JOTRON electronics a.s.

RCH-20

Charger for Tron TR20 GMDSS / PLUS

Technical Handbook

Dec.2001

AMENDMENT RECORD

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The information in this book has been carefully checked and is believed to be accurate. However, no responsibility is assumed for inaccuracies.

CAUTION!
This equipment contains CMOS integrated circuits. Observe handling precautions to avoid static discharges which may damage these devices.

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1. SYSTEM DESCRIPTION

General information

RCH-20 is designed to charge the NiMH battery pack for the Tron TR20 GMDSS and Tron TR20 PLUS handheld VHF radios.
It is a dual slot intelligent rapid charger with microprocessor control.
It will fully charge an empty battery pack in less than 4 hours.
It is designed to operate from 12 –24 VDC or 115 / 230VAC with an external adapter.

It is equipped with mounting holes for wall mounting or mounting on a table or shelf.

2. TECHNICAL SPECIFICATION

General

Dual slot rapid charger with trickle charging.
Wall and table mountable.

Operating voltage:	12 - 24VDC (30VDC max) 115/230VAC with external mains adapter.
Current consumption:	< 600mA @12VDC
Charging current: Trickle charge	450 – 500mA (Rapid charge) approx 10mA
Charge termination method:	ΔV, Δt and timeout.
Charging time:	< 4 hours on a fully discharged NiMH battery (X-80059)
Operating temperature range:	0 to +40°C.
Size: Weight :	155mm wide x 69mm height x 83mm depth Approx. 300g

3. FUNCTIONAL DESCRIPTION

Precautions and Warnings

Batteries

The rechargeable battery is of NiMH type with a capacity of 7.2V/1500mAh. The following should be noticed:

- Do not short-circuit, solder, crush, disassemble or incinerate the battery pack. This may result in fire, explosion and severe burn hazard.
- Avoid charging batteries below 0 °C or above 40 °C.

Connectors and cables

When handling connectors and cables, notice the following warnings:

- Do not force plugs in place, as this may damage the pins in the plugs.

Storage and safe handling

Storage temperature range is from –30°C to +70°C and operating temperature is from 0 °C to +40 °C.
Cleaning of the equipment can be done with a cloth soaked in a mixture of ordinary dish-detergent and water.

4. OPERATING INSTRUCTIONS

Operation

The charger RCH-20 is a dual slot quick charger. The charger will accept a complete radio or the battery alone (see fig 4). If two batteries are present, the charger will automatically start fast charging the second battery when the first battery is fully charged. The first battery will then be trickle charged to keep it fully charged.

Fig. 1

The charger operates from 12 – 24 VDC or from 115 / 230 VAC using an appropriate adapter.

When using DC supply, the DC cable (80084) should be used. The connector is a standard 5.5mm AC adaptor type.

To prevent problems with wrong polarity the RCH-20 is designed to be independent of the power supply polarity.

The charger has two LED indicators, one for each battery. They have the following functions:

Flashing orange	-	No battery detected
Flashing red	-	Battery detected, trickle charging
Continuous red	-	Fast charging
Continuous green	-	Battery fully charged, trickle charging

Notes on charging

The battery pack, 80059, is of NiMH type. To get the most out of your battery pack, a few precautions should be taken.

- Always charge the battery to full charge when charging.

- All rechargeable batteries lose charge while stored. The rate is dependent on the temperature. When stored at 25°C a fully charged battery will have more than 50% capacity after a few months, while at 45°C it might be down at 50% after approx one month.

- Although it is possible to charge the battery while the Tron TR20 is switched on it is recommended to charge with the radio switched off. Otherwise the current consumption of the radio may confuse the charger to terminate before full charge is reached.

- If the battery has been totally discharged (below the Tron TR20 switch off threshold), or stored for a long time, the charger may terminate before full charge is reached.
  In this case do as follows:
  - Insert the battery and charge for a few minutes.
  - Discharge the battery by inserting it into the radio, and press PTT a few times.
  - Start charging.

- Never short-circuit, solder, reverse charge, crush, disassemble or incinerate. This may result in fire, explosion and severe burn hazard.

- Avoid charging under 0^{o}C or over 40^{o}C.

5. TECHNICAL DESCRIPTION

Introduction

The Charger consists of 1 printed circuit board.

- Main board (80011)

Main board (80011)

The charger can be divided into following functional blocks:

- Switch mode regulator
- Current measurement circuit
- Voltage measurement circuit
- Temperature measurement circuit
- Charge control circuits

Switch mode regulator
The supply voltage is supplied trough the bridge rectifier D5, to make the charger independent of supply polarity.
The microcontroller (IC1) with software controls all functions in the charger, including the switch mode regulator. The microcontroller operates on 5V, supplied from voltage regulator (IC3).
The switch mode regulator delivers the charging current to the batteries. The switching transistor (Q2 or Q1) is controlled by the PWM (Pulse Width Modulator) output of the microcontroller. The pulse width is adjusted according to the reading from the current measurement circuit.

Current measurement circuit
The current flowing through the batteries will generate a voltage across the resistors R32 – R36. This voltage is amplified by IC2A, and fed to one of the A/D inputs of IC1. The reading from this A/D input is used to correct the duty cycle of the PWM output, and hence adjust the charging current.

Voltage measurement circuit
IC2B and IC2C are used as voltage amplifiers. The offset voltage, supplied from IC2D, is used to give the amplifiers a 0 – 5V output, which is feed to one of the A/D inputs of the microcontroller, IC1. The voltage is used by the microcontroller to detect the ΔV slope which is used for charging termination. The voltage is measured every 120 second, and compared with the previous reading. A negative or no change will terminate the charging.
I addition a voltage above approx. 9.7 V will terminate the charging as well.

Temperature measurement circuit
The NiMH batteries contain a 2.2kohm NTC which is used to measure the temperature of the battery. R15 and R16 act as pull up resistors for the NTC. R30 and 31 is for future use with batteries with different chemistry and a different NTC value.
The voltage from the NTC is fed to one of the A/D inputs of IC1. The reading from this A/D input is used to detect a temperature rise in the batteries, which again will make the charger terminate charging.

Charge control circuits
Each battery position has a separate switch to select charging. Q3 and Q7 are used to switch charging on and off, and are controlled by output ports on IC1, to select which battery is going to be charged. In addition to the voltage and temperature reading, an internal timer is used to terminate the charging if no other termination occurs within approx 4.5 hours.

When there is no battery, or a fully charge battery is placed in the slot, the charger will send short charging pulses to each slot. This is used to detect whether a battery is present in each slot, as well as supplying trickle charge to fully charged batteries. The trickle charge is approx 10mA on average.

Status of the charging is indicated by D1 and D2, which are bicolour LED's. The function of these diodes is explained in chapter 4.

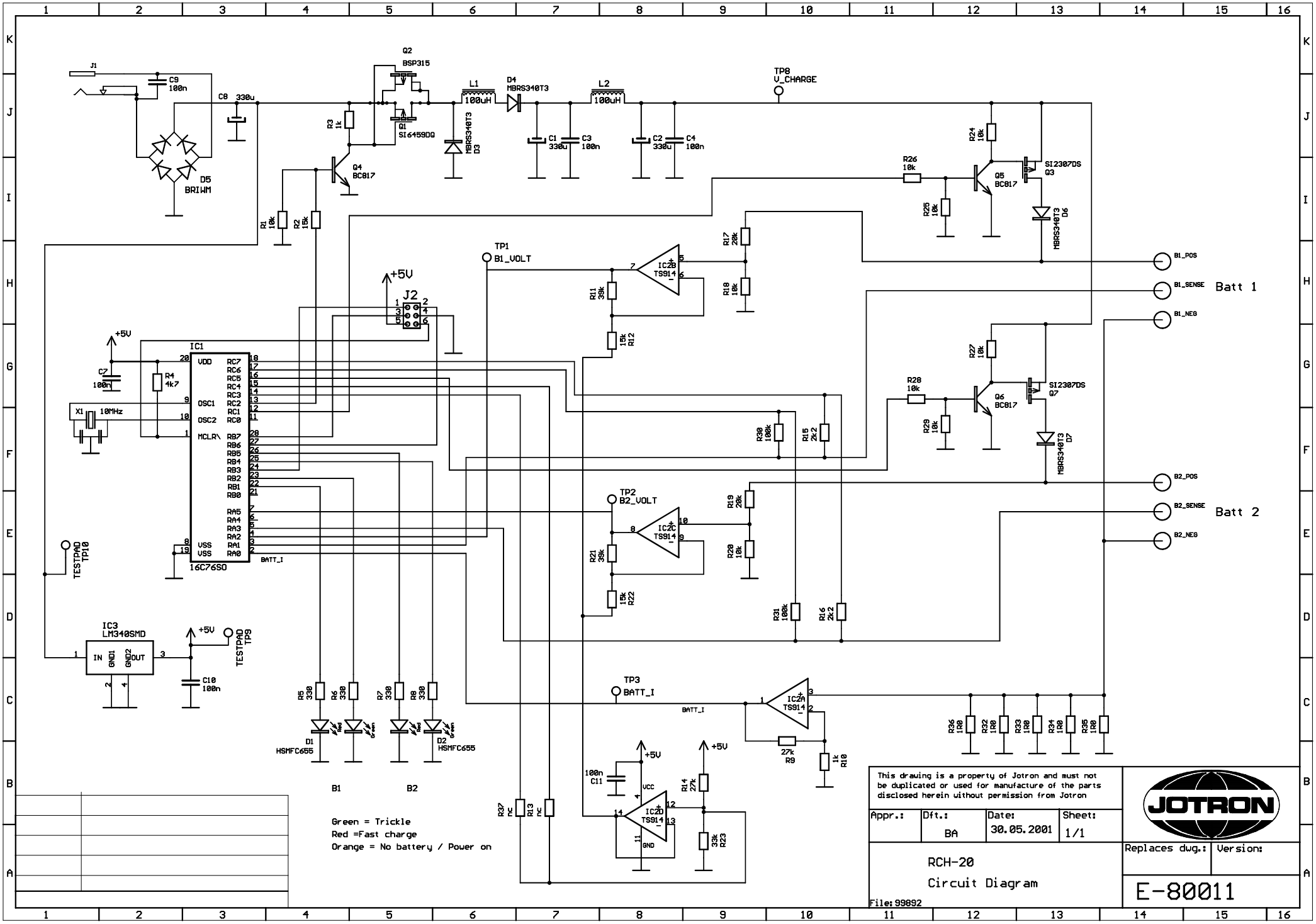
6. MAINTENANCE

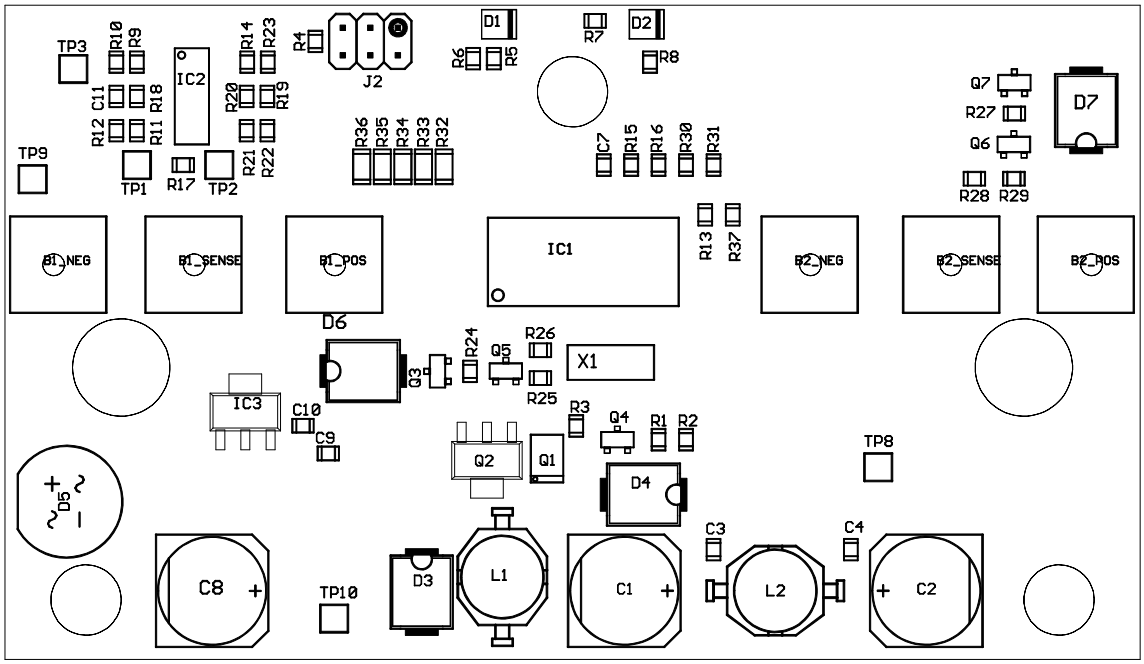
No maintenance is necessary.

7. DIAGRAMS

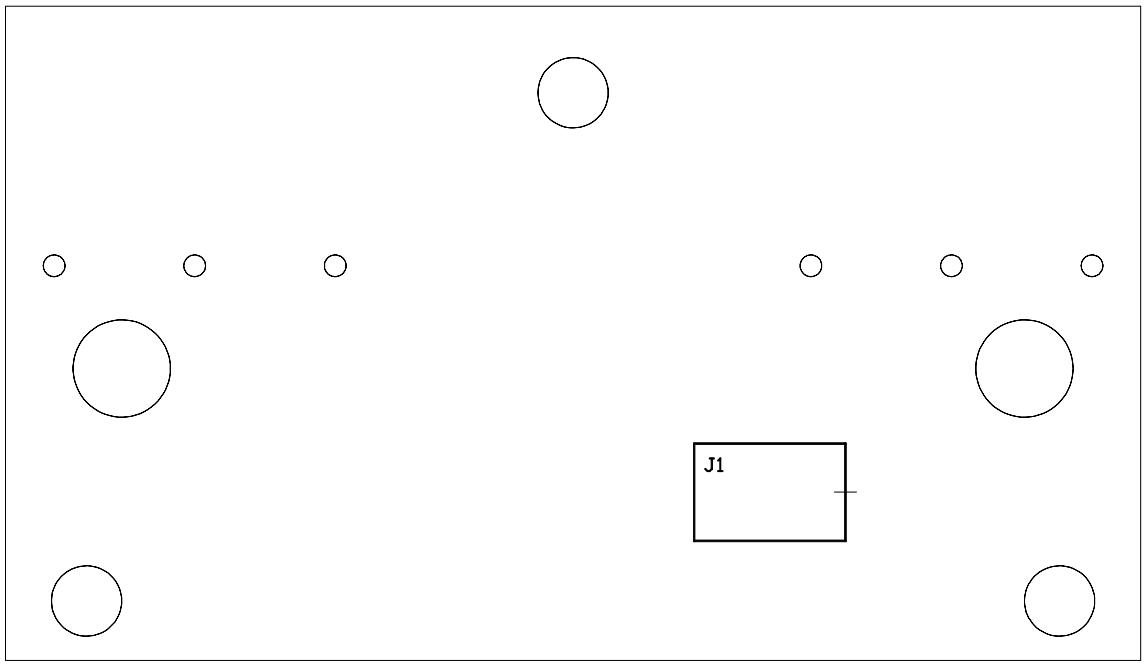
Circuit diagram, Main board	E-80011
Place plan, Main board, part 1	KP-80011-1/2
Place plan, Main board, part 2	KP-80011-2/2

NOTE! The place plan drawings show the maximum configuration for a printed circuit board. For components actually fitted on a printed circuit board, please refer to the parts list for that board.


J1
C9 100n
C8 330u
D5 BRIWM
Q2 BSP315
Q1 SI6459DQ
R3 1k
Q4 BC817
L1 100uH
D4 MBRS340T3
MBRS340T3 D3
L2 100uH
C1 330u
C3 100n
C2 330u
C4 100n
TP8 V_CHARGE
R1 10k
R2 15k
R24 10k
R26 10k
R25 10k
Q5 BC817
SI2307DS Q3
MBRS340T3 D6
TP1 B1_VOLT
+5V
J2
IC2B TS914
R17 20k
R18 10k
R11 39k
R12 15k
B1_POS
B1_SENSE
Batt 1
B1_NEG
IC1
16C76SO
VDD
VSS
OSC1
OSC2
MCLR\
RC7
RC6
RC5
RC4
RC3
RC2
RC1
RC0
RB7
RB6
RB5
RB4
RB3
RB2
RB1
RB0
RA5
RA4
RA3
RA2
RA1
RA0
BATT_I
C7 100n
R4 4k7
X1 10MHz
R27 10k
R28 10k
R29 10k
Q6 BC817
SI2307DS Q7
MBRS340T3 D7
R30 100k
R15 2k2
TP2 B2_VOLT
IC2C TS914
R19 20k
R20 10k
R21 39k
R22 15k
B2_POS
B2_SENSE
Batt 2
B2_NEG
R31 100k
R16 2k2
TESTPAD TP10
IC3 LM340SMD
IN
GND1
GND2
OUT
C10 100n
TESTPAD TP9
R5 330
R6 330
R7 330
R8 330
D1 HSMFC655
D2 HSMFC655
TP3 BATT_I
IC2A TS914
27k R9
1k R10
R36 100
R32 100
R33 100
R34 100
R35 100
R37 nc
R13 nc
C11 100n
IC2D TS914
VCC
GND
R14 27k
33k R23
B1
B2
Green = Trickle
Red =Fast charge
Orange = No battery / Power on
This drawing is a property of Jotron and must not be duplicated or used for manufacture of the parts disclosed herein without permission from Jotron
Appr.:
Dft.: BA
Date: 30.05.2001
Sheet: 1/1
RCH-20
Circuit Diagram
File: 99892
JOTRON
Replaces dwg.:
Version:
E-80011



Material:			This drawing is a property of Jotron and must not be duplicated or used for manufacture of the parts disclosed herein without permission from Jotron
Tolerance: (when not otherwise shown)			Scale:
Appr.:	Dft.: BA	Date: 30.05.2001	
RCH-20 Charger board Component placement, Top layer			Replaces dwg.: 17.1.2001 Repl. by dwg.: KP-80011-1 Rev.:0115



Material:			This drawing is a property of Jotron and must not be duplicated or used for manufacture of the parts disclosed herein without permission from Jotron
Tolerance: (when not otherwise shown)			Scale:
Appr.:	Dft.: BA	Date: 17.1.2001	
RCH-20 Charger board Component placement, Bottom layer			Replaces dwg.: / Repl. by dwg.:
			KP-80011-2

8. PARTS LISTS

- Part list, Complete Charger BOM-99920
- Part list, Main Board BOM-80011

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Bill Of Material

Date 17.12.2001

Item 99920 BATTERY CHARGER 12/24VDC FOR Tron ˚ Manufacturing

Version

Item	Name / Description	Makes no. / Additional name	Sub pos.
80011	Electronic unit, RCH-20		1
80084	DC CABLE FOR RCH-20		10
80357	LABEL FOR PACKINGBOX LADER	TR-20	11
80061	Etikett til RCH-20 batteri lader	Fascal 805, Orange/Sort txt	2
99886	BATTERILADER - BUNNDEL	Cycoloy C2100 HF Sort	3
99887	Spring, 3.0 x 2.4 x10mm, BeCu		4
99888	KONTAKTPINNE I LADER	RCH-20	5
99889	LYSLEDER I LADER	RCH-20	6
99916	Hjelpesnepp lader	Cycoloy C2100 HF Sort	7
99883	BATTERILADER, TOPPDEL	Cycoloy C2100 HF Sort	8
99890	PT.SCREW SENKH. KB30X30	EJOT-PT KB30x30 WN 1452	9

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Date 17.12.2001

Item **80011** **Electronic unit, RCH-20** **Design**

Version

Item	Name / Description	Makes no. / Additional name	Sub pos.
99123	CAP.EL 330uF/25V 10X10 SMD	ELNA RVH25V331MVH-10-R	C001
99123	CAP.EL 330uF/25V 10X10 SMD	ELNA RVH25V331MVH-10-R	C002
93225	CHIP CAP 100nF 50V X7R 10% - 0805	MURATA GRM40 X7R 104 K50	C003
93225	CHIP CAP 100nF 50V X7R 10% - 0805	MURATA GRM40 X7R 104 K50	C004
OMIT	Utgår		C005
OMIT	Utgår		C006
93225	CHIP CAP 100nF 50V X7R 10% - 0805	MURATA GRM40 X7R 104 K50	C007
99123	CAP.EL 330uF/25V 10X10 SMD	ELNA RVH25V331MVH-10-R	C008
93225	CHIP CAP 100nF 50V X7R 10% - 0805	MURATA GRM40 X7R 104 K50	C009
93225	CHIP CAP 100nF 50V X7R 10% - 0805	MURATA GRM40 X7R 104 K50	C010
93225	CHIP CAP 100nF 50V X7R 10% - 0805	MURATA GRM40 X7R 104 K50	C011
80031	LED SMD bicolor Red/Green, HSMF-C155	HP HSMF-C155	D001
80031	LED SMD bicolor Red/Green, HSMF-C155	HP HSMF-C155	D002
94704	DIODE ,Schottky, smd, 3A ,MBRS340T3	Motorola MBRS340T3	D003
94704	DIODE ,Schottky, smd, 3A ,MBRS340T3	Motorola MBRS340T3	D004
96655	BRIDGE RECTIFIER	Micro El. WO-005G	D005
94704	DIODE ,Schottky, smd, 3A ,MBRS340T3	Motorola MBRS340T3	D006
94704	DIODE ,Schottky, smd, 3A ,MBRS340T3	Motorola MBRS340T3	D007
80055	PIC16F73-I/SO	Microchip PIC 16F73-I/SO	IC001
99262	TS914, Quad R/R CMOS OpAmp	2.7-16Volt, SO14, -40 to +125°C	IC002
99644	Voltage regulator 5 V , SOT223	National LM340MP-5.0	IC003
80032	DC Power Jack Ø=5.5, ø= 2.0 mm, LD-0202	Lih Sheng LD-0202	J001
99807	TERM. STRIP, 2,54mm, 2x3pin, l=11mm	Samtec TSW103-07TD	J002
99124	INDUCTOR POWER 100uH/1.2A SMD	PULSE P0752.104T	L001
99124	INDUCTOR POWER 100uH/1.2A SMD	PULSE P0752.104T	L002
99892	PCB I LADER	TRON VHF MkII	PCB
OMIT	Utgår		Q001
97787	P-FET, SOT-223	Siemens BSP315	Q002
99762	SI2307, P-MFET,30V, 80mOhm@10V, SOT-23	Siliconix SI2307DS	Q003
94443	TRANSISTOR BC 817 SOT-23	PHILIPS BC817,215	Q004
94443	TRANSISTOR BC 817 SOT-23	PHILIPS BC817,215	Q005
94443	TRANSISTOR BC 817 SOT-23	PHILIPS BC817,215	Q006
99762	SI2307, P-MFET,30V, 80mOhm@10V, SOT-23	Siliconix SI2307DS	Q007
93280	CR 0805 10k 1%	ROHM MCR10 EZH F-1002	R001
93284	CR 0805 15k 1%	ROHM MCR10 EZH F-1502	R002
93256	CR 0805 1k0 1%	ROHM MCR10 EZH F-1001	R003
93272	CR 0805 4k7 1%	ROHM MCR10 EZH F-4701	R004
93244	CR 0805 330R 1%	ROHM MCR10 EZH F-3300	R005
93244	CR 0805 330R 1%	ROHM MCR10 EZH F-3300	R006
93244	CR 0805 330R 1%	ROHM MCR10 EZH F-3300	R007
93244	CR 0805 330R 1%	ROHM MCR10 EZH F-3300	R008
93290	CR 0805 27k 1%	ROHM MCR10 EZH F-2702	R009
93256	CR 0805 1k0 1%	ROHM MCR10 EZH F-1001	R010
93294	CR 0805 39k 1%	ROHM MCR10 EZH F-3902	R011
93284	CR 0805 15k 1%	ROHM MCR10 EZH F-1502	R012

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Bill Of Material

Date 17.12.2001

Item **80011** **Electronic unit, RCH-20** **Design**

Version

Item	Name / Description	Makes no. / Additional name	Sub pos.
OMIT	Utgår		R013
93290	CR 0805 27k 1%	ROHM MCR10 EZH F-2702	R014
93264	CR 0805 2k2 1%	ROHM MCR10 EZH F-2201	R015
93264	CR 0805 2k2 1%	ROHM MCR10 EZH F-2201	R016
93287	CR 0805 20k 1%	ROHM MCR10 EZH F-2002	R017
93280	CR 0805 10k 1%	ROHM MCR10 EZH F-1002	R018
93287	CR 0805 20k 1%	ROHM MCR10 EZH F-2002	R019
93280	CR 0805 10k 1%	ROHM MCR10 EZH F-1002	R020
93294	CR 0805 39k 1%	ROHM MCR10 EZH F-3902	R021
93284	CR 0805 15k 1%	ROHM MCR10 EZH F-1502	R022
93292	CR 0805 33k 1%	ROHM MCR10 EZH F-3302	R023
93280	CR 0805 10k 1%	ROHM MCR10 EZH F-1002	R024
93280	CR 0805 10k 1%	ROHM MCR10 EZH F-1002	R025
93280	CR 0805 10k 1%	ROHM MCR10 EZH F-1002	R026
93280	CR 0805 10k 1%	ROHM MCR10 EZH F-1002	R027
93280	CR 0805 10k 1%	ROHM MCR10 EZH F-1002	R028
93280	CR 0805 10k 1%	ROHM MCR10 EZH F-1002	R029
93304	CR 0805 100k 1%	ROHM MCR10 EZH F-1003	R030
93304	CR 0805 100k 1%	ROHM MCR10 EZH F-1003	R031
97180	RC-01 1R	PHILIPS 2322 711 61108	R032
97180	RC-01 1R	PHILIPS 2322 711 61108	R033
97180	RC-01 1R	PHILIPS 2322 711 61108	R034
97180	RC-01 1R	PHILIPS 2322 711 61108	R035
97180	RC-01 1R	PHILIPS 2322 711 61108	R036
80052	10 MHz Ceramic resonator	MURATA CSTCC 10.00MHZ MG	X001

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