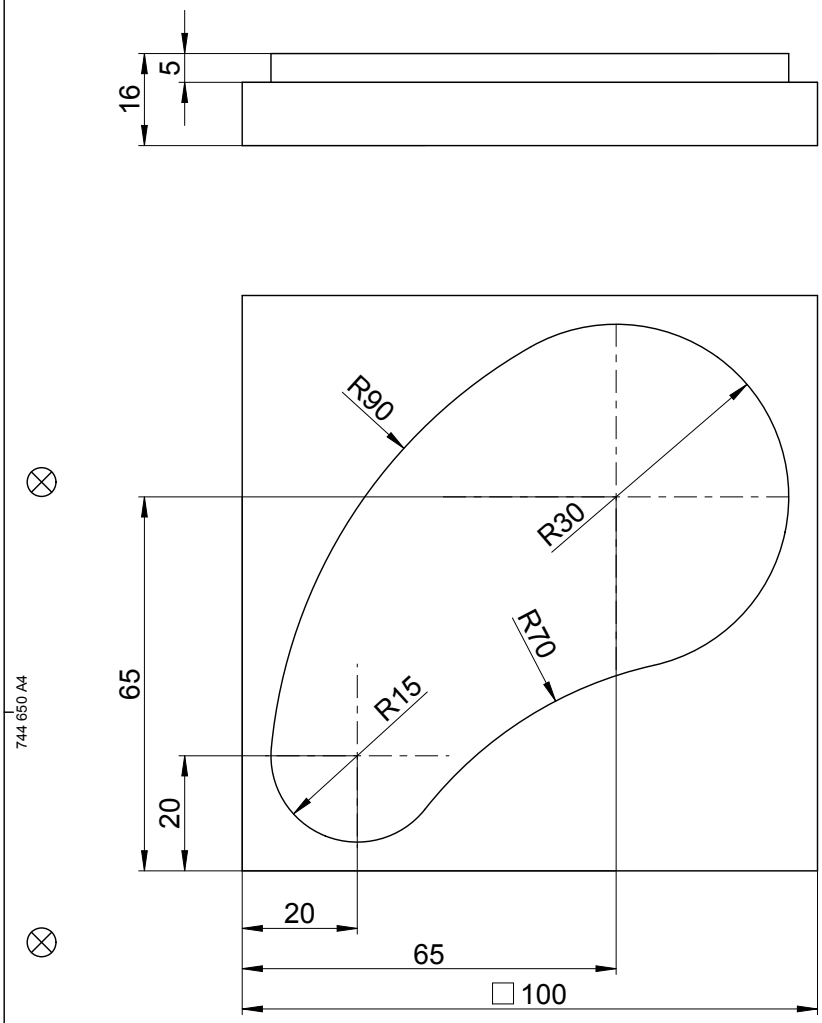
	Ø	T	S	F_1	F_2	DZ	IZ
	20	10	4500	1700	2000	-5	5

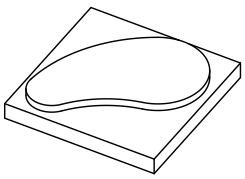
Ø) Diameter
T) Tool number
S) Speed
F_1) Machining feed
F_2) Retraction feed rate
DZ) Max. machining / drilling depth
IZ) Infeed

Solution

```
0  BEGIN PGM 1226662 MM
1  BLK FORM 0.1 Z X+0 Y+0 Z-16
2  BLK FORM 0.2  X+100  Y+100  Z+0
3  TOOL CALL 10 Z S4500 F1700
4  L  Z+100 R0 FMAX M3
5  L  X-20  Y+30  Z+5 R0 FMAX M8
6  L  Z-5 R0 F AUTO
7  APPR LT  X+0  Y+50 LEN20 RL
8  FL  Y+100  AN+75
9  FL  X+70  Y+100  AN+0
10 FC DR- R30  CCY+85
11 FSELECT2
12 FLT
13 FCT  X+60  Y+15 DR+ R25  CCX+75  CCY+35
14 L  X+60  Y+0
15 L  X+0
16 L  Y+50
17 DEP LCT  X-20  Y+30 R5
18 L  Z+5 R0 F2000
19 L  X+150  Y+150  Z+100 R0 FMAX
20 M30
21 END PGM 1226662 MM
```

1.9 Contour milling – 1226666





3:10

				ID number
Text:				Change No. C000941-05 Phase: Nicht-Serie
	Original drawing Scale / Format	Platte Plate		Werkstoff: 3.1645 Material:
RoHS	1:1 / A4			
Maße in mm / Dimensions in mm		Einzelteilzeichnung / Component Drawing		●blanke Flächen/Blank surfaces
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715	Allgemeintoleranzen ISO 2768-mH ≦6mm: ±0,2 General tolerances ISO 2768-mH ≦6mm: ±0,2		Tolerierung nach ISO 8015 Tolerances as per ISO 8015	Oberflächen nach ISO 1302 Surfaces as per ISO 1302
			Oberflächenbehandlung: Surface treatment:	

HEIDENHAIN	Created	Responsible	Released	Version	Revision	Sheet	Page
DR. JOHANNES HEIDENHAIN GmbH 83301 Traunreut, Germany	M-TS 05.09.2017			D1226666-00-A-01 Document number			1 of 1

Program parameters

Milling an external contour	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
Pre-position		-20	+20	+100
Start/End point of the contour		+5	+20	-
Approach/Departure strategy	Circular arc with tangential connection to the contour and a straight line			
Approach/Departure radius	R5			
Machining direction	Climb milling			

Tool parameters

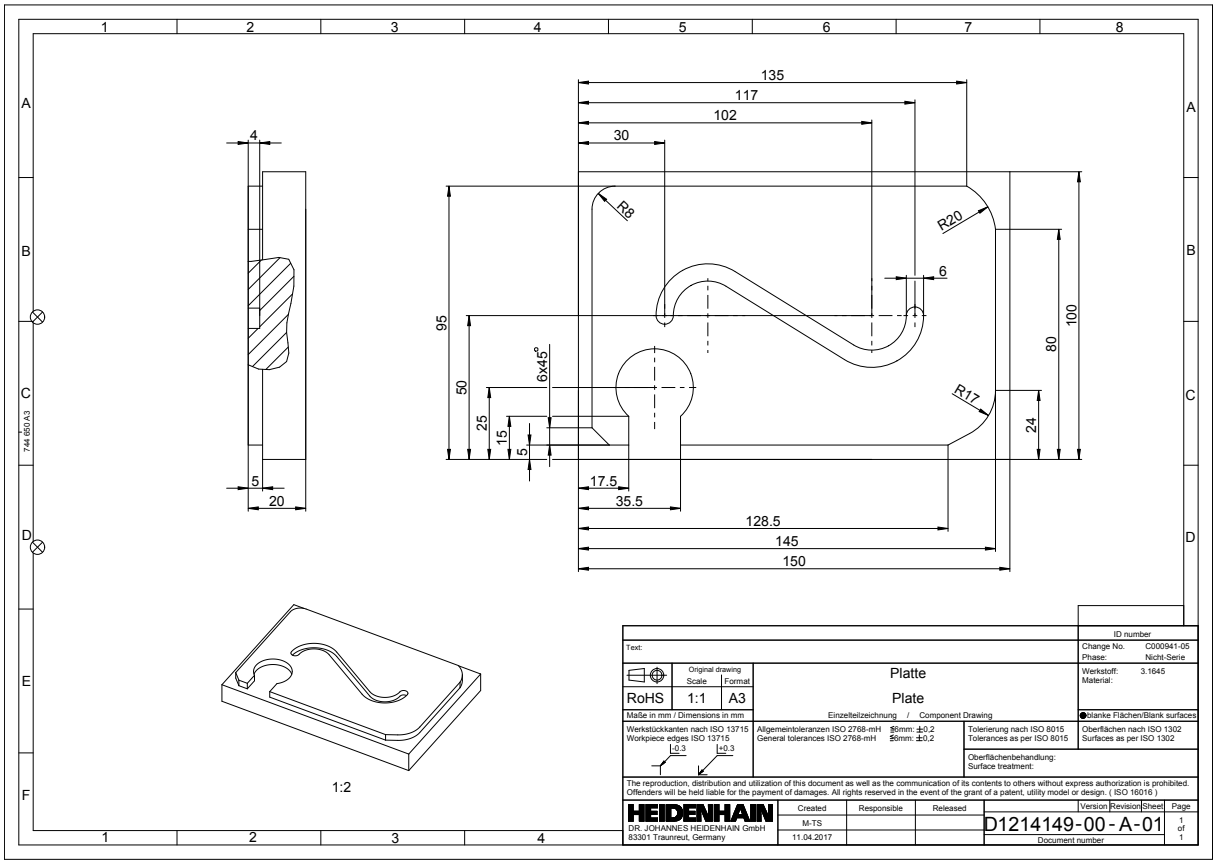
	Ø	T	S	F_1	F_2	DZ	IZ
	20	10	4500	1700	2000	-5	5

Ø) Diameter
T) Tool number
S) Speed
F_1) Machining feed
F_2) Retraction feed rate
DZ) Max. machining / drilling depth
IZ) Infeed

Solution

```
0  BEGIN PGM 1226666 MM
1  BLK FORM 0.1 Z X+0 Y+0 Z-16
2  BLK FORM 0.2  X+100  Y+100  Z+0
3  TOOL CALL 10 Z S4500 F1700
4  L  Z+100 R0 FMAX M3
5  L  X-20  Y+20  Z+5 R0 FMAX M8
6  L  Z-5 R0 F AUTO
7  APPR LCT  X+5  Y+20 R5 RL
8  FC DR- R15  CCX+20  CCY+20
9  FCT DR- R90
10 FCT DR- R30  CCX+65  CCY+65
11 FSELECT2
12 FCT DR+ R70
13 FCT  X+5  Y+20 DR- R15  CCX+20  CCY+20
14 FSELECT1
15 DEP LCT  X-20  Y+20 R5
16 L  Z+5 R0 F2000
17 L  X+150  Y+150  Z+100 R0 FMAX
18 M30
19 END PGM 1226666 MM
```

1.10 Milling a contour and slot – 1214149



Program parameters

Milling an external contour	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
Pre-position		-20	-20	+100
Start/End point of the contour		+5	+11	-
Approach/Departure path	LEN30			
Machining direction	Climb milling			

Milling of a slot	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
Pre-position		+117	+50	+100
Starting point of contour		+117	+50	-
End point of the contour		+30	+50	-

Tool parameters

	Ø	T	S	F_1	F_2	DZ	IZ
	16	8	5600	1600	2000	-5	5
	6	3	15000	1100	2000	-4	4

Ø) Diameter
T) Tool number
S) Speed
F_1) Machining feed
F_2) Retraction feed rate
DZ) Max. machining / drilling depth
IZ) Infeed

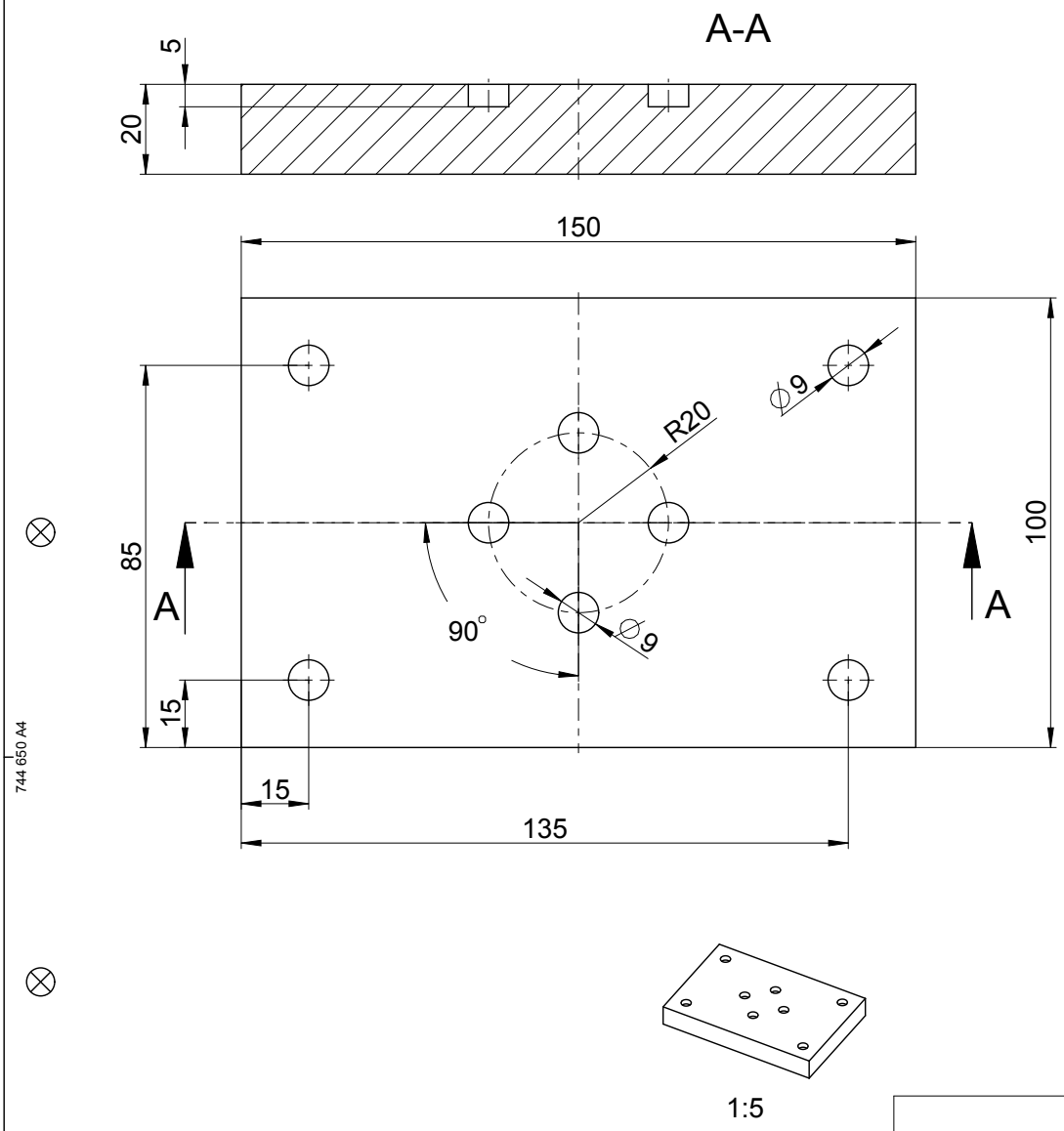
Solution

```
0  BEGIN PGM 1214149 MM
1  BLK FORM 0.1 Z X+0 Y+0 Z-20
2  BLK FORM 0.2  X+150  Y+100  Z+0
3  TOOL CALL 8 Z S5600 F1600
4  L  Z+100 R0 FMAX M3
5  L  X-20  Y-20  Z+5 R0 FMAX M8
6  L  Z-5 R0 F AUTO
7  APPR LT  X+5  Y+11 LEN30 RL
8  L  Y+95
9  RND R8
10 L  X+135
11 CR  X+145  Y+80 R+20 DR-
12 L  Y+24
13 FCT DR- R17
14 FLT  X+128.5  Y+5
15 L  X+35.5
16 L  Y+15
17 CC  X+26.5  Y+25
18 C  X+17.5  Y+15 DR+
19 L  Y+5
20 L  X+11
21 L  X+5  Y+11
22 DEP LT LEN30
23 L  Z+5 R0 F2000
24 L  Z+100 R0 FMAX
25 TOOL CALL 3 Z S15000 F1100
26 L  X+117  Y+50  Z+100 R0 FMAX M3
27 L  Z+5 R0 FMAX M8
28 L  Z-4 R0 F AUTO
29 FC DR-  CCX+102  CCY+50 R15
30 FLT
31 FCT  X+30  Y+50 DR+  CCX+45  CCY+50 R15
32 L  Z+5 R0 F2000
33 L  X+150  Y+150  Z+100 R0 FMAX
34 M30
35 END PGM 1214149 MM
```

2

Cycle Programming

2.1 Bore milling – 1206105



1:5

				ID number
Text:				Change No. C000941-05 Phase: Nicht-Serie
	Original drawing Scale / Format	Platte Plate		Werkstoff: 3.1645 Material:
RoHS	4:5 / A4			
Maße in mm / Dimensions in mm		Einzelteilzeichnung / Component Drawing		●blanke Flächen/Blank surfaces
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715 -0.3 +0.3		Allgemeintoleranzen ISO 2768-mH ≦6mm: ±0,2 General tolerances ISO 2768-mH ≦6mm: ±0,2	Tolerierung nach ISO 8015 Tolerances as per ISO 8015 Oberflächenbehandlung: Surface treatment:	Oberflächen nach ISO 1302 Surfaces as per ISO 1302

HEIDENHAIN	Created	Responsible	Released	Version	Revision	Sheet	Page
DR. JOHANNES HEIDENHAIN GmbH 83301 Traunreut, Germany	M-TS 14.02.2017			D1206105-00-A-01 Document number			1 of 1

Program parameters

Bore milling	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
2nd set-up clearance				+50
Machining direction	Climb milling			

Tool parameters

	Ø	T	S	F_1	F_2	DZ	IZ
	6	3	15000	1100	2000	-5	0.25

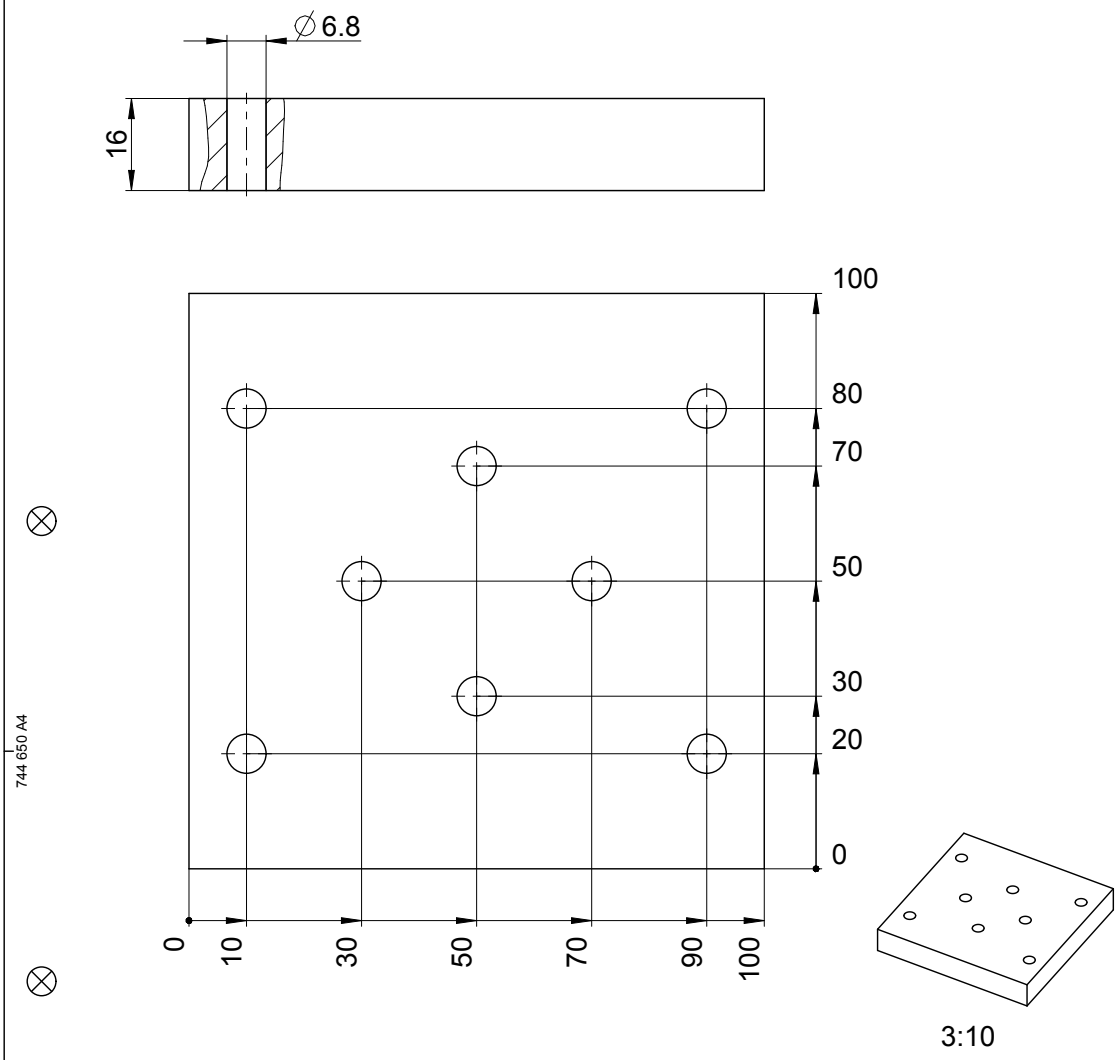
Ø) Diameter
T) Tool number
S) Speed
F_1) Machining feed
F_2) Retraction feed rate
DZ) Max. machining / drilling depth
IZ) Infeed

Solution

```
0  BEGIN PGM 1206105 MM
1  BLK FORM 0.1 Z X+0 Y+0 Z-20
2  BLK FORM 0.2  X+150  Y+100  Z+0
3  TOOL CALL 3 Z S15000 F1100
4  L  Z+100 R0 FMAX M3
5  CYCL DEF 208 BORE MILLING ~
     Q200=+5          ;SET-UP CLEARANCE ~
     Q201=-5          ;DEPTH ~
     Q206= AUTO       ;FEED RATE FOR PLNGNG ~
     Q334=+0.25       ;PLUNGING DEPTH ~
     Q203=+0          ;SURFACE COORDINATE ~
     Q204=+50         ;2ND SET-UP CLEARANCE ~
     Q335=+9          ;NOMINAL DIAMETER ~
     Q342=+0          ;ROUGHING DIAMETER ~
     Q351=+1          ;CLIMB OR UP-CUT
6  CYCL DEF 220 POLAR PATTERN ~
     Q216=+75         ;CENTER IN 1ST AXIS ~
     Q217=+50         ;CENTER IN 2ND AXIS ~
     Q244=+40         ;PITCH CIRCLE DIAMETR ~
     Q245=+0          ;STARTING ANGLE ~
     Q246=+360        ;STOPPING ANGLE ~
     Q247=+90         ;STEPPING ANGLE ~
     Q241=+4          ;NR OF REPETITIONS ~
     Q200=+5          ;SET-UP CLEARANCE ~
     Q203=+0          ;SURFACE COORDINATE ~
     Q204=+50         ;2ND SET-UP CLEARANCE ~
     Q301=+1          ;MOVE TO CLEARANCE ~
     Q365=+0          ;TYPE OF TRAVERSE
7  CYCL DEF 221 CARTESIAN PATTERN ~
     Q225=+15         ;STARTNG PNT 1ST AXIS ~
     Q226=+15         ;STARTNG PNT 2ND AXIS ~
     Q237=+120        ;SPACING IN 1ST AXIS ~
     Q238=+70         ;SPACING IN 2ND AXIS ~
     Q242=+2          ;NUMBER OF COLUMNS ~
     Q243=+2          ;NUMBER OF LINES ~
     Q224=+0          ;ANGLE OF ROTATION ~
     Q200=+5          ;SET-UP CLEARANCE ~
     Q203=+0          ;SURFACE COORDINATE ~
     Q204=+50         ;2ND SET-UP CLEARANCE ~
     Q301=+1          ;MOVE TO CLEARANCE
```

```
8  L  X+150  Y+150  Z+100 R0 FMAX
9  M30
10 END PGM 1206105 MM
```

2.2 Drilling – 1226649



				ID number
Text:				Change No. C000941-05 Phase: Nicht-Serie
	Original drawing Scale: 1:1	Format: A4	Platte Plate	Werkstoff: 3.1645 Material:
RoHS				
Maße in mm / Dimensions in mm			Einzelteilzeichnung / Component Drawing	●blanke Flächen/Blank surfaces
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715	Allgemeintoleranzen ISO 2768-mH ≦6mm: ±0,2 General tolerances ISO 2768-mH ≦6mm: ±0,2		Tolerierung nach ISO 8015 Tolerances as per ISO 8015	Oberflächen nach ISO 1302 Surfaces as per ISO 1302
			Oberflächenbehandlung: Surface treatment:	

HEIDENHAIN	Created	Responsible	Released	Version	Revision	Sheet	Page
DR. JOHANNES HEIDENHAIN GmbH 83301 Traunreut, Germany	M-TS 05.09.2017			D1226649-00-A-01 Document number			1 of 1

Program parameters

Drilling	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
2nd set-up clearance		-	-	+50

Tool parameters

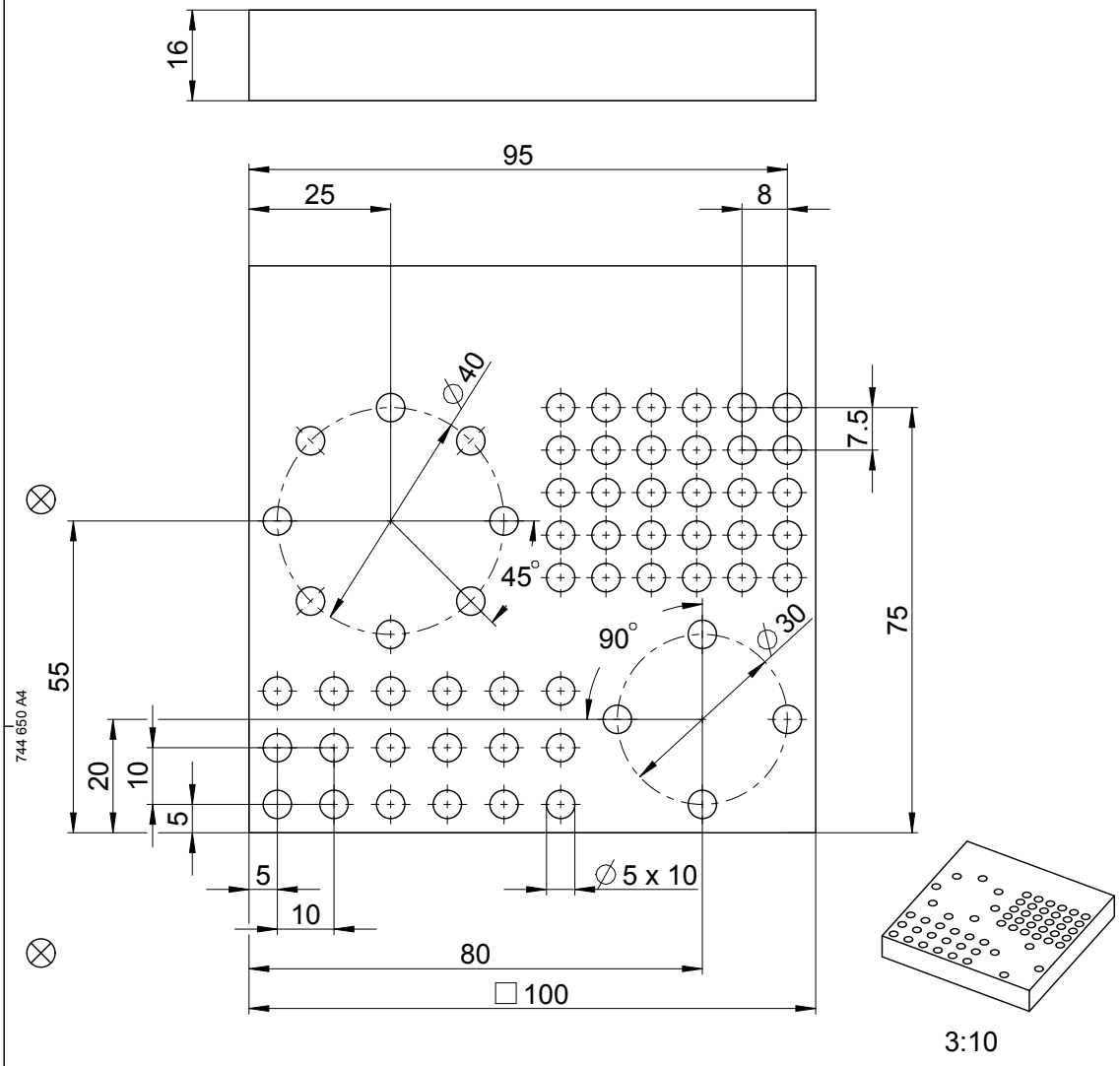
	Ø	T	S	F_1	F_2	DZ	IZ
	6.8	229	6000	840	2000	-17	17

Ø) Diameter
T) Tool number
S) Speed
F_1) Machining feed
F_2) Retraction feed rate
DZ) Max. machining / drilling depth
IZ) Infeed

Solution

```
0 BEGIN PGM 1226649 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-16
2 BLK FORM 0.2 X+100 Y+100 Z+0
3 TOOL CALL 229 Z S6000 F840
4 L Z+100 R0 FMAX M3
5 CYCL DEF 200 DRILLING ~
    Q200=+5          ;SET-UP CLEARANCE ~
    Q201=-17         ;DEPTH ~
    Q206= AUTO       ;FEED RATE FOR PLNGNG ~
    Q202=+17         ;PLUNGING DEPTH ~
    Q210=+0          ;DWELL TIME AT TOP ~
    Q203=+0          ;SURFACE COORDINATE ~
    Q204=+50         ;2ND SET-UP CLEARANCE ~
    Q211=+0          ;DWELL TIME AT DEPTH ~
    Q395=+1          ;DEPTH REFERENCE
6 L X+10 Y+20 R0 FMAX M99 M8
7 L X+90 Y+20 R0 FMAX M99
8 L X+90 Y+80 R0 FMAX M99
9 L X+10 Y+80 R0 FMAX M99
10 L X+30 Y+50 R0 FMAX M99
11 L X+50 Y+30 R0 FMAX M99
12 L X+70 Y+50 R0 FMAX M99
13 L X+50 Y+70 R0 FMAX M99
14 L X+150 Y+150 Z+100 R0 FMAX
15 M30
16 END PGM 1226649 MM
```

2.3 Drilling – 1226671



				ID number
Text:				Change No. C000941-05 Phase: Nicht-Serie
	Original drawing Scale: 1:1	Format: A4	Platte Plate	Werkstoff: 3.1645 Material:
RoHS				
Maße in mm / Dimensions in mm			Einzelteilzeichnung / Component Drawing	●blanke Flächen/Blank surfaces
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715 -0.3 +0.3		Allgemeintoleranzen ISO 2768-mH ≦6mm: ±0,2 General tolerances ISO 2768-mH ≦6mm: ±0,2	Tolerierung nach ISO 8015 Tolerances as per ISO 8015	Oberflächen nach ISO 1302 Surfaces as per ISO 1302
			Oberflächenbehandlung: Surface treatment:	

HEIDENHAIN	Created	Responsible	Released	Version	Revision	Sheet	Page
DR. JOHANNES HEIDENHAIN GmbH 83301 Traunreut, Germany	M-TS 05.09.2017			D1226671-00-A-01 Document number			1 of 1

Program parameters

Drilling	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
2nd set-up clearance		-	-	+50

Tool parameters

	Ø	T	S	F_1	F_2	DZ	IZ
	5	227	6000	840	2000	-10	10

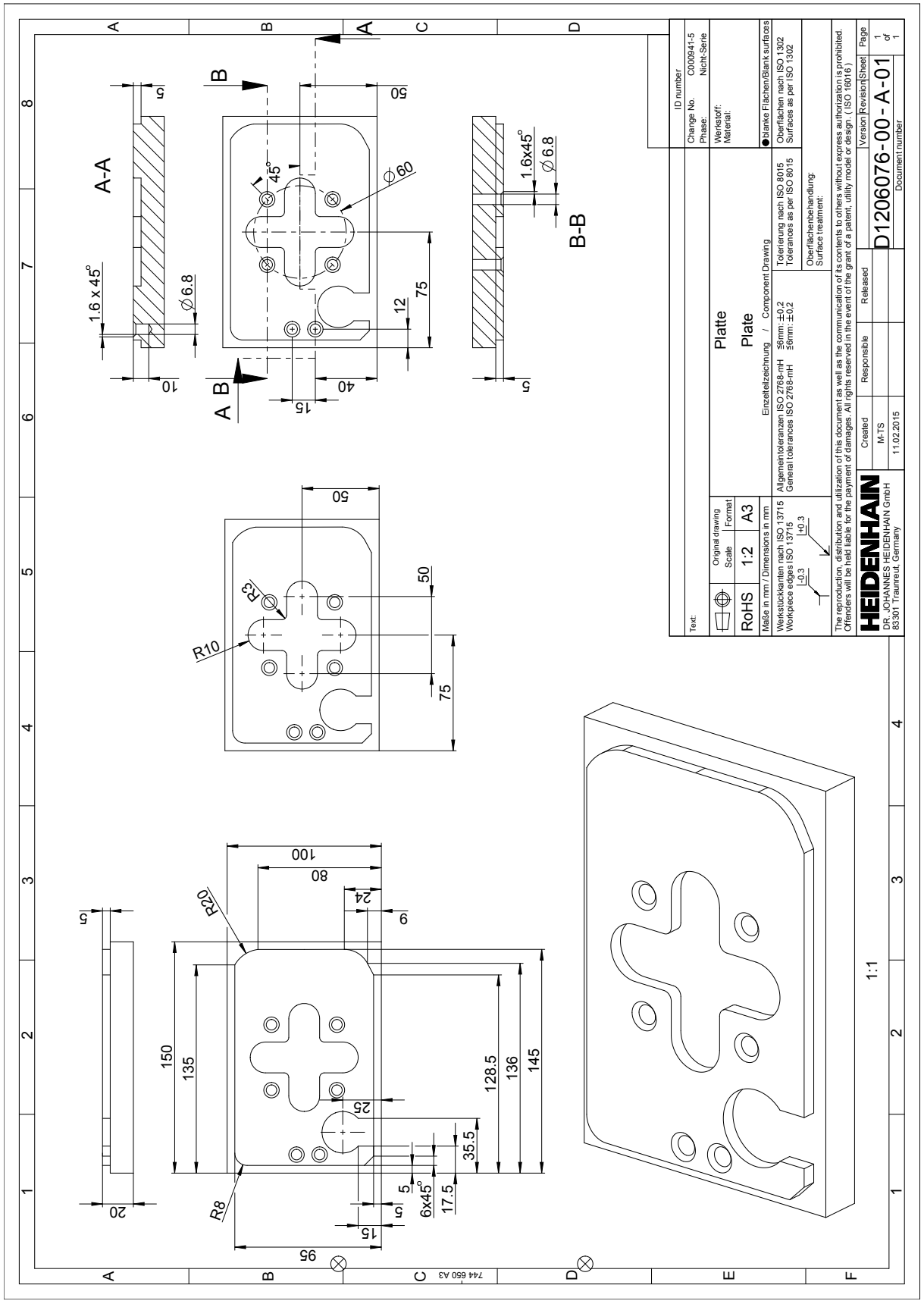
Ø) Diameter
T) Tool number
S) Speed
F_1) Machining feed
F_2) Retraction feed rate
DZ) Max. machining / drilling depth
IZ) Infeed

Solution

```
0 BEGIN PGM 1226671 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-16
2 BLK FORM 0.2 X+100 Y+100 Z+0
3 TOOL CALL 227 Z S6000 F840
4 L Z+100 R0 FMAX M3
5 CYCL DEF 200 DRILLING ~
    Q200=+5          ;SET-UP CLEARANCE ~
    Q201=-10         ;DEPTH ~
    Q206= AUTO       ;FEED RATE FOR PLNGNG ~
    Q202=+10         ;PLUNGING DEPTH ~
    Q210=+0          ;DWELL TIME AT TOP ~
    Q203=+0          ;SURFACE COORDINATE ~
    Q204=+50         ;2ND SET-UP CLEARANCE ~
    Q211=+0.1        ;DWELL TIME AT DEPTH ~
    Q395=+1          ;DEPTH REFERENCE
6 CYCL DEF 220 POLAR PATTERN ~
    Q216=+25         ;CENTER IN 1ST AXIS ~
    Q217=+55         ;CENTER IN 2ND AXIS ~
    Q244=+40         ;PITCH CIRCLE DIAMETR ~
    Q245=+0          ;STARTING ANGLE ~
    Q246=+360        ;STOPPING ANGLE ~
    Q247=+45         ;STEPPING ANGLE ~
    Q241=+8          ;NR OF REPETITIONS ~
    Q200=+5          ;SET-UP CLEARANCE ~
    Q203=+0          ;SURFACE COORDINATE ~
    Q204=+50         ;2ND SET-UP CLEARANCE ~
    Q301=+1          ;MOVE TO CLEARANCE ~
    Q365=+0          ;TYPE OF TRAVERSE
7 CYCL DEF 220 POLAR PATTERN ~
    Q216=+80         ;CENTER IN 1ST AXIS ~
    Q217=+20         ;CENTER IN 2ND AXIS ~
    Q244=+30         ;PITCH CIRCLE DIAMETR ~
    Q245=+0          ;STARTING ANGLE ~
    Q246=+360        ;STOPPING ANGLE ~
    Q247=+90         ;STEPPING ANGLE ~
    Q241=+4          ;NR OF REPETITIONS ~
    Q200=+5          ;SET-UP CLEARANCE ~
    Q203=+0          ;SURFACE COORDINATE ~
    Q204=+50         ;2ND SET-UP CLEARANCE ~
    Q301=+1          ;MOVE TO CLEARANCE ~
    Q365=+0          ;TYPE OF TRAVERSE
8 CYCL DEF 221 CARTESIAN PATTERN ~
```

```
Q225=+95          ;STARTNG PNT 1ST AXIS ~
Q226=+75          ;STARTNG PNT 2ND AXIS ~
Q237=-8           ;SPACING IN 1ST AXIS ~
Q238=-7.5         ;SPACING IN 2ND AXIS ~
Q242=+6           ;NUMBER OF COLUMNS ~
Q243=+5           ;NUMBER OF LINES ~
Q224=+0           ;ANGLE OF ROTATION ~
Q200=+5           ;SET-UP CLEARANCE ~
Q203=+0           ;SURFACE COORDINATE ~
Q204=+50          ;2ND SET-UP CLEARANCE ~
Q301=+1           ;MOVE TO CLEARANCE
9  CYCL DEF 221 CARTESIAN PATTERN ~
Q225=+5           ;STARTNG PNT 1ST AXIS ~
Q226=+5           ;STARTNG PNT 2ND AXIS ~
Q237=+10          ;SPACING IN 1ST AXIS ~
Q238=+10          ;SPACING IN 2ND AXIS ~
Q242=+6           ;NUMBER OF COLUMNS ~
Q243=+3           ;NUMBER OF LINES ~
Q224=+0           ;ANGLE OF ROTATION ~
Q200=+5           ;SET-UP CLEARANCE ~
Q203=+0           ;SURFACE COORDINATE ~
Q204=+50          ;2ND SET-UP CLEARANCE ~
Q301=+1           ;MOVE TO CLEARANCE
10 L  X+150  Y+150  Z+100 R0 FMAX
11 M30
12 END PGM 1226671 MM
```

2.4 Milling, drilling, and countersinking – 1206076



Program parameters

Milling an external contour	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
Pre-position		-20	-20	+100
Start/End point of the contour		+5	+11	
Approach/Departure path	LEN30			
Machining direction	Climb milling			

Milling the slots	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
2nd set-up clearance		-	-	+50
Allowance for side	0.2			
Allowance for floor	0.1			
Climb/Up-cut	Climb milling			

Drilling / Countersinking	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
2nd set-up clearance		-	-	+50
Dwell time at depth	0.1			

Tool parameters

	Ø	T	S	F_1	F_2	DZ	IZ
	16	8	5600	1600	2000	-5	5
	6.8	229	6000	840	2000	-21	21
	12	204	4800	340	2000	-5	5

Ø) Diameter
T) Tool number
S) Speed
F_1) Machining feed
F_2) Retraction feed rate
DZ) Max. machining / drilling depth
IZ) Infeed

Solution

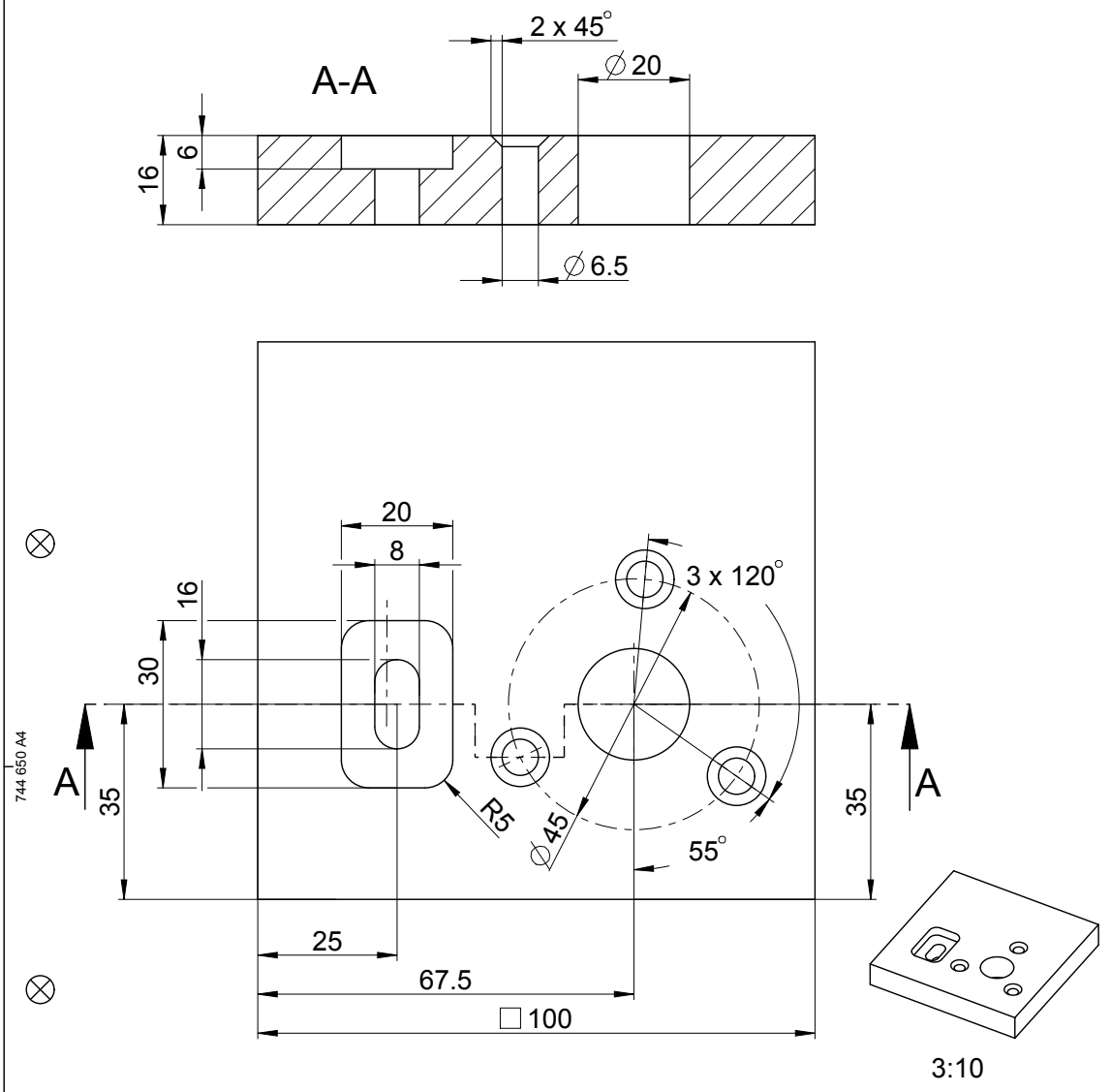
```
0  BEGIN PGM 1206076 MM
1  BLK FORM 0.1 Z X+0 Y+0 Z-20
2  BLK FORM 0.2  X+150  Y+100  Z+0
3  TOOL CALL 8 Z S5600 F1600
4  L  Z+100 R0 FMAX M3
5  L  X-20  Y-20  Z+5 R0 FMAX M8
6  L  Z-5 R0 F AUTO
7  APPR LT  X+5  Y+11 LEN30 RL
8  L  Y+95
9  RND R8
10 L  X+135
11 CR  X+145  Y+80 R+20 DR-
12 L  Y+24
13 FCT DR- R17
14 FLT  X+128.5  Y+5
15 L  X+35.5
16 L  Y+15
17 CC  X+26.5  Y+25
18 C  X+17.5  Y+15 DR+
19 L  Y+5
20 L  X+11
21 L  X+5  Y+11
22 DEP LT LEN30
23 L  Z+5 R0 F2000
24 L  Z+100 R0 FMAX
25 CYCL DEF 253 SLOT MILLING ~
    Q215=+0          ;MACHINING OPERATION ~
    Q218=+70         ;SLOT LENGTH ~
    Q219=+20         ;SLOT WIDTH ~
    Q368=+0.2        ;ALLOWANCE FOR SIDE ~
    Q374=+0          ;ANGLE OF ROTATION ~
    Q367=+0          ;SLOT POSITION ~
    Q207= AUTO       ;FEED RATE FOR MILLNG ~
    Q351=+1          ;CLIMB OR UP-CUT ~
    Q201=-5          ;DEPTH ~
    Q202=+5          ;PLUNGING DEPTH ~
    Q369=+0.1        ;ALLOWANCE FOR FLOOR ~
    Q206= AUTO       ;FEED RATE FOR PLNGNG ~
    Q338=+0          ;INFEED FOR FINISHING ~
    Q200=+5          ;SET-UP CLEARANCE ~
    Q203=+0          ;SURFACE COORDINATE ~
    Q204=+50         ;2ND SET-UP CLEARANCE ~
```

```
    Q366=+2          ;PLUNGE ~
    Q385= AUTO       ;FINISHING FEED RATE ~
    Q439=+3          ;FEED RATE REFERENCE
26 L  X+75  Y+50 R0 FMAX M99
27 CYCL DEF 253 SLOT MILLING ~
    Q215=+0          ;MACHINING OPERATION ~
    Q218=+70         ;SLOT LENGTH ~
    Q219=+20         ;SLOT WIDTH ~
    Q368=+0.2        ;ALLOWANCE FOR SIDE ~
    Q374=+90         ;ANGLE OF ROTATION ~
    Q367=+0          ;SLOT POSITION ~
    Q207= AUTO       ;FEED RATE FOR MILLNG ~
    Q351=+1          ;CLIMB OR UP-CUT ~
    Q201=-5          ;DEPTH ~
    Q202=+5          ;PLUNGING DEPTH ~
    Q369=+0.1        ;ALLOWANCE FOR FLOOR ~
    Q206= AUTO       ;FEED RATE FOR PLNGNG ~
    Q338=+0          ;INFEED FOR FINISHING ~
    Q200=+5          ;SET-UP CLEARANCE ~
    Q203=+0          ;SURFACE COORDINATE ~
    Q204=+50         ;2ND SET-UP CLEARANCE ~
    Q366=+2          ;PLUNGE ~
    Q385= AUTO       ;FINISHING FEED RATE ~
    Q439=+3          ;FEED RATE REFERENCE
28 L  X+75  Y+50 R0 FMAX M99
29 L  Z+100 R0 FMAX
30 TOOL CALL 229 Z S6000 F840
31 L  Z+100 R0 FMAX M3
32 CYCL DEF 200 DRILLING ~
    Q200=+5          ;SET-UP CLEARANCE ~
    Q201=-10         ;DEPTH ~
    Q206= AUTO       ;FEED RATE FOR PLNGNG ~
    Q202=+10         ;PLUNGING DEPTH ~
    Q210=+0          ;DWELL TIME AT TOP ~
    Q203=+0          ;SURFACE COORDINATE ~
    Q204=+50         ;2ND SET-UP CLEARANCE ~
    Q211=+0.1        ;DWELL TIME AT DEPTH ~
    Q395=+1          ;DEPTH REFERENCE
33 L  X+12  Y+40 R0 FMAX M99 M8
34 L  X+12  Y+55 R0 FMAX M99
35 CYCL DEF 200 DRILLING ~
    Q200=+5          ;SET-UP CLEARANCE ~
    Q201=-21         ;DEPTH ~
```

```
Q206= AUTO          ;FEED RATE FOR PLNGNG ~
Q202=+21            ;PLUNGING DEPTH ~
Q210=+0             ;DWELL TIME AT TOP ~
Q203=+0             ;SURFACE COORDINATE ~
Q204=+50            ;2ND SET-UP CLEARANCE ~
Q211=+0             ;DWELL TIME AT DEPTH ~
Q395=+1             ;DEPTH REFERENCE
36 CYCL DEF 220 POLAR PATTERN ~
Q216=+75            ;CENTER IN 1ST AXIS ~
Q217=+50            ;CENTER IN 2ND AXIS ~
Q244=+60            ;PITCH CIRCLE DIAMETR ~
Q245=+45            ;STARTING ANGLE ~
Q246=+360           ;STOPPING ANGLE ~
Q247=+90            ;STEPPING ANGLE ~
Q241=+4             ;NR OF REPETITIONS ~
Q200=+5             ;SET-UP CLEARANCE ~
Q203=+0             ;SURFACE COORDINATE ~
Q204=+50            ;2ND SET-UP CLEARANCE ~
Q301=+1             ;MOVE TO CLEARANCE ~
Q365=+0             ;TYPE OF TRAVERSE
37 L  Z+100 R0 FMAX
38 TOOL CALL 204 Z S4800 F340
39 L  Z+100 R0 FMAX M3
40 CYCL DEF 240 CENTERING ~
Q200=+5             ;SET-UP CLEARANCE ~
Q343=+1             ;SELECT DIA./DEPTH ~
Q201=-2             ;DEPTH ~
Q344=-10            ;DIAMETER ~
Q206= AUTO          ;FEED RATE FOR PLNGNG ~
Q211=+0.1           ;DWELL TIME AT DEPTH ~
Q203=+0             ;SURFACE COORDINATE ~
Q204=+50            ;2ND SET-UP CLEARANCE
41 L  X+12  Y+40 R0 FMAX M99 M8
42 L  X+12  Y+55 R0 FMAX M99
43 CYCL DEF 220 POLAR PATTERN ~
Q216=+75            ;CENTER IN 1ST AXIS ~
Q217=+50            ;CENTER IN 2ND AXIS ~
Q244=+60            ;PITCH CIRCLE DIAMETR ~
Q245=+45            ;STARTING ANGLE ~
Q246=+360           ;STOPPING ANGLE ~
Q247=+90            ;STEPPING ANGLE ~
Q241=+4             ;NR OF REPETITIONS ~
Q200=+5             ;SET-UP CLEARANCE ~
```

```
    Q203=+0          ;SURFACE COORDINATE ~
    Q204=+50         ;2ND SET-UP CLEARANCE ~
    Q301=+1          ;MOVE TO CLEARANCE ~
    Q365=+0          ;TYPE OF TRAVERSE
44 L  X+150  Y+150  Z+100 R0 FMAX
45 M30
46 END PGM 1206076 MM
```

2.5 Milling pockets and a slot – 1226667



			ID number
Text:			Change No. C000941-05 Phase: Nicht-Serie
Original drawing Scale: 1:1	Format: A4	Platte Plate	Werkstoff: 3.1645 Material:
RoHS			
Maße in mm / Dimensions in mm		Einzelteilzeichnung / Component Drawing	●blanke Flächen/Blank surfaces
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715 -0.3 +0.3	Allgemeintoleranzen ISO 2768-mH ≦6mm: ±0,2 General tolerances ISO 2768-mH ≦6mm: ±0,2	Tolerierung nach ISO 8015 Tolerances as per ISO 8015 Oberflächenbehandlung: Surface treatment:	Oberflächen nach ISO 1302 Surfaces as per ISO 1302

HEIDENHAIN	Created	Responsible	Released	Version	Revision	Sheet	Page
DR. JOHANNES HEIDENHAIN GmbH 83301 Traunreut, Germany	M-TS 05.09.2017			D1226667-00-A-01 Document number			1 of 1

Program parameters

Milling of pockets/slot	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
2nd set-up clearance		-	-	+50
Allowance for side	0.2			
Allowance for floor	0.1			
Climb/Up-cut	Climb milling			
Path overlap	0.7			

Drilling / Countersinking	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
2nd set-up clearance		-	-	+50
Dwell time at depth	0.1			

Tool parameters

	Ø	T	S	F_1	F_2	DZ	IZ
	10	5	8900	1100	2000	-16.5	6
	6	3	15000	1100	2000	-10	
	6	228	6000	840	2000	-17	17
	12	204	4800	340	2000	-5	5

Ø) Diameter
T) Tool number
S) Speed
F_1) Machining feed
F_2) Retraction feed rate
DZ) Max. machining / drilling depth
IZ) Infeed

Solution

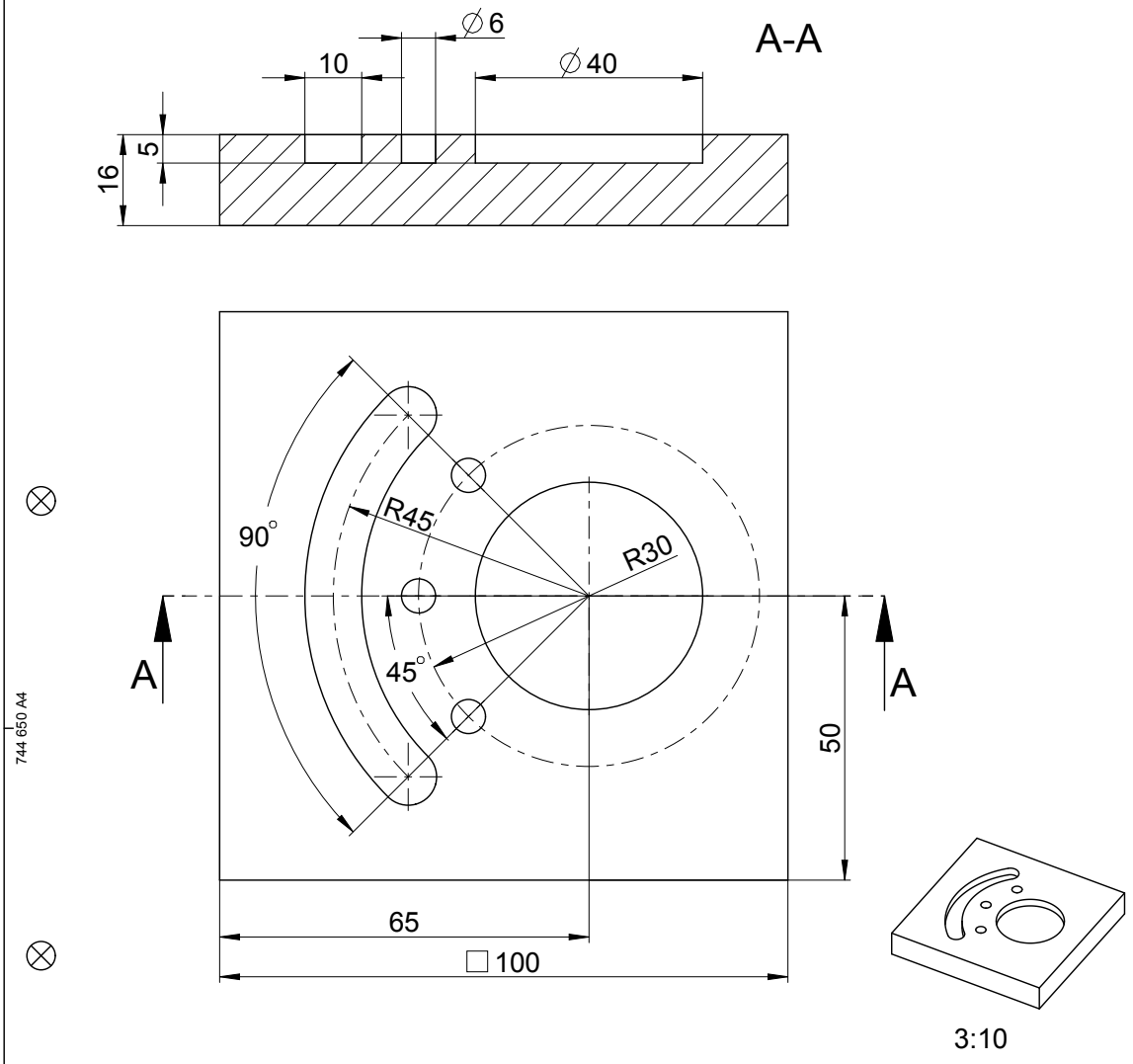
```
0  BEGIN PGM 1226667 MM
1  BLK FORM 0.1 Z X+0 Y+0 Z-16
2  BLK FORM 0.2  X+100  Y+100  Z+0
3  TOOL CALL 5 Z S8900 F1100
4  L  Z+100 R0 FMAX M3
5  CYCL DEF 252 CIRCULAR POCKET ~
     Q215=+0          ;MACHINING OPERATION ~
     Q223=+20         ;CIRCLE DIAMETER ~
     Q368=+0.2        ;ALLOWANCE FOR SIDE ~
     Q207= AUTO       ;FEED RATE FOR MILLNG ~
     Q351=+1          ;CLIMB OR UP-CUT ~
     Q201=-16.5       ;DEPTH ~
     Q202=+5.5        ;PLUNGING DEPTH ~
     Q369=+0          ;ALLOWANCE FOR FLOOR ~
     Q206= AUTO       ;FEED RATE FOR PLNGNG ~
     Q338=+0          ;INFEED FOR FINISHING ~
     Q200=+5          ;SET-UP CLEARANCE ~
     Q203=+0          ;SURFACE COORDINATE ~
     Q204=+50         ;2ND SET-UP CLEARANCE ~
     Q370=+0.7        ;TOOL PATH OVERLAP ~
     Q366=+1          ;PLUNGE ~
     Q385= AUTO       ;FINISHING FEED RATE ~
     Q439=+3          ;FEED RATE REFERENCE
6  L  X+67.5  Y+35 R0 FMAX M99 M8
7  L  Z+100 R0 FMAX
8  CYCL DEF 251 RECTANGULAR POCKET ~
     Q215=+1          ;MACHINING OPERATION ~
     Q218=+20         ;FIRST SIDE LENGTH ~
     Q219=+30         ;2ND SIDE LENGTH ~
     Q220=+0          ;CORNER RADIUS ~
     Q368=+0.2        ;ALLOWANCE FOR SIDE ~
     Q224=+0          ;ANGLE OF ROTATION ~
     Q367=+0          ;POCKET POSITION ~
     Q207= AUTO       ;FEED RATE FOR MILLNG ~
     Q351=+1          ;CLIMB OR UP-CUT ~
     Q201=-6          ;DEPTH ~
     Q202=+5          ;PLUNGING DEPTH ~
     Q369=+0.1        ;ALLOWANCE FOR FLOOR ~
     Q206= AUTO       ;FEED RATE FOR PLNGNG ~
     Q338=+0          ;INFEED FOR FINISHING ~
     Q200=+5          ;SET-UP CLEARANCE ~
     Q203=+0          ;SURFACE COORDINATE ~
```

```
    Q204=+50          ;2ND SET-UP CLEARANCE ~
    Q370=+0.7         ;TOOL PATH OVERLAP ~
    Q366=+1           ;PLUNGE ~
    Q385= AUTO        ;FINISHING FEED RATE ~
    Q439=+3           ;FEED RATE REFERENCE
9 L  X+25  Y+35 R0 FMAX M99
10 L  Z+100 R0 FMAX
11 TOOL CALL 3 Z S15000 F1100
12 L  Z+100 R0 FMAX M3
13 CYCL DEF 251 RECTANGULAR POCKET ~
    Q215=+2           ;MACHINING OPERATION ~
    Q218=+20          ;FIRST SIDE LENGTH ~
    Q219=+30          ;2ND SIDE LENGTH ~
    Q220=+5           ;CORNER RADIUS ~
    Q368=+0.2         ;ALLOWANCE FOR SIDE ~
    Q224=+0           ;ANGLE OF ROTATION ~
    Q367=+0           ;POCKET POSITION ~
    Q207= AUTO        ;FEED RATE FOR MILLNG ~
    Q351=+1           ;CLIMB OR UP-CUT ~
    Q201=-6           ;DEPTH ~
    Q202=+5           ;PLUNGING DEPTH ~
    Q369=+0.1         ;ALLOWANCE FOR FLOOR ~
    Q206= AUTO        ;FEED RATE FOR PLNGNG ~
    Q338=+0           ;INFEED FOR FINISHING ~
    Q200=+5           ;SET-UP CLEARANCE ~
    Q203=+0           ;SURFACE COORDINATE ~
    Q204=+50          ;2ND SET-UP CLEARANCE ~
    Q370=+0.7         ;TOOL PATH OVERLAP ~
    Q366=+1           ;PLUNGE ~
    Q385= AUTO        ;FINISHING FEED RATE ~
    Q439=+3           ;FEED RATE REFERENCE
14 L  X+25  Y+35 R0 FMAX M99 M8
15 L  Z+100 R0 FMAX
16 CYCL DEF 253 SLOT MILLING ~
    Q215=+0           ;MACHINING OPERATION ~
    Q218=+16          ;SLOT LENGTH ~
    Q219=+8           ;SLOT WIDTH ~
    Q368=+0.2         ;ALLOWANCE FOR SIDE ~
    Q374=+90          ;ANGLE OF ROTATION ~
    Q367=+0           ;SLOT POSITION ~
    Q207= AUTO        ;FEED RATE FOR MILLNG ~
    Q351=+1           ;CLIMB OR UP-CUT ~
    Q201=-10.5        ;DEPTH ~
```

```
    Q202=+6          ;PLUNGING DEPTH ~
    Q369=+0          ;ALLOWANCE FOR FLOOR ~
    Q206= AUTO       ;FEED RATE FOR PLNGNG ~
    Q338=+0          ;INFEED FOR FINISHING ~
    Q200=+5          ;SET-UP CLEARANCE ~
    Q203=-6          ;SURFACE COORDINATE ~
    Q204=+50         ;2ND SET-UP CLEARANCE ~
    Q366=+2          ;PLUNGE ~
    Q385= AUTO       ;FINISHING FEED RATE ~
    Q439=+3          ;FEED RATE REFERENCE
17 L  X+25  Y+35 R0 FMAX M99
18 L  Z+100 R0 FMAX
19 TOOL CALL 228 Z S6000 F840
20 L  Z+100 R0 FMAX M3
21 CYCL DEF 200 DRILLING ~
    Q200=+5          ;SET-UP CLEARANCE ~
    Q201=-17         ;DEPTH ~
    Q206= AUTO       ;FEED RATE FOR PLNGNG ~
    Q202=+17         ;PLUNGING DEPTH ~
    Q210=+0          ;DWELL TIME AT TOP ~
    Q203=+0          ;SURFACE COORDINATE ~
    Q204=+50         ;2ND SET-UP CLEARANCE ~
    Q211=+0          ;DWELL TIME AT DEPTH ~
    Q395=+1          ;DEPTH REFERENCE
22 CYCL DEF 220 POLAR PATTERN ~
    Q216=+67.5       ;CENTER IN 1ST AXIS ~
    Q217=+35         ;CENTER IN 2ND AXIS ~
    Q244=+45         ;PITCH CIRCLE DIAMETR ~
    Q245=-35         ;STARTING ANGLE ~
    Q246=+360        ;STOPPING ANGLE ~
    Q247=+120        ;STEPPING ANGLE ~
    Q241=+3          ;NR OF REPETITIONS ~
    Q200=+5          ;SET-UP CLEARANCE. ~
    Q203=+0          ;SURFACE COORDINATE ~
    Q204=+50         ;2ND SET-UP CLEARANCE ~
    Q301=+1          ;MOVE TO CLEARANCE ~
    Q365=+0          ;TYPE OF TRAVERSE
23 L  Z+100 R0 FMAX
24 TOOL CALL 204 Z S4800 F340
25 L  Z+100 R0 FMAX M3
26 CYCL DEF 240 CENTERING ~
    Q200=+5          ;SET-UP CLEARANCE ~
    Q343=+1          ;SELECT DIA./DEPTH ~
```

```
    Q201=-2          ;DEPTH ~
    Q344=-10         ;DIAMETER ~
    Q206= AUTO       ;FEED RATE FOR PLNGNG ~
    Q211=+0.1        ;DWELL TIME AT DEPTH ~
    Q203=+0          ;SURFACE COORDINATE ~
    Q204=+50         ;2ND SET-UP CLEARANCE
27 CYCL DEF 220 POLAR PATTERN ~
    Q216=+67.5       ;CENTER IN 1ST AXIS ~
    Q217=+35         ;CENTER IN 2ND AXIS ~
    Q244=+45         ;PITCH CIRCLE DIAMETR ~
    Q245=-35         ;STARTING ANGLE ~
    Q246=+360        ;STOPPING ANGLE ~
    Q247=+120        ;STEPPING ANGLE ~
    Q241=+3          ;NR OF REPETITIONS ~
    Q200=+5          ;SET-UP CLEARANCE ~
    Q203=+0          ;SURFACE COORDINATE ~
    Q204=+50         ;2ND SET-UP CLEARANCE ~
    Q301=+1          ;MOVE TO CLEARANCE ~
    Q365=+0          ;TYPE OF TRAVERSE
28 L  X+150  Y+150  Z+100 R0 FMAX
29 M30
30 END PGM 1226667 MM
```

2.6 Milling and bore milling – 1226669



				ID number
Text:				Change No. C000941-05 Phase: Nicht-Serie
	Original drawing Scale / Format		Platte Plate	Werkstoff: 3.1645 Material:
RoHS	1:1	A4		
Maße in mm / Dimensions in mm			Einzelteilzeichnung / Component Drawing	●blanke Flächen/Blank surfaces
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715		Allgemeintoleranzen ISO 2768-mH ≦6mm: ±0,2 General tolerances ISO 2768-mH ≦6mm: ±0,2	Tolerierung nach ISO 8015 Tolerances as per ISO 8015	Oberflächen nach ISO 1302 Surfaces as per ISO 1302
-0.3 +0.3			Oberflächenbehandlung: Surface treatment:	

HEIDENHAIN	Created	Responsible	Released	Version	Revision	Sheet	Page
DR. JOHANNES HEIDENHAIN GmbH 83301 Traunreut, Germany	M-TS 05.09.2017			D1226669-00-A-01 Document number			1 of 1

Program parameters

Milling of pocket/slot (roughing + finishing)	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
2nd set-up clearance		-	-	+50
Allowance for side	0.2			
Allowance for floor	0.1			
Climb/Up-cut	Climb milling			
Path overlap	0.7			

Bore milling	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
2nd set-up clearance		-	-	+50

Tool parameters

	Ø	T	S	F_1	F_2	DZ	IZ
	16	8	5600	1100	2000	-5	5
	8	4	12000	1000	2000	-5	5
	4	2	18000	1000	2000	-5	0.25

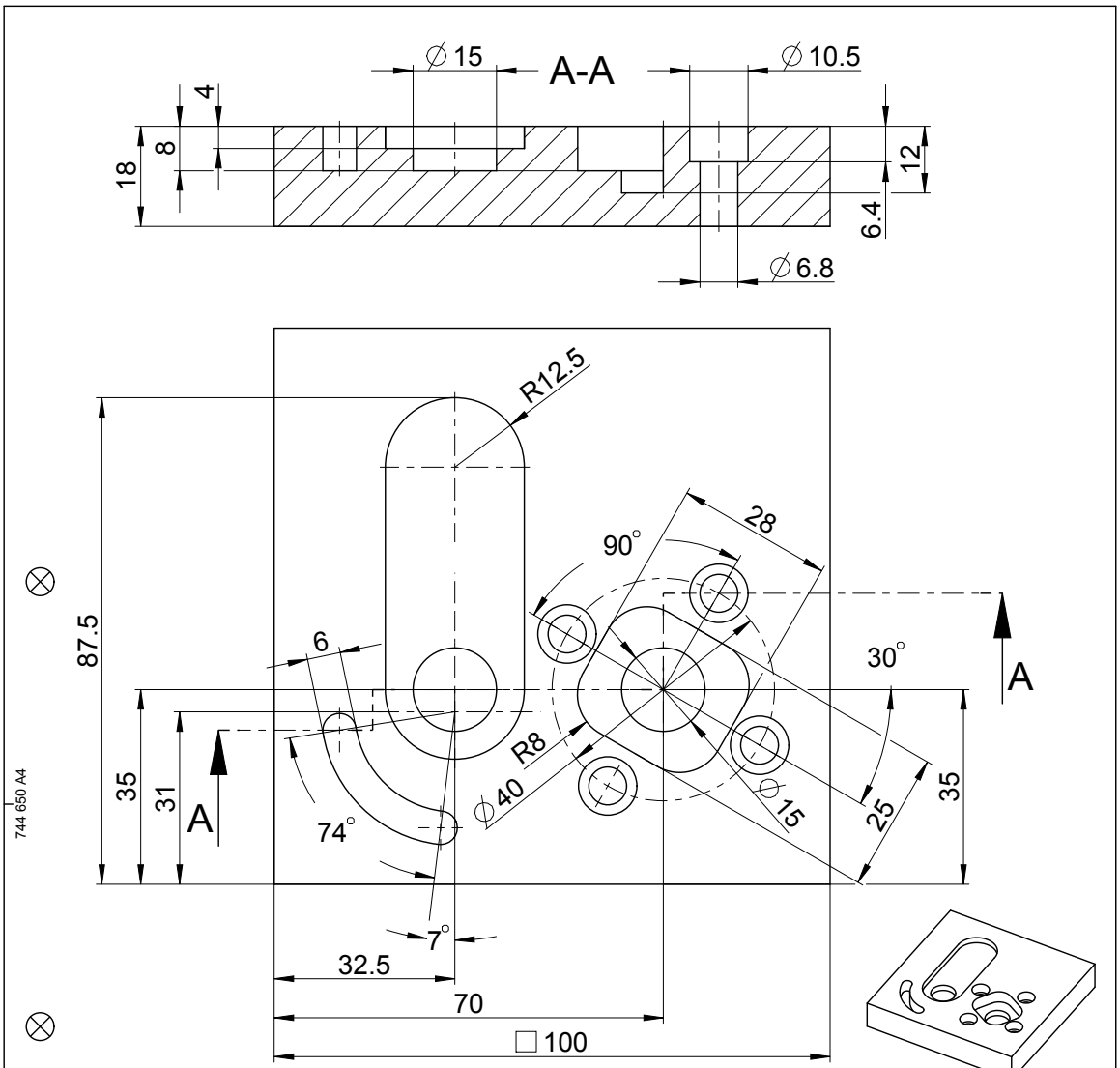
Ø) Diameter
T) Tool number
S) Speed
F_1) Machining feed
F_2) Retraction feed rate
DZ) Max. machining / drilling depth
IZ) Infeed

Solution

```
0  BEGIN PGM 1226669 MM
1  BLK FORM 0.1 Z X+0 Y+0 Z-16
2  BLK FORM 0.2  X+100  Y+100  Z+0
3  TOOL CALL 8 Z S5600 F1100
4  L  Z+100 R0 FMAX M3
5  CYCL DEF 252 CIRCULAR POCKET ~
    Q215=+0          ;MACHINING OPERATION ~
    Q223=+40         ;CIRCLE DIAMETER ~
    Q368=+0.2        ;ALLOWANCE FOR SIDE ~
    Q207= AUTO       ;FEED RATE FOR MILLNG ~
    Q351=+1          ;CLIMB OR UP-CUT ~
    Q201=-5          ;DEPTH ~
    Q202=+5          ;PLUNGING DEPTH ~
    Q369=+0.1        ;ALLOWANCE FOR FLOOR ~
    Q206= AUTO       ;FEED RATE FOR PLNGNG ~
    Q338=+0          ;INFEED FOR FINISHING~
    Q200=+5          ;SET-UP CLEARANCE ~
    Q203=+0          ;SURFACE COORDINATE ~
    Q204=+50         ;2ND SET-UP CLEARANCE ~
    Q370=+0.7        ;TOOL PATH OVERLAP ~
    Q366=+1          ;PLUNGE ~
    Q385= AUTO       ;FINISHING FEED RATE ~
    Q439=+3          ;FEED RATE REFERENCE
6  L  X+65  Y+50 R0 FMAX M99 M8
7  L  Z+100 R0 FMAX
8  TOOL CALL 4 Z S12000 F1000
9  L  Z+100 R0 FMAX M3
10 CYCL DEF 254 CIRCULAR SLOT ~
    Q215=+0          ;MACHINING OPERATION ~
    Q219=+10         ;SLOT WIDTH ~
    Q368=+0.2        ;ALLOWANCE FOR SIDE ~
    Q375=+90         ;PITCH CIRCLE DIAMETR ~
    Q367=+0          ;REF. SLOT POSITION ~
    Q216=+65         ;CENTER IN 1ST AXIS ~
    Q217=+50         ;CENTER IN 2ND AXIS ~
    Q376=+135        ;STARTING ANGLE ~
    Q248=+90         ;ANGULAR LENGTH ~
    Q378=+0          ;STEPPING ANGLE ~
    Q377=+1          ;NR OF REPETITIONS ~
    Q207= AUTO       ;FEED RATE FOR MILLNG ~
    Q351=+1          ;CLIMB OR UP-CUT ~
    Q201=-5          ;DEPTH ~
```

```
    Q202=+5          ;PLUNGING DEPTH ~
    Q369=+0.1        ;ALLOWANCE FOR FLOOR ~
    Q206= AUTO       ;FEED RATE FOR PLNGNG ~
    Q338=+0          ;INFEED FOR FINISHING ~
    Q200=+2          ;SET-UP CLEARANCE ~
    Q203=+0          ;SURFACE COORDINATE ~
    Q204=+50         ;2ND SET-UP CLEARANCE ~
    Q366=+2          ;PLUNGE ~
    Q385= AUTO       ;FINISHING FEED RATE ~
    Q439=+3          ;FEED RATE REFERENCE
11 CYCL CALL M8
12 L  Z+100 R0 FMAX
13 TOOL CALL 2 Z S18000 F1000
14 L  Z+100 R0 FMAX M3
15 CYCL DEF 208 BORE MILLING ~
    Q200=+5          ;SET-UP CLEARANCE~
    Q201=-5          ;DEPTH ~
    Q206= AUTO       ;FEED RATE FOR PLNGNG ~
    Q334=+0.25       ;PLUNGING DEPTH ~
    Q203=+0          ;SURFACE COORDINATE ~
    Q204=+50         ;2ND SET-UP CLEARANCE ~
    Q335=+6          ;NOMINAL DIAMETER ~
    Q342=+0          ;ROUGHING DIAMETER ~
    Q351=+1          ;CLIMB OR UP-CUT
16 CYCL DEF 220 POLAR PATTERN ~
    Q216=+65         ;CENTER IN 1ST AXIS ~
    Q217=+50         ;CENTER IN 2ND AXIS ~
    Q244=+60         ;PITCH CIRCLE DIAMETR. ~
    Q245=+135        ;STARTING ANGLE ~
    Q246=+225        ;STOPPING ANGLE ~
    Q247=+0          ;STEPPING ANGLE ~
    Q241=+3          ;NR OF REPETITIONS ~
    Q200=+5          ;SET-UP CLEARANCE ~
    Q203=+0          ;SURFACE COORDINATE ~
    Q204=+50         ;2ND SET-UP CLEARANCE. ~
    Q301=+1          ;MOVE TO CLEARANCE ~
    Q365=+0          ;TYPE OF TRAVERSE
17 L  Z+100 R0 FMAX
18 L  X+150  Y+150  Z+100 R0 FMAX
19 M30
20 END PGM 1226669 MM
```

2.7 Milling, drilling, and bore milling – 1226672



				ID number
Text:				Change No. C000941-05 Phase: Nicht-Serie
	Original drawing Scale / Format	Platte Plate Einzelteilzeichnung / Component Drawing		Werkstoff: 3.1645 Material:
RoHS	1:1 / A4			●blanke Flächen/Blank surfaces
Maße in mm / Dimensions in mm				
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715		Allgemeintoleranzen ISO 2768-mH ≦6mm: ±0,2 General tolerances ISO 2768-mH ≦6mm: ±0,2	Tolerierung nach ISO 8015 Tolerances as per ISO 8015	Oberflächen nach ISO 1302 Surfaces as per ISO 1302
			Oberflächenbehandlung: Surface treatment:	

HEIDENHAIN	Created	Responsible	Released	Version	Revision	Sheet	Page
DR. JOHANNES HEIDENHAIN GmbH 83301 Traunreut, Germany	M-TS 05.09.2017			D1226672-00-A-01 Document number			1 of 1

Program parameters

Milling of pockets/slots (roughing + finishing)	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
2nd set-up clearance		-	-	+50
Allowance for side	0.2			
Allowance for floor	0.1			
Climb/Up-cut	Climb milling			
Path overlap	0.7			

Drilling / Bore milling	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
2nd set-up clearance		-	-	+50

Tool parameters

	Ø	T	S	F_1	F_2	DZ	IZ
	20	10	4500	1100	2000	-4	4
	12	6	7400	1100	2000	-8	4
	8	4	12000	1000	2000	-6.4	0.25
	6.8	229	6000	840	2000	-12	12
	4	2	18000	1000	2000	-8	4

Ø) Diameter
T) Tool number
S) Speed
F_1) Machining feed
F_2) Retraction feed rate
DZ) Max. machining / drilling depth
IZ) Infeed

Solution

```
0  BEGIN PGM 1226672 MM
1  BLK FORM 0.1 Z X+0 Y+0 Z-18
2  BLK FORM 0.2  X+100  Y+100  Z+0
3  TOOL CALL 10 Z S4500 F1100
4  L  Z+100 R0 FMAX M3
5  CYCL DEF 253 SLOT MILLING ~
    Q215=+0          ;MACHINING OPERATION ~
    Q218=+65         ;SLOT LENGTH ~
    Q219=+25         ;SLOT WIDTH ~
    Q368=+0.2        ;ALLOWANCE FOR SIDE ~
    Q374=-90         ;ANGLE OF ROTATION ~
    Q367=+1          ;SLOT POSITION ~
    Q207= AUTO       ;FEED RATE FOR MILLNG ~
    Q351=+1          ;CLIMB OR UP-CUT ~
    Q201=-4          ;DEPTH ~
    Q202=+4          ;PLUNGING DEPTH ~
    Q369=+0.1        ;ALLOWANCE FOR FLOOR ~
    Q206= AUTO       ;FEED RATE FOR PLNGNG ~
    Q338=+0          ;INFEED FOR FINISHING ~
    Q200=+5          ;SET-UP CLEARANCE ~
    Q203=+0          ;SURFACE COORDINATE ~
    Q204=+50         ;2ND SET-UP CLEARANCE~
    Q366=+2          ;PLUNGE ~
    Q385= AUTO       ;FINISHING FEED RATE ~
    Q439=+3          ;FEED RATE REFERENCE
6  L  X+32.5  Y+87.5 R0 FMAX M99 M8
7  L  Z+100 R0 FMAX
8  TOOL CALL 6 Z S7400 F1100
9  L  Z+100 R0 FMAX M3
10 CYCL DEF 251 RECTANGULAR POCKET ~
    Q215=+0          ;MACHINING OPERATION ~
    Q218=+28         ;1ST SIDE LENGTH ~
    Q219=+25         ;2ND SIDE LENGTH ~
    Q220=+8          ;CORNER RADIUS ~
    Q368=+0.2        ;ALLOWANCE FOR SIDE ~
    Q224=-30         ;ANGLE OF ROTATION ~
    Q367=+0          ;POCKET POSITION ~
    Q207= AUTO       ;FEED RATE FOR MILLNG ~
    Q351=+1          ;CLIMB OR UP-CUT ~
    Q201=-8          ;DEPTH ~
    Q202=+4          ;PLUNGING DEPTH ~
    Q369=+0.1        ;ALLOWANCE FOR FLOOR ~
```

```
    Q206= AUTO          ;FEED RATE FOR PLNGNG~
    Q338=+0             ;INFEED FOR FINISHING ~
    Q200=+5             ;SET-UP CLEARANCE ~
    Q203=+0             ;SURFACE COORDINATE ~
    Q204=+50            ;2ND SET-UP CLEARANCE ~
    Q370=+0.7           ;TOOL PATH OVERLAP ~
    Q366=+1             ;PLUNGE ~
    Q385= AUTO          ;FINISHING FEED RATE ~
    Q439=+3             ;FEED RATE REFERENCE
11 L  X+70  Y+35 R0 FMAX M99 M8
12 L  Z+100 R0 FMAX
13 TOOL CALL 4 Z S12000 F1000
14 L  Z+100 R0 FMAX M3
15 CYCL DEF 208 BORE MILLING ~
    Q200=+5             ;SET-UP CLEARANCE ~
    Q201=-4             ;DEPTH ~
    Q206= AUTO          ;FEED RATE FOR PLNGNG ~
    Q334=+0.25          ;PLUNGING DEPTH ~
    Q203=-4             ;SURFACE COORDINATE ~
    Q204=+50            ;2ND SET-UP CLEARANCE ~
    Q335=+15            ;NOMINAL DIAMETER ~
    Q342=+0             ;ROUGHING DIAMETER ~
    Q351=+1             ;CLIMB OR UP-CUT
16 L  X+32.5  Y+35 R0 FMAX M99 M8
17 L  Z+100 R0 FMAX
18 CYCL DEF 208 BORE MILLING ~
    Q200=+5             ;SET-UP CLEARANCE ~
    Q201=-4             ;DEPTH ~
    Q206= AUTO          ;FEED RATE FOR PLNGNG ~
    Q334=+0.25          ;PLUNGING DEPTH ~
    Q203=-8             ;SURFACE COORDINATE ~
    Q204=+50            ;2ND SET-UP CLEARANCE ~
    Q335=+15            ;NOMINAL DIAMETER ~
    Q342=+0             ;ROUGHING DIAMETER ~
    Q351=+1             ;CLIMB OR UP-CUT
19 L  X+70  Y+35 R0 FMAX M99
20 L  Z+100 R0 FMAX
21 CYCL DEF 208 BORE MILLING ~
    Q200=+5             ;SET-UP CLEARANCE ~
    Q201=-6.4           ;DEPTH ~
    Q206= AUTO          ;FEED RATE FOR PLNGNG~
    Q334=+0.25          ;PLUNGING DEPTH ~
    Q203=+0             ;SURFACE COORDINATE ~
```

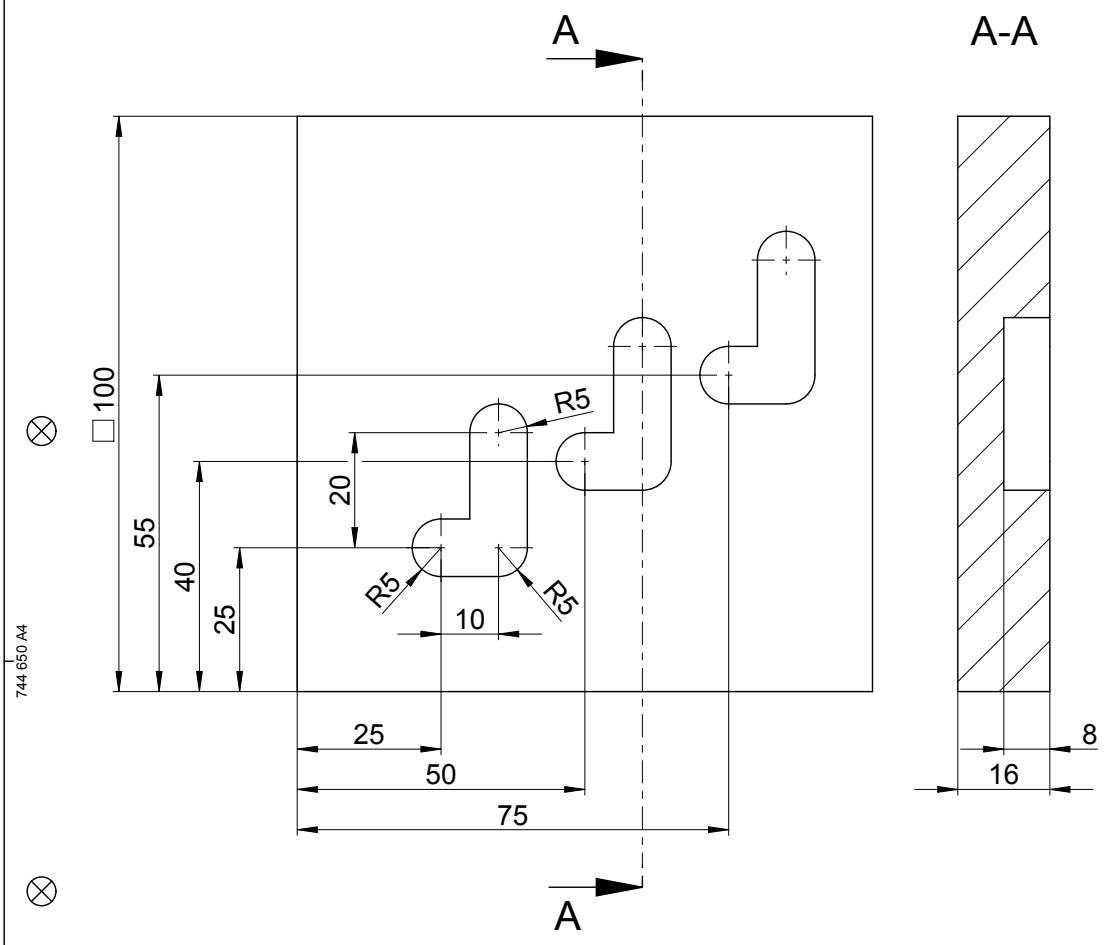
```
Q204=+50          ;2ND SET-UP CLEARANCE ~
Q335=+10.5        ;NOMINAL DIAMETER~
Q342=+0           ;ROUGHING DIAMETER ~
Q351=+1           ;CLIMB OR UP-CUT
22 CYCL DEF 220 POLAR PATTERN ~
Q216=+70          ;CENTER IN 1ST AXIS ~
Q217=+35          ;CENTER IN 2ND AXIS ~
Q244=+40          ;PITCH CIRCLE DIAMETR ~
Q245=-30          ;STARTING ANGLE ~
Q246=+360         ;STOPPING ANGLE ~
Q247=+90          ;STEPPING ANGLE ~
Q241=+4           ;NR OF REPETITIONS ~
Q200=+5           ;SET-UP CLEARANCE~
Q203=+0           ;SURFACE COORDINATE ~
Q204=+50          ;2ND SET-UP CLEARANCE ~
Q301=+1           ;MOVE TO CLEARANCE ~
Q365=+0           ;TYPE OF TRAVERSE
23 L  Z+100 R0 FMAX
24 TOOL CALL 229 Z S6000 F840
25 L  Z+100 R0 FMAX M3
26 CYCL DEF 200 DRILLING ~
Q200=+5           ;SET-UP CLEARANCE ~
Q201=-12          ;DEPTH~
Q206= AUTO        ;FEED RATE FOR PLNGNG ~
Q202=+12          ;PLUNGING DEPTH ~
Q210=+0           ;DWELL TIME AT TOP ~
Q203=-6.4         ;SURFACE COORDINATE ~
Q204=+50          ;2ND SET-UP CLEARANCE ~
Q211=+0           ;DWELL TIME AT DEPTH ~
Q395=+1           ;DEPTH REFERENCE
27 CYCL DEF 220 POLAR PATTERN ~
Q216=+70          ;CENTER IN 1ST AXIS ~
Q217=+35          ;CENTER IN 2ND AXIS ~
Q244=+40          ;PITCH CIRCLE DIAMETR ~
Q245=-30          ;STARTING ANGLE ~
Q246=+360         ;STOPPING ANGLE ~
Q247=+90          ;STEPPING ANGLE ~
Q241=+4           ;NR OF REPETITIONS ~
Q200=+5           ;SET-UP CLEARANCE ~
Q203=-6.4         ;SURFACE COORDINATE ~
Q204=+50          ;2ND SET-UP CLEARANCE ~
Q301=+1           ;MOVE TO CLEARANCE ~
Q365=+0           ;TYPE OF TRAVERSE
```

```
28 L  Z+100 R0 FMAX
29 TOOL CALL 2 Z S18000 F1000
30 L  Z+100 R0 FMAX M3
31 CYCL DEF 254 CIRCULAR SLOT ~
    Q215=+0          ;MACHINING OPERATION ~
    Q219=+6          ;SLOT WIDTH ~
    Q368=+0.2        ;ALLOWANCE FOR SIDE ~
    Q375=+40         ;PITCH CIRCLE DIAMETR ~
    Q367=+0          ;REF. SLOT POSITION ~
    Q216=+32.5       ;CENTER IN 1ST AXIS ~
    Q217=+31         ;CENTER IN 2ND AXIS ~
    Q376=-171        ;STARTING ANGLE ~
    Q248=+74         ;ANGULAR LENGTH ~
    Q378=+0          ;STEPPING ANGLE ~
    Q377=+1          ;NR OF REPETITIONS ~
    Q207= AUTO       ;FEED RATE FOR MILLNG ~
    Q351=+1          ;CLIMB OR UP-CUT ~
    Q201=-8          ;DEPTH~
    Q202=+4          ;PLUNGING DEPTH ~
    Q369=+0.1        ;ALLOWANCE FOR FLOOR ~
    Q206= AUTO       ;FEED RATE FOR PLNGNG ~
    Q338=+0          ;INFEED FOR FINISHING ~
    Q200=+5          ;SET-UP CLEARANCE~
    Q203=+0          ;SURFACE COORDINATE ~
    Q204=+50         ;2ND SET-UP CLEARANCE ~
    Q366=+2          ;PLUNGE ~
    Q385= AUTO       ;FINISHING FEED RATE ~
    Q439=+3          ;FEED RATE REFERENCE
32 CYCL CALL M8
33 L  X+150  Y+150  Z+100 R0 FMAX
34 M30
35 END PGM 1226672 MM
```

3

Programming techniques

3.1 Slot milling – 1082746



				1082746-01
				ID number
Text:				Release number:
	Original drawing Scale	Format	Platte Plate	Werkstoff: Material:
RoHS	1:1	A4		
Maße in mm / Dimensions in mm			Einzelteilzeichnung / Component Drawing	●blanke Flächen/Blank surfaces
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715 -0.3 +0.3		Allgemeintoleranzen ISO 2768-mH ≦6mm: ±0,2 General tolerances ISO 2768-mH ≦6mm: ±0,2	Tolerierung nach ISO 8015 Tolerances as per ISO 8015 Oberflächenbehandlung: Surface treatment:	Oberflächen nach ISO 1302 Surfaces as per ISO 1302

HEIDENHAIN	Created	Responsible	Released	Version	Revision	Sheet	Page
DR. JOHANNES HEIDENHAIN GmbH 83301 Traunreut, Germany	M-TS 21.08.2013			D1082746-00 - A-01 Document number			1 of 1

Program parameters

Milling the slots	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
2nd set-up clearance		-	-	+50
Allowance for side	0.2			
Allowance for floor	0.1			
Climb/Up-cut	Climb milling			

Tool parameters

	Ø	T	S	F_1	F_2	DZ	IZ
	8	4	12000	1000	2000	-8	4

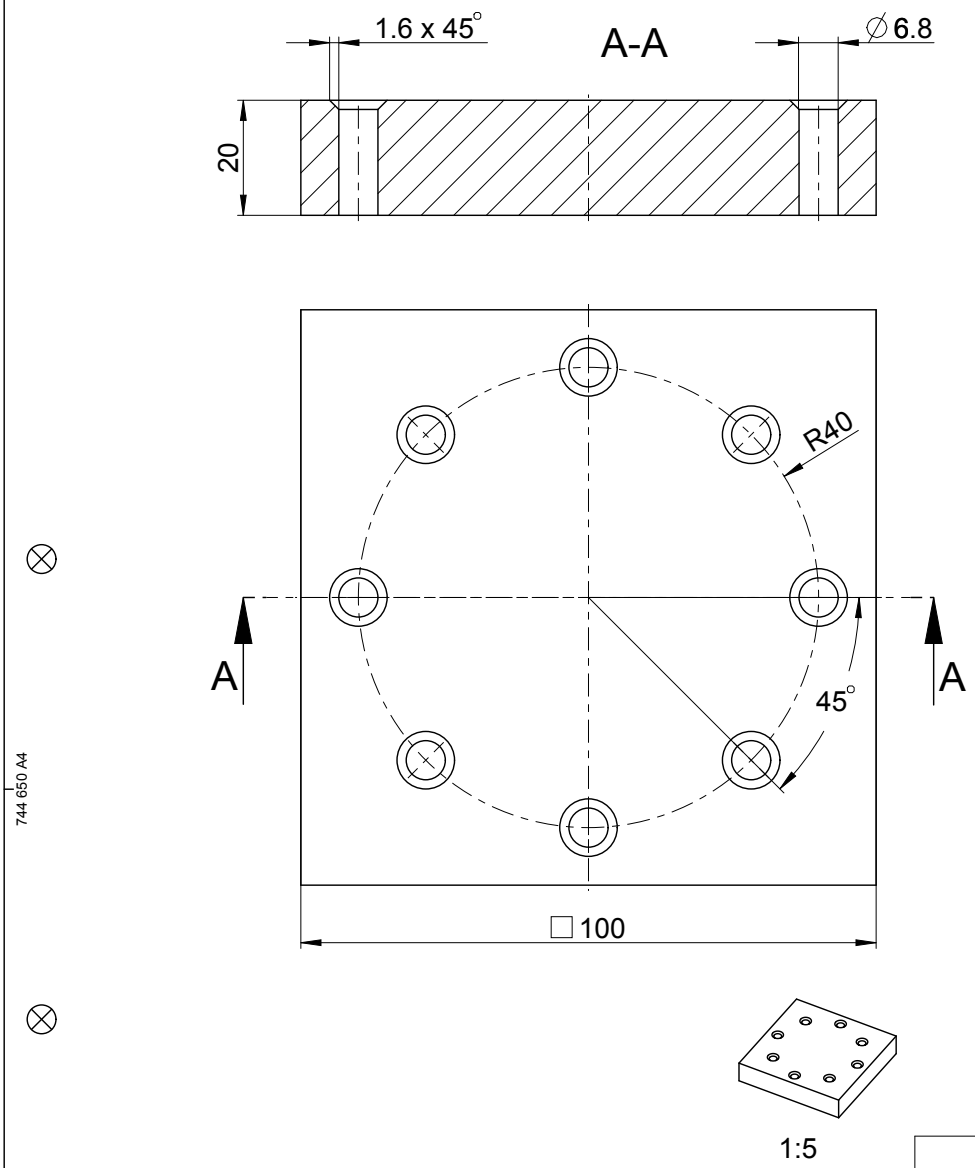
Ø) Diameter
T) Tool number
S) Speed
F_1) Machining feed
F_2) Retraction feed rate
DZ) Max. machining / drilling depth
IZ) Infeed

Solution

```
0  BEGIN PGM 1082746 MM
1  BLK FORM 0.1 Z X+0 Y+0 Z-16
2  BLK FORM 0.2  X+100  Y+100  Z+0
3  TOOL CALL 4 Z S12000 F1000
4  L  Z+100 R0 FMAX M3
5  CYCL DEF 253 SLOT MILLING ~
     Q215=+0          ;MACHINING OPERATION ~
     Q218=+30         ;SLOT LENGTH ~
     Q219=+10         ;SLOT WIDTH ~
     Q368=+0.2        ;ALLOWANCE FOR SIDE ~
     Q374=+90         ;ANGLE OF ROTATION ~
     Q367=+2          ;SLOT POSITION ~
     Q207= AUTO       ;FEED RATE FOR MILLNG ~
     Q351=+1          ;CLIMB OR UP-CUT ~
     Q201=-8          ;DEPTH ~
     Q202=+4          ;PLUNGING DEPTH ~
     Q369=+0.1        ;ALLOWANCE FOR FLOOR ~
     Q206= AUTO       ;FEED RATE FOR PLNGNG ~
     Q338=+0          ;INFEED FOR FINISHING ~
     Q200=+5          ;SET-UP CLEARANCE ~
     Q203=+0          ;SURFACE COORDINATE ~
     Q204=+50         ;2ND SET-UP CLEARANCE ~
     Q366=+2          ;PLUNGE ~
     Q385= AUTO       ;FINISHING FEED RATE ~
     Q439=+3          ;FEED RATE REFERENCE
6  CALL LBL 1
7  CYCL DEF 253 SLOT MILLING ~
     Q215=+0          ;MACHINING OPERATION ~
     Q218=+20         ;SLOT LENGTH ~
     Q219=+10         ;SLOT WIDTH ~
     Q368=+0.2        ;ALLOWANCE FOR SIDE ~
     Q374=+0          ;ANGLE OF ROTATION ~
     Q367=+3          ;SLOT POSITION ~
     Q207= AUTO       ;FEED RATE FOR MILLNG ~
     Q351=+1          ;CLIMB OR UP-CUT ~
     Q201=-8          ;DEPTH ~
     Q202=+4          ;PLUNGING DEPTH ~
     Q369=+0.1        ;ALLOWANCE FOR FLOOR ~
     Q206= AUTO       ;FEED RATE FOR PLNGNG ~
     Q338=+0          ;INFEED FOR FINISHING ~
     Q200=+5          ;SET-UP CLEARANCE ~
     Q203=+0          ;SURFACE COORDINATE ~
```

```
    Q204=+50          ;2ND SET-UP CLEARANCE ~
    Q366=+2           ;PLUNGE ~
    Q385= AUTO        ;FINISHING FEED RATE ~
    Q439=+3           ;FEED RATE REFERENCE
8  CALL LBL 1
9  L  Z+100 R0 FMAX
10 L  X+150  Y+150  Z+100 R0 FMAX
11 M30
12 LBL 1
13 L  X+35  Y+25 R0 FMAX M99 M8
14 L  X+60  Y+40 R0 FMAX M99
15 L  X+85  Y+55 R0 FMAX M99
16 LBL 0
17 END PGM 1082746 MM
```

3.2 Drilling and countersinking – 1206123



				ID number
Text:				Change No. C000941-05 Phase: Nicht-Serie
	Original drawing Scale / Format	Platte Plate		Werkstoff: 3.1645 Material:
RoHS	1:1 / A4			
Maße in mm / Dimensions in mm		Einzelteilzeichnung / Component Drawing		●blanke Flächen/Blank surfaces
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715 -0.3 +0.3	Allgemeintoleranzen ISO 2768-mH ≦6mm: ±0,2 General tolerances ISO 2768-mH ≦6mm: ±0,2		Tolerierung nach ISO 8015 Tolerances as per ISO 8015 Oberflächenbehandlung: Surface treatment:	Oberflächen nach ISO 1302 Surfaces as per ISO 1302

HEIDENHAIN	Created	Responsible	Released	Version	Revision	Sheet	Page
DR. JOHANNES HEIDENHAIN GmbH 83301 Traunreut, Germany	M-TS 14.02.2017			D1206123-00-A-01 Document number			1 of 1

Program parameters

Drilling / Countersinking	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
2nd set-up clearance		-	-	+50
Dwell time at depth	0.1			

Tool parameters

	Ø	T	S	F_1	F_2	DZ	IZ
	6.8	229	6000	840	2000	-21	21
	12	204	4800	340	2000	-5	5

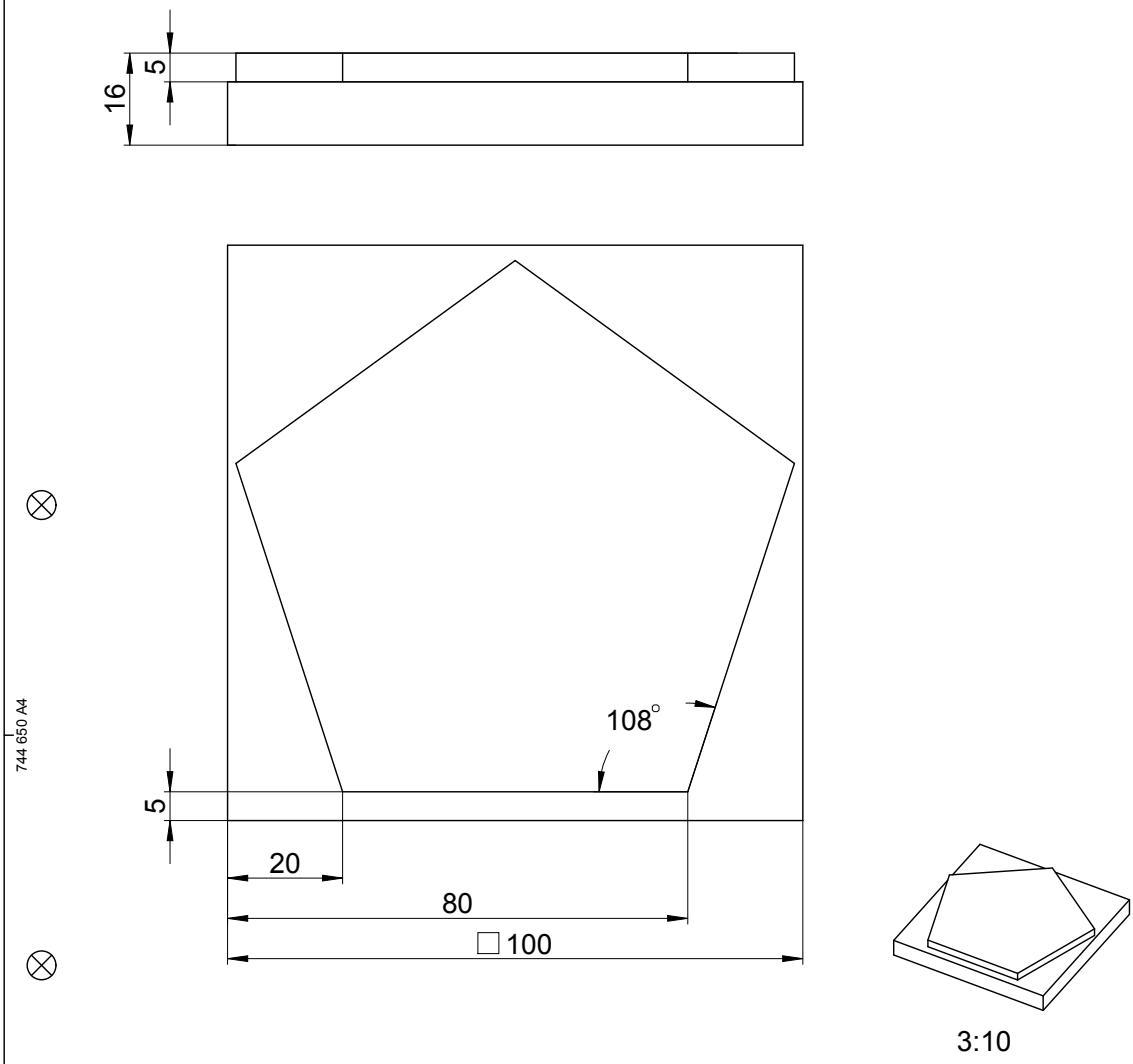
Ø) Diameter
T) Tool number
S) Speed
F_1) Machining feed
F_2) Retraction feed rate
DZ) Max. machining / drilling depth
IZ) Infeed

Solution

```
0  BEGIN PGM 1206123 MM
1  BLK FORM 0.1 Z X+0 Y+0 Z-20
2  BLK FORM 0.2  X+100  Y+100  Z+0
3  TOOL CALL 229 Z S6000 F840
4  L  Z+100 R0 FMAX M3 M8
5  CYCL DEF 200 DRILLING ~
    Q200=+5          ;SET-UP CLEARANCE ~
    Q201=-21         ;DEPTH ~
    Q206= AUTO       ;FEED RATE FOR PLNGNG ~
    Q202=+21         ;PLUNGING DEPTH ~
    Q210=+0          ;DWELL TIME AT TOP ~
    Q203=+0          ;SURFACE COORDINATE ~
    Q204=+50         ;2ND SET-UP CLEARANCE ~
    Q211=+0.1        ;DWELL TIME AT DEPTH ~
    Q395=+1          ;DEPTH REFERENCE
6  CALL LBL 1
7  L  Z+100 R0 FMAX
8  TOOL CALL 204 Z S4800 F340
9  L  Z+100 R0 FMAX M3 M8
10 CYCL DEF 240 CENTERING ~
    Q200=+5          ;SET-UP CLEARANCE ~
    Q343=+1          ;SELECT DIA./DEPTH ~
    Q201=-2          ;DEPTH ~
    Q344=-10         ;DIAMETER ~
    Q206= AUTO       ;FEED RATE FOR PLNGNG ~
    Q211=+0.1        ;DWELL TIME AT DEPTH ~
    Q203=+0          ;SURFACE COORDINATE ~
    Q204=+50         ;2ND SET-UP CLEARANCE
11 CALL LBL 1
12 L  Z+100 R0 FMAX
13 L  X+150  Y+150  Z+100 R0 FMAX
14 M30
15 LBL 1
16 CYCL DEF 220 POLAR PATTERN ~
    Q216=+50         ;CENTER IN 1ST AXIS ~
    Q217=+50         ;CENTER IN 2ND AXIS ~
    Q244=+80         ;PITCH CIRCLE DIAMETR ~
    Q245=+0          ;STARTING ANGLE ~
    Q246=+360        ;STOPPING ANGLE ~
    Q247=+45         ;STEPPING ANGLE ~
    Q241=+8          ;NR OF REPETITIONS ~
    Q200=+5          ;SET-UP CLEARANCE ~
```

```
Q203=+0          ;SURFACE COORDINATE ~
Q204=+50         ;2ND SET-UP CLEARANCE ~
Q301=+1          ;MOVE TO CLEARANCE ~
Q365=+0          ;TYPE OF TRAVERSE
17 LBL 0
18 END PGM 1206123 MM
```

3.3 Contour milling – 1226660



			ID number
Text:			Change No. C000941-05 Phase: Nicht-Serie
Original drawing Scale: 1:1 Format: A4 RoHS	Platte Plate Einzelteilzeichnung / Component Drawing		Werkstoff: 3.1645 Material: ●blanke Flächen/Blank surfaces
Maße in mm / Dimensions in mm			
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715 -0.3 +0.3	Allgemeintoleranzen ISO 2768-mH ≦6mm: ±0,2 General tolerances ISO 2768-mH ≦6mm: ±0,2	Tolerierung nach ISO 8015 Tolerances as per ISO 8015 Oberflächenbehandlung: Surface treatment:	Oberflächen nach ISO 1302 Surfaces as per ISO 1302

HEIDENHAIN	Created	Responsible	Released	Version	Revision	Sheet	Page
DR. JOHANNES HEIDENHAIN GmbH 83301 Traunreut, Germany	M-TS 05.09.2017			D1226660-00-A-01 Document number			1 of 1

Program parameters

Milling an external contour	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
Pre-position		+0	-30	+100
Start/End point of the contour		+20	+5	-
Approach/Departure strategy	Straight line with tangential connection to the contour			
Approach/Departure path	LEN30			
Machining direction	Climb milling			

Tool parameters

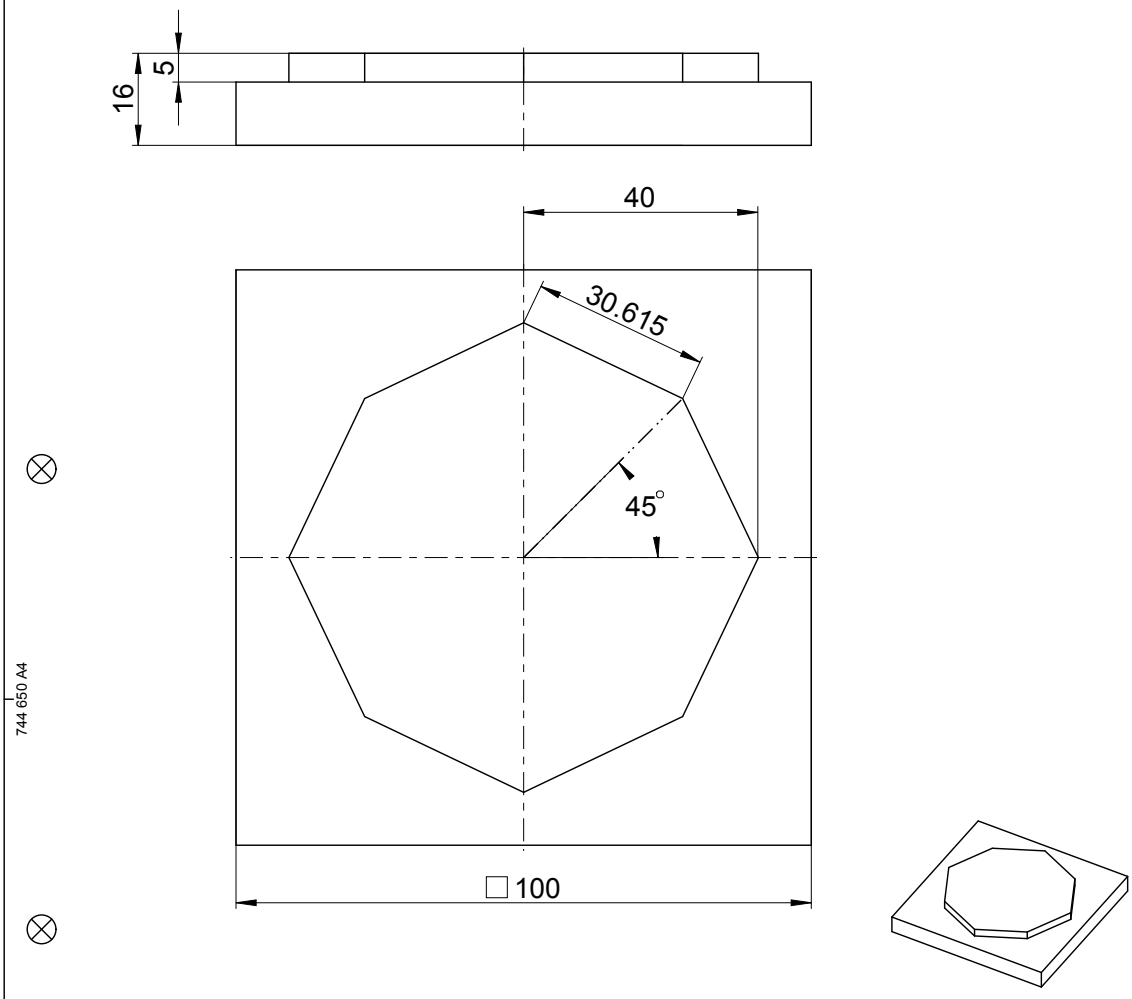
	Ø	T	S	F_1	F_2	DZ	IZ
	20	10	4500	1700	2000	-5	5

Ø) Diameter
T) Tool number
S) Speed
F_1) Machining feed
F_2) Retraction feed rate
DZ) Max. machining / drilling depth
IZ) Infeed

Solution

```
0  BEGIN PGM 1226660 MM
1  BLK FORM 0.1 Z X+0 Y+0 Z-16
2  BLK FORM 0.2  X+100  Y+100  Z+0
3  TOOL CALL 10 Z S4500 F1700
4  L  Z+100 R0 FMAX M3
5  L  X+0  Y-30  Z+5 R0 FMAX M8
6  L  Z-5 R0 F AUTO
7  APPR LT  X+20  Y+5 LEN30 RL
8  CC
9  LP  PR+60  PA+108
10 LBL 1
11 CC
12 LP  PR+60 IPA-72
13 CALL LBL 1 REP3
14 DEP LT LEN30
15 L  Z+5 R0 F2000
16 L  X+150  Y+150  Z+100 R0 FMAX
17 M30
18 END PGM 1226660 MM
```

3.4 Contour milling – 1226658



3:10

			ID number
Text:			Change No. C000941-05 Phase: Nicht-Serie
Original drawing Scale / Format	Platte Plate		Werkstoff: 3.1645 Material:
RoHS / 1:1 / A4			
Maße in mm / Dimensions in mm	Einzelteilzeichnung / Component Drawing		●blanke Flächen/Blank surfaces
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715 -0.3 +0.3	Allgemeintoleranzen ISO 2768-mH ≦6mm: ±0,2 General tolerances ISO 2768-mH ≦6mm: ±0,2	Tolerierung nach ISO 8015 Tolerances as per ISO 8015 Oberflächenbehandlung: Surface treatment:	Oberflächen nach ISO 1302 Surfaces as per ISO 1302

HEIDENHAIN	Created	Responsible	Released	Version	Revision	Sheet	Page
DR. JOHANNES HEIDENHAIN GmbH 83301 Traunreut, Germany	M-TS 05.09.2017			D1226658-00-A-01 Document number			1 of 1

Program parameters

Milling an external contour	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
Pre-position		+0	-70	+100
Start/End point of the contour		+0	-40	-
Approach/Departure strategy	Straight line with tangential connection to the contour			
Approach/Departure path	LEN30			
Machining direction	Climb milling			

Tool parameters

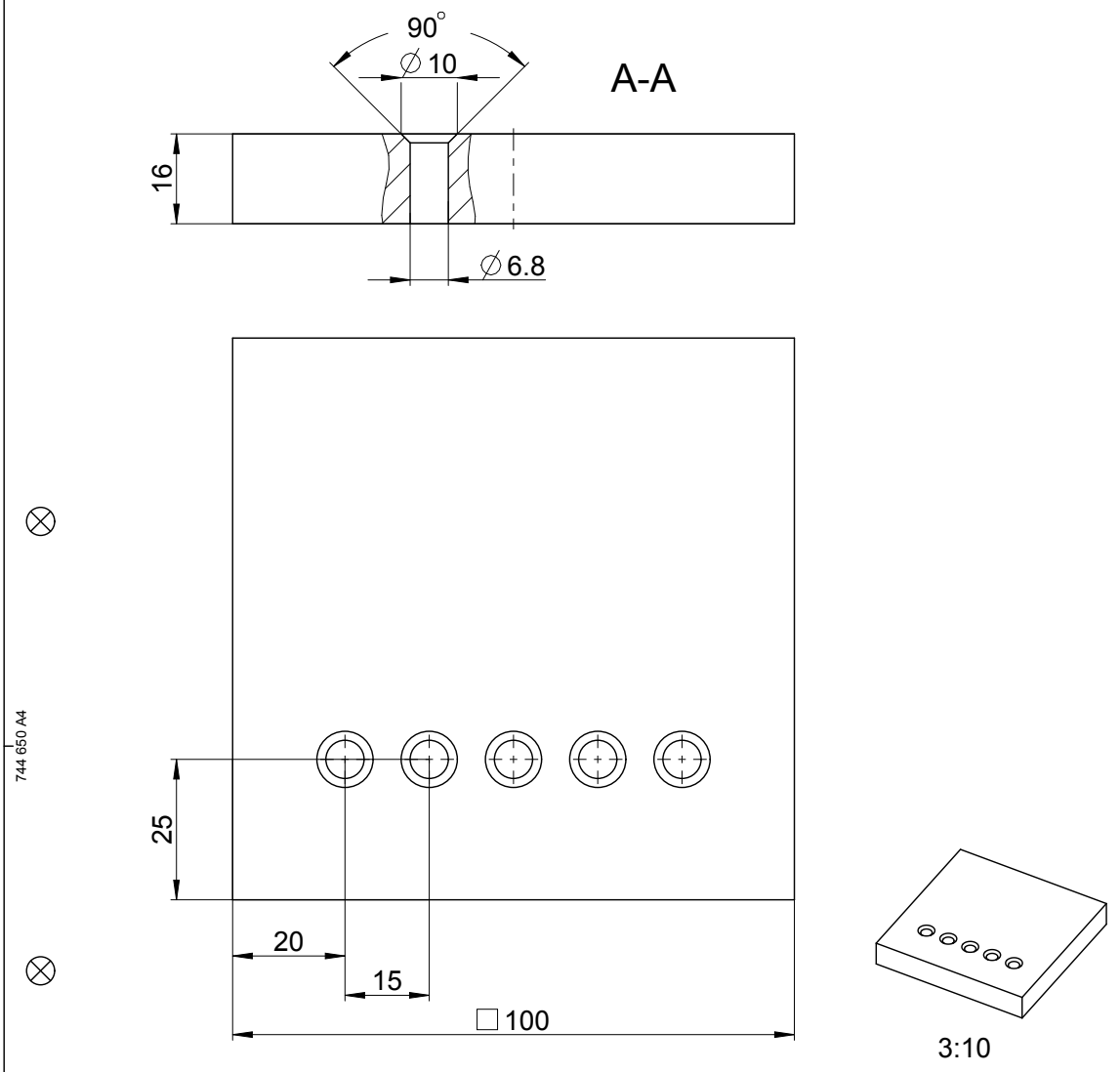
	Ø	T	S	F_1	F_2	DZ	IZ
	20	10	4500	1700	2000	-5	5

Ø) Diameter
T) Tool number
S) Speed
F_1) Machining feed
F_2) Retraction feed rate
DZ) Max. machining / drilling depth
IZ) Infeed

Solution

```
0  BEGIN PGM 1226658 MM
1  BLK FORM 0.1 Z X-50 Y-50 Z-16
2  BLK FORM 0.2  X+50  Y+50  Z+0
3  TOOL CALL 10 Z S4500 F1700
4  L  Z+100 R0 FMAX M3
5  L  X+0  Y-70  Z+5 R0 FMAX M8
6  L  Z-5 R0 F AUTO
7  APPR LT  X+0  Y-40 LEN30 RL
8  CC  X+0  Y+0
9  LP  PR+40  PA+225
10 LBL 1
11 LP  PR+40 IPA-45
12 CALL LBL 1 REP6
13 DEP LT LEN30
14 L  Z+5 R0 F2000
15 L  X+150  Y+150  Z+100 R0 FMAX
16 M30
17 END PGM 1226658 MM
```

3.5 Drilling and countersinking – 1226674



744 650 A4

				ID number
Text:				Change No. C000941-05 Phase: Nicht-Serie
	Original drawing Scale / Format	Platte Plate		Werkstoff: 3.1645 Material:
RoHS	1:1 / A4			
Maße in mm / Dimensions in mm		Einzelteilzeichnung / Component Drawing		●blanke Flächen/Blank surfaces
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715 -0.3 +0.3		Allgemeintoleranzen ISO 2768-mH ≦6mm: ±0,2 General tolerances ISO 2768-mH ≦6mm: ±0,2	Tolerierung nach ISO 8015 Tolerances as per ISO 8015	Oberflächen nach ISO 1302 Surfaces as per ISO 1302
			Oberflächenbehandlung: Surface treatment:	

HEIDENHAIN	Created	Responsible	Released	Version	Revision	Sheet	Page
DR. JOHANNES HEIDENHAIN GmbH 83301 Traunreut, Germany	M-TS 05.09.2017			D1226674-00-A-01 Document number			1 of 1

Program parameters

Drilling / Countersinking	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
2nd set-up clearance		-	-	+50
Dwell time at depth	0.1			

Tool parameters

	Ø	T	S	F_1	F_2	DZ	IZ
	6.8	229	6000	840	2000	-17	17
	12	204	4800	340	2000	-5	5

Ø) Diameter
T) Tool number
S) Speed
F_1) Machining feed
F_2) Retraction feed rate
DZ) Max. machining / drilling depth
IZ) Infeed

Solution

```
0 BEGIN PGM 1226674 MM
1 BLK FORM 0.1 Z X+0 Y+0 Z-16
2 BLK FORM 0.2 X+100 Y+100 Z+0
3 TOOL CALL 229 Z S6000 F840
4 L Z+100 R0 FMAX M3 M8
5 CYCL DEF 200 DRILLING ~
    Q200=+5          ;SET-UP CLEARANCE ~
    Q201=-17         ;DEPTH ~
    Q206= AUTO       ;FEED RATE FOR PLNGNG ~
    Q202=+17         ;PLUNGING DEPTH ~
    Q210=+0          ;DWELL TIME AT TOP ~
    Q203=+0          ;SURFACE COORDINATE ~
    Q204=+50         ;2ND SET-UP CLEARANCE ~
    Q211=+0          ;DWELL TIME AT DEPTH ~
    Q395=+1          ;DEPTH REFERENCE
6 CALL LBL 1
7 L Z+100 R0 FMAX
8 TOOL CALL 204 Z S4800 F340
9 L Z+100 R0 FMAX M3 M8
10 CYCL DEF 240 CENTERING ~
    Q200=+5          ;SET-UP CLEARANCE ~
    Q343=+1          ;SELECT DIA./DEPTH ~
    Q201=-2          ;DEPTH ~
    Q344=-10         ;DIAMETER ~
    Q206= AUTO       ;FEED RATE FOR PLNGNG ~
    Q211=+0.1        ;DWELL TIME AT DEPTH ~
    Q203=+0          ;SURFACE COORDINATE ~
    Q204=+50         ;2ND SET-UP CLEARANCE
11 CALL LBL 1
12 L Z+100 R0 FMAX
13 L X+150 Y+150 Z+100 R0 FMAX
14 M30
15 LBL 1
16 L X+20 Y+25 R0 FMAX M99 M8
17 LBL 2
18 L IX+15 R0 FMAX M99
19 CALL LBL 2 REP3
20 LBL 0
21 END PGM 1226674 MM
```