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FCC CERTIFICATION TEST REPORT
ON
Union Switch & Signal Inc.
4.5 MHz Transponder
MODEL L34000 0000
FCC ID: J8C7869C9554J

CUSTOMER NAME: Union Switch & Signal Inc.

CUSTOMER P.O.: T97H10D44

DATE OF REPORT: December 29, 1998

TEST REPORT NO.: R-7864-2

TEST START DATE: October 13, 1998

TEST FINISH DATE: December 22, 1998

TEST TECHNICIAN: P. Krauss

TEST ENGINEER: T. Schneider

SUPERVISOR: R. Reitz

REPORT PREPARED BY: T. Schneider

GOVERNMENT SOURCE INSPECTION: Not Applicable

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CERTIFICATION AND SIGNATURES

We certify that this report is a true representation of the results obtained from the tests of the equipment stated. We further certify that the measurements shown in this report were made in accordance with the procedures indicated and vouch for the qualifications of all Retlif Testing Laboratories personnel taking them.

Thomas J. Schneider
EMC Test Engineer

Richard J. Reitz
Laboratory Manager

NON-WARRANTY PROVISION
The testing services have been performed, findings obtained and reports prepared in accordance with generally accepted laboratory principles and practices. This warranty is in lieu of all others, either expressed or implied.

NON-ENDORSEMENT
This test report contains only findings and results arrived at after employing the specific test procedures and standards listed herein. It is not intended to constitute a recommendation, endorsement or certification of the product or material tested.

ADMINISTRATIVE DATA

RETLIF TESTING LABORATORIES TEST REPORT NUMBER: R-7864-2

TEST SPECIFICATION: FCC Part 15, Subpart C
Section 15.223

CUSTOMER: Union Switch & Signal Inc.
645 Russel Street
Batesburg, SC 29006

TEST SAMPLE: 4.5 MHz Transponder Model L34000 0000
FCC ID: J8C7869C9554J

APPLICABLE DOCUMENTS: FCC Part 2
FCC Part 15
ANSI C63.4:1992

CLASSIFICATION: Not Classified

TESTING DATES: October 13, 1998 TO December 22, 1998

DATE OF REPORT: December 29, 1998

APPLICATION FOR CERTIFICATION - 2.1033

2.1033 (a), 731 Form

Attached

2.1033 (b)(1), Manufacturer

Union Switch & Signal Inc.
645 Russel Street
Batesburg, SC 29006

2.1033 (b)(1), Applicant

Union Switch & Signal Inc.
645 Russel Street
Batesburg, SC 29006

2.1033 (b)(2), FCC Identifier

J8C7869C9554J

2.1033 (b)(3), Installation and Operating Instructions

See Exhibit 2

2.1033 (b)(4), Circuit Description

See Exhibit 3

2.1033 (b)(5), Block and Schematic Diagrams

See Exhibit 4

2.1033 (b)(6), Report of Measurements

See Exhibit 5

2.1033 (b)(7), Equipment Photographs and FCC ID Label

See Exhibit 1

APPLICATION FOR CERTIFICATION - 2.1033 (con't.)

2.1033 (b)(8), Peripheral Equipment

The device did not require any peripheral equipment.

2.1033 (b)(9), Transition Requirements

The device is being certified pursuant to the current FCC requirements.

2.1033 (b)(10), EBS Requirements

Not Applicable

2.1033 (b)(11), Processing Gain & frequency Hopping Requirements

Not Applicable

2.1033 (b)(12), Certification of Scanning Receivers

Not Applicable

2.1033 (c), Composite Devices

Not Applicable

EXHIBIT 5

REPORT OF MEASUREMENTS

2.1033 (b)(6)

Retlif Testing Laboratories

Test Report Number R-7864-2

REPORT OF MEASUREMENTS

GENERAL

Applicant:	Union Switch & Signal Inc.
Device:	4.5 MHz Transponder
Model:	L34000 0000
Serial Number:	NA
FCC ID:	J8C7869C9554J
Input Power Requirements:	Derives power from 27.115 MHz transmitter as it passes over the transponder
Rule Section:	Part 15, Subpart C, Section 15.223

TEST METHODS PERFORMED

15.223 (a) Radiated Emissions within the 1.705-10.0 MHz band

15.223 (a) 6 dB Bandwidth Measurement

15.223 (b) Radiated Emissions, Spurious Emissions, 9.0 kHz to 272 MHz

TEST RESULTS

15.223 (a) The device operates within the 1.705 to 10.0 MHz frequency band. The bandwidth, as measured 6 dB down from the modulated carrier was less than 10 % of the center frequency. Therefore, the field strength limit was reduced to 15 microvolts per meter at a distance of thirty meters. However, measurements were recorded at three meters and extrapolated to 30 meters using the square of the inverse linear distance extrapolation factor as specified in 15.31(f)(2). The Peak field strength of the fundamental emission did not exceed 1500 microvolts per meter at three meters.

15.223 (b) The emissions radiated outside of the specified frequency band of 1.705 to 10.0 MHz did not exceed the general radiated emission limits of 15.209.

NOTES

15.31 (a)(b)	All measurements were made in accordance with ANSI C63.4:1992.
15.31 (c)	The device does not use swept frequency techniques.
15.31 (d)	All testing was performed at Delaware Car Companies facility in Wilmington DE. The device was installed under three representative train locomotives. Please refer to Figures 1 thru 3 of this report for a detailed description of test layout.
15.31 (e)	The transponder derives its operating voltages from the train mounted 27.115 MHz transmitter, which in turn derives its 72 VDC operating voltage from on board 72 VDC battery. The transponder was tested while the 27.115 MHz transmitter was drawing from the 72 VDC batteries on board the locomotive. NOTE: The purpose of the 27.115 MHz transmitter is to transfer energy to the transponder in order to power it. No data is transmitted.
15.31 (f)(1)	Where testing was performed at distances other than the specified test distance, the obtained readings were extrapolated to the specified test distance using an inverse linear-distance extrapolation factor (20dB / decade) for measurements between 30 MHZ and 40 GHz. For measurements at frequencies below 30 MHz, an inverse linear-distance squared factor (40dB / decade) was utilized.
15.31 (f)(5)	Measurements were performed at 16 radials, three meters from the envelope occupied by the locomotive under which the transponder was mounted.. The maximum field strength observed has been reported.
15.31 (g)	The transponder has no adjustable controls which are accessible to the consumer.
15.31 (m)	The device operates at a single frequency of 4.5 MHz.
15.31 (o)	All emissions within 20 dB of the specified limits have been reported unless otherwise stated.
15.33 (a)(1)	The device operates below 10 GHz at a frequency of 4.5 MHz. Therefore radiated emissions measurements were made from 9.0 kHz to 272 MHz, the tenth harmonic of the 27.115 MHz transmitter which powers the transponder.

FCC 15.223 RADIATED EMISSIONS 4.5 MHz TRANSMITTER

PURPOSE

The Model L34000 0000 track mounted transponder's fundamental field strength and spurious case emissions were measured from 9 kHz to 272 MHz in order to determine compliance with the limits specified in FCC Part 15, Subpart C.

LIMITS

The limits listed in the table below were used to determine if the equipment complies with the requirements of FCC Part 15. These limits were derived from sections 15.209 and 15.223:

FREQUENCY (MHz)	FIELD STRENGTH (MICROVOLTS/METER) AT 3 METERS
0.009-0.490	24,000,000/F (kHz)
0.490-1.705	2,400,000/F (kHz)
1.705-10.0	1500*
10.0-30.0	3000
30-88	100
88-216	150
216-272	200

*- limit specified for 6 dB bandwidth of fundamental equal to 53 kHz

TEST SETUP

The Model L34000 0000, 4.5 MHz transmitter was mounted between the rails, underneath the locomotive, directly below the 27.115 MHz transmitter. The device derives its power from the 27.115 MHz transmitter and requires no external power source or cabling. The locomotive was located on the track in Delaware Car Company's facility in Wilmington,

TEST SETUP(continued)

Delaware. The measurement antenna was placed three meters from the envelope occupied by the locomotive under which the transponder was mounted, at one of the 16 equidistant positions . The measurement antenna was connected to the spectrum analyzer via a fifty ohm coaxial cable. This test setup was based on the requirements of FCC Part 15, paragraph 15.31(d) for measurements made at the installation site and ANSI C63.4-1992 for methods of measurement of radio noise for intentional radiators. Refer to Figures 1 through 3 herein for the general test setup for each locomotive during testing.

TEST PROCEDURE

With the test setup as specified above the following procedure was performed:

1. The loop antenna was mounted on a tripod at a 1 meter vertical height, at the position closest to the 4.5 MHz transmit antenna.
2. The spectrum analyzer was configured to measure the fundamental transmit frequency using a peak detector.
3. The loop antenna was rotated 360 degrees until the maximum reading was obtained on the spectrum analyzer. The orientation of loop was changed to horizontal and it was again rotated 360 degrees until the maximum reading was obtained.
4. The antenna position, orientation, meter reading, and antenna factor was recorded.
5. Steps 2 thru 4 were repeated at the 15 remaining positions around the locomotive.
6. The 6 dB bandwidth of the fundamental transponder frequency was measured in order to determine the limit as specified in FCC 15.223(a).
7. The spectrum analyzer was configured to measure emissions in the 9 kHz to 150 kHz range.
8. Steps 3 thru 5 were repeated for each emission found in the 9 kHz to 150 kHz range.
9. The spectrum analyzer was configured to measure the 150 kHz to 30 MHz range.
10. Steps 3 thru 5 were repeated for each emission found within the 150 kHz to 30 MHz range excluding the fundamental transmit frequency.

TEST PROCEDURE (continued)

11. The loop antenna and tripod were replaced with the biconical antenna and a mast which varied the antenna height from 1 to 4 meters.

12. The biconical antenna, vertically polarized, was placed at the first antenna location and the analyzer was configured to measure emissions in the 30 MHz to 200 MHz range.

13. At each frequency that an emission was found, the following steps were performed:

    a. The antenna height was varied from 1 to 4 meters.

    b. The antenna was horizontally polarized, and height varied from 1 to 4 meters.

14. When the maximum meter reading was achieved, the meter reading, antenna factor, antenna polarization, and antenna height was recorded.

15. Steps 12 thru 14 were repeated for each of the 15 remaining positions.

16. The biconical antenna was replaced by the log periodic antenna, and the spectrum analyzer was configured to measure the 200 MHz to 272 MHz range. Steps 12 thru 15 were repeated.

17. Steps 1 thru 16 were repeated with the transponder mounted below the two remaining locomotives.

TEST RESULTS

The 4.5 MHz transponder, Model L320440000, was found to comply with the limits of section 15.223 of the FCC rules when measured at three meters.

No spurious case emissions within 20 dB of the limit were detected. See the 7 pages following for a more complete presentation of the results.

Figure 1

GENERAL TEST CONFIGURATION FOR THE F40PH

DIESEL LOCOMOTIVE #4116

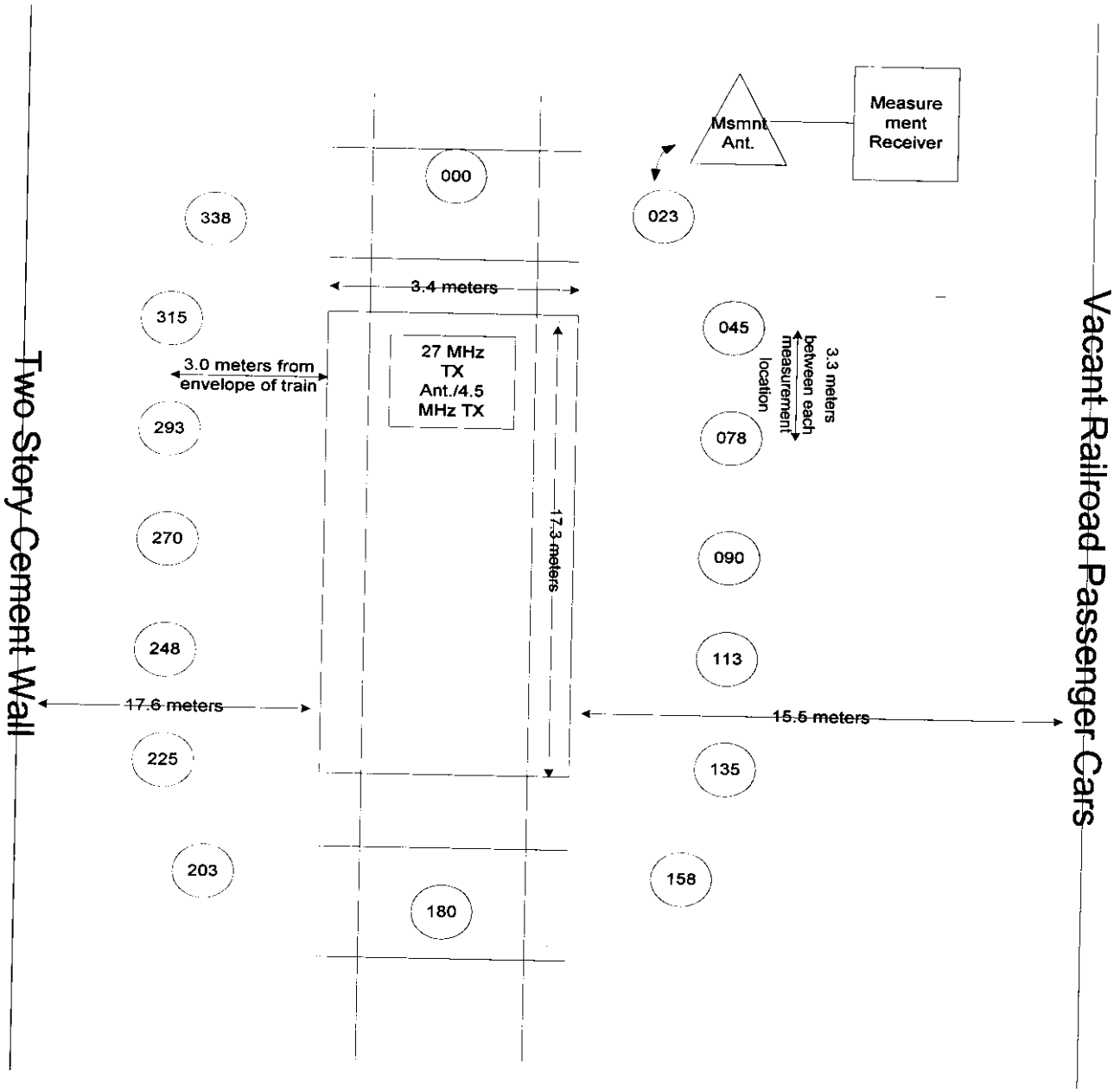


Figure 2

GENERAL TEST CONFIGURATION FOR THE ARROW III

ELECTRIC LOCOMOTIVE #1327

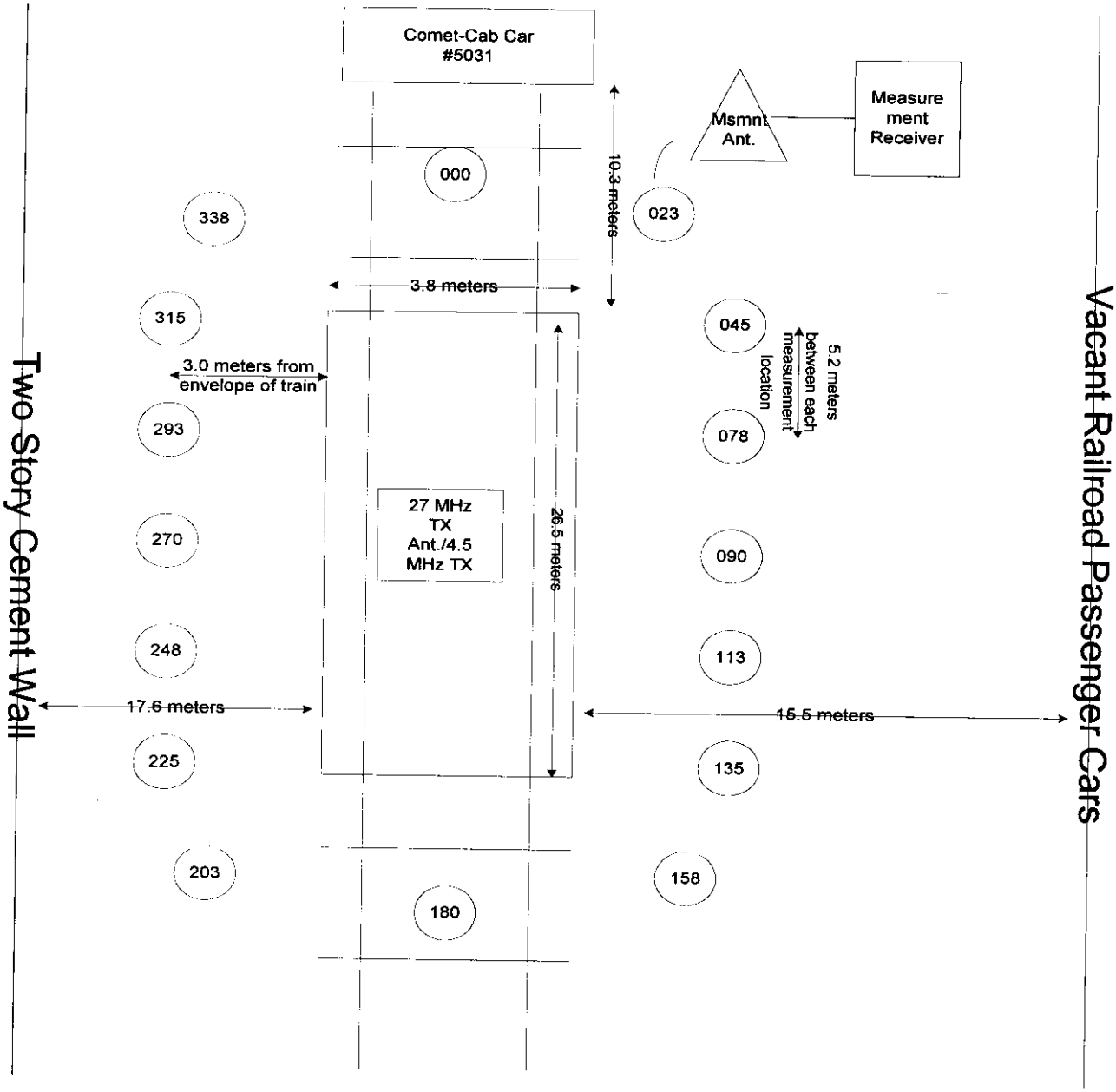
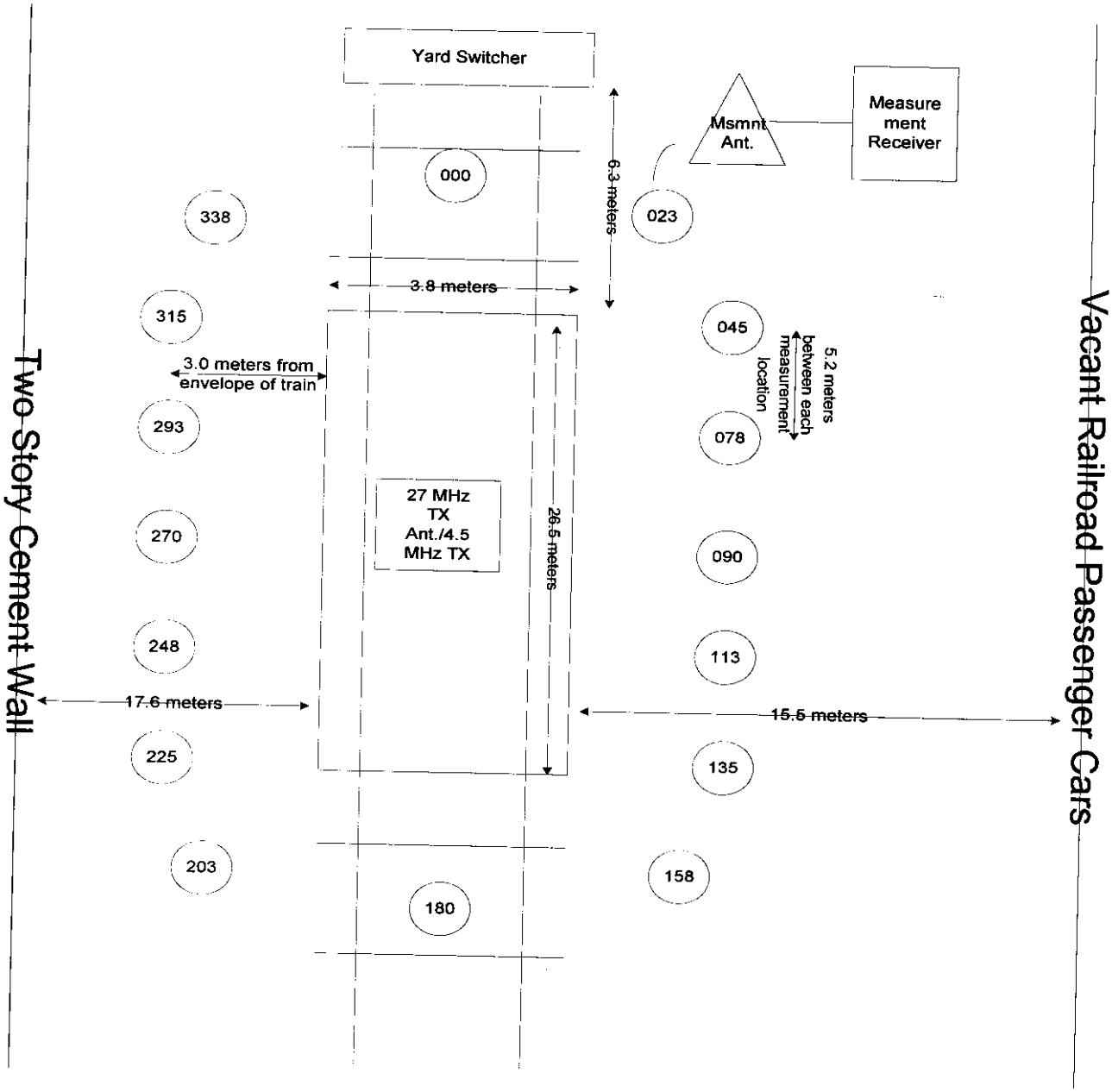


Figure 3

GENERAL TEST CONFIGURATION FOR THE COMET-CAB CAR ELECTRIC LOCOMOTIVE #5031



EQUIPMENT LIST

FCC Part 15, Subpart C, Intentional Radaitors

EN	Type	Manufacturer	Frequency Range	Model No.	Cal Date	Due Date
012	Loop Antenna, Active	EMCO	9 kHz - 30 MHz	6502	10/12/98	10/12/99
092H	Loop Antenna	Empire Devices	150 kHz - 30 MHz	LP-105	6/4/98	6/4/99
127B	Biconical Antenna	Electro-Metrics	20 MHz - 200 MHz	BIA-25	8/21/97	8/21/98
443	Log Periodic Antenna	Electro-Metrics	200 MHz - 1000 MHz	LPA-25	12/16/97	12/16/98
575	Graphics Plotter	Hewlett Packard	N/A	7470A	4/28/98	4/28/99
7016	Spectrum Analyzer	Hewlett Packard	9kHz - 1.8GHz	8591EM	4/30/98	4/30/99

4.5 MHz Transponder

Fundamental Emission Measurements

Retlif Testing Laboratories

Test Report Number R-7864-2

TEST SAMPLE: 4.5 MHz Transponder

LOCATION: Under F40PH Diesel Locomotive, NJ Transit #4116

FCC ID: J8C7869C9554J

APPLICANT: Union Switch & Signal Inc.

TEST METHOD: Radiated Emissions, Fundamental

SPECIFICATION: FCC Part 15, Section 15.223 (a)

PERFORMED BY: P. Krauss

DATE: 10/13/98

NOTES: Detector= Peak, RBW= 10 kHz, VBW= 30 kHz, Test Distance= 3 meters

Frequency MHz	Antenna Position Degrees	Antenna Orientation Degrees	Peak Corrected Reading dBuV/M		Converted Reading uV/M	Avg. Limit at 3 Meters uV/M
4.50	000	330	59.2		912.0	1500
4.50	023	330	55.8		616.6	1500
4.50	045	045	52.8		436.5	1500
4.50	078	070	49.8		309.0	1500
4.50	090	120	35.3		58.2	1500
4.50	113	080	35.8		61.6	1500
4.50	135	090	32.8		43.6	1500
4.50	158	110	39.3		92.2	1500
4.50	180	080	34.8		54.9	1500
4.50	203	270	39.3		92.2	1500
4.50	225	250	43.4		147.9	1500
4.50	248	290	47.6		239.9	1500
4.50	270	290	51.5		375.8	1500
4.50	293	340	57.1		716.1	1500
4.50	315	020	57.7		767.4	1500
4.50	338	090	54.9		555.9	1500

TEST SAMPLE: 4.5 MHz Transponder

LOCATION: Under Arrow III, NJ Transit #1327

FCC ID: J8C7869C9554J

APPLICANT: Union Switch & Signal Inc.

TEST METHOD: Radiated Emissions, Fundamental

SPECIFICATION: FCC Part 15, Section 15.223 (a)

PERFORMED BY: P. Krauss

DATE: 10/14/98

NOTES: Detector= Peak, RBW= 10 kHz, VBW= 30 kHz, Test Distance= 3 meters

Frequency MHz	Antenna Position Degrees	Antenna Orientation Degrees	Peak Corrected Reading dBuV/M		Converted Reading uV/M	Avg. Limit at 3 Meters uV/M
4.50	000	330	37.1		71.6	1500
4.50	023	015	42.8		138.0	1500
4.50	045	060	48.6		269.1	1500
4.50	078	022	51.6		380.2	1500
4.50	090	080	38.2		81.3	1500
4.50	113	015	30.6		33.9	1500
4.50	135	022	40.6		107.2	1500
4.50	158	015	29.2		28.8	1500
4.50	180	060	40.5		105.9	1500
4.50	203	315	28.8		27.5	1500
4.50	225	310	43.3		146.2	1500
4.50	248	320	43.5		149.6	1500
4.50	270	000	47.3		231.7	1500
4.50	293	060	48.8		275.4	1500
4.50	315	350	56.2		645.6	1500
4.50	338	040	38.8		87.1	1500

TEST SAMPLE: 4.5 MHz Transponder

LOCATION: Under Comet-Cab Car, NJ Transit #5031

FCC ID: J8C7869C9554J

APPLICANT: Union Switch & Signal Inc.

TEST METHOD: Radiated Emissions, Fundamental

SPECIFICATION: FCC Part 15, Section 15.223 (a)

PERFORMED BY: P. Krauss

DATE: 10/15/98

NOTES: Detector= Peak, RBW= 10 kHz, VBW= 30 kHz, Test Distance= 3 meters

Frequency MHz	Antenna Position Degrees	Antenna Orientation Degrees	Peak Corrected Reading dBuV/M		Converted Reading uV/M	Avg. Limit at 3 Meters uV/M
4.50	000	120	48.8		275.4	1500
4.50	023	250	45.4		186.2	1500
4.50	045	170	51.2		363.1	1500
4.50	078	045	49.3		291.7	1500
4.50	090	070	45.0		177.8	1500
4.50	113	075	41.1		113.5	1500
4.50	135	225	47.9		248.3	1500
4.50	158	315	44.6		169.8	1500
4.50	180	100	43.9		156.7	1500
4.50	203	280	45.4		186.2	1500
4.50	225	330	45.4		186.2	1500
4.50	248	000	43.4		147.9	1500
4.50	270	355	46.4		208.9	1500
4.50	293	225	55.0		562.3	1500
4.50	315	330	54.3		518.8	1500
4.50	338	000	44.1		160.3	1500

4.5 MHz Transponder

Spurious Case Emission Measurements

Retlif Testing Laboratories

Test Report Number R-7864-2

TEST SAMPLE: 4.5 MHz Transponder

FCC ID: J8C7869C9554J

LOCATION: Under F40PH Diesel Locomotive, NJ Transit #4116

APPLICANT: Union Switch & Signal Inc.

TEST METHOD: Spurious Emissions, 9.0 kHz to 272 MHz

SPECIFICATION: FCC Part 15, Section 15.223 (a)

PERFORMED BY: P. Krauss

DATE: 10/13/98

Frequency MHz	Antenna Polarization & Height C/V/H-M	Meter Reading dBuV	Antenna Factor +dB	Test Distance Correction -dB	Corrected Reading dBuV/M	Converted Reading uV/M	Limit at 3 Meters uV/M
0.009	C-1.0	-					2666667
	C-1.0	-					
0.490	C-1.0	-					4898
	C-1.0	-					
1.705	C-1.0	-					1408
10.00	C-1.0	-					3000
	C-1.0	-					
30.00	V/H-1 to 4	-					3000/100
	V/H-1 to 4	-					
88.00	V/H-1 to 4	-					100 /150
	V/H-1 to 4	-					
216.00	V/H-1 to 4	-					150 /200
	V/H-1 to 4	-					
272.00	V/H-1 to 4	-					200

The frequency range was scanned from 9.0 kHz to 272 MHz. No spurious emissions were observed within 20 dB of the specified limit

Detector: Peak	For F < 30 MHz	For F > 30 MHz
Resolution Bandwidth:	10 kHz	100 kHz
Video Bandwidth:	30 kHz	300 kHz

FCC ID: J8C7869C9554J

LOCATION: Under Arrow III, NJ Transit #1327

APPLICANT: Union Switch & Signal Inc.

TEST METHOD: Spurious Emissions, 9.0 kHz to 272 MHz

SPECIFICATION: FCC Part 15, Section 15.223 (a)

PERFORMED BY: P. Krauss

DATE: 10/14/98

Frequency MHz	Antenna Polarization & Height C/V/H-M	Meter Reading dBuV	Antenna Factor +dB	Test Distance Correction -dB	Corrected Reading dBuV/M	Converted Reading uV/M	Limit at 3 Meters uV/M
0.009	C-1.0	-					2666667
	C-1.0	-					
0.490	C-1.0	-					4898
	C-1.0	-					
1.705	C-1.0	-					1408
10.00	C-1.0	-					3000
	C-1.0	-					
30.00	V/H-1 to 4	-					3000/100
	V/H-1 to 4	-					
88.00	V/H-1 to 4	-					100 /150
	V/H-1 to 4	-					
216.00	V/H-1 to 4	-					150 /200
	V/H-1 to 4	-					
272.00	V/H-1 to 4	-					200

The frequency range was scanned from 9.0 kHz to 272 MHz. No spurious emissions were observed within 20 dB of the specified limit

Detector: Peak	For F < 30 MHz	For F > 30 MHz
Resolution Bandwidth:	10 kHz	100 kHz
Video Bandwidth:	30 kHz	300 kHz

FCC ID: J8C7869C9554J

LOCATION: Under Comet-Cab Car, NJ Transit #5031

APPLICANT: Union Switch & Signal Inc.

TEST METHOD: Spurious Emissions, 9.0 kHz to 272 MHz

SPECIFICATION: FCC Part 15, Section 15.223 (a)

PERFORMED BY: P. Krauss

DATE: 10/15/98

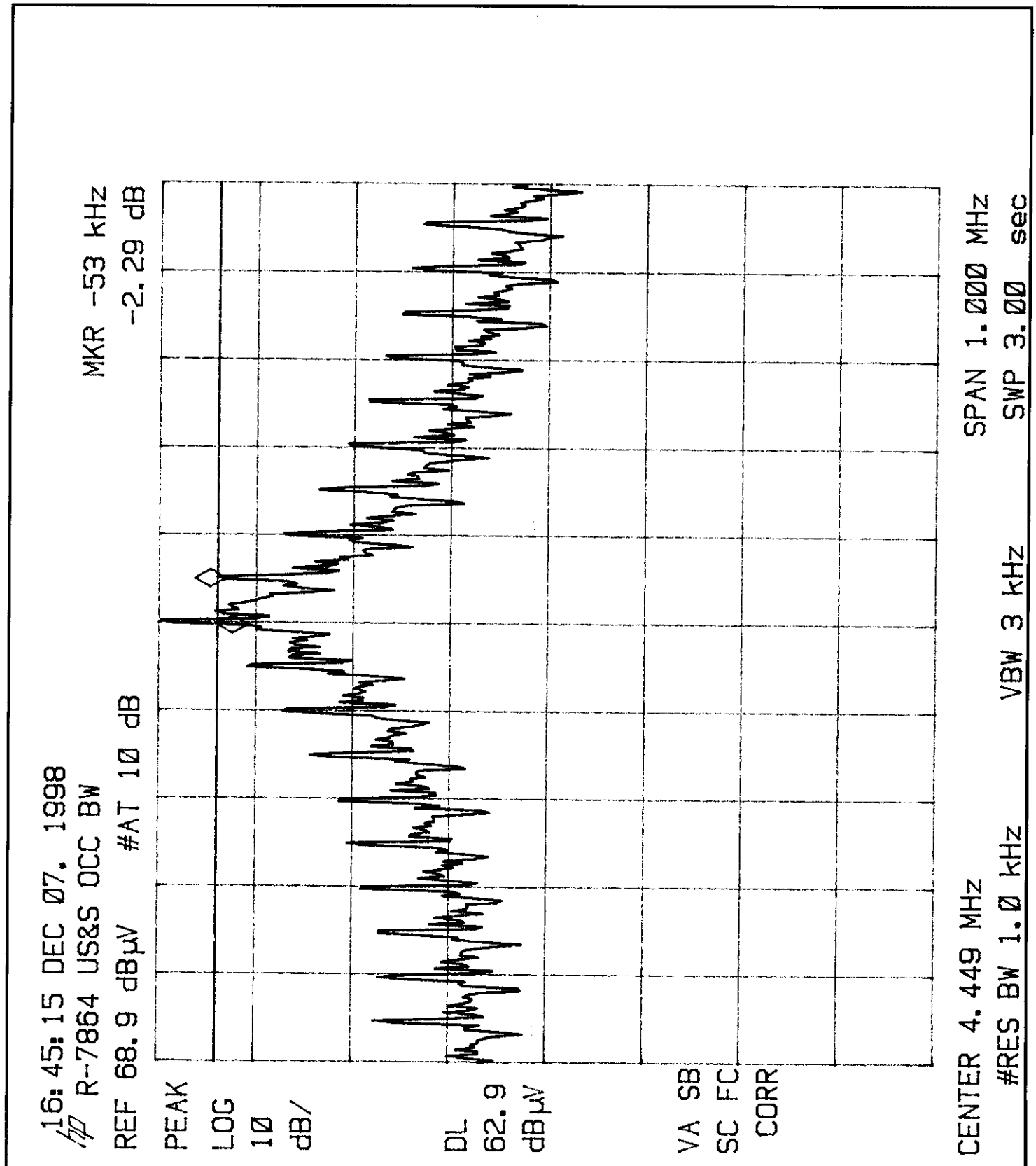
Frequency MHz	Antenna Polarization & Height C/V/H-M	Meter Reading dBuV	Antenna Factor +dB	Test Distance Correction -dB	Corrected Reading dBuV/M	Converted Reading uV/M	Limit at 3 Meters uV/M
0.009	C-1.0	-					2666667
	C-1.0	-					
0.490	C-1.0	-					4898
	C-1.0	-					
1.705	C-1.0	-					1408
10.00	C-1.0	-					3000
	C-1.0	-					
30.00	V/H-1 to 4	-					3000/100
	V/H-1 to 4	-					
88.00	V/H-1 to 4	-					100 /150
	V/H-1 to 4	-					
216.00	V/H-1 to 4	-					150 /200
	V/H-1 to 4	-					
272.00	V/H-1 to 4	-					200

The frequency range was scanned from 9.0 kHz to 272 MHz. No spurious emissions were observed within 20 dB of the specified limit

Detector: Peak	For F < 30 MHz	For F > 30 MHz
Resolution Bandwidth:	10 kHz	100 kHz
Video Bandwidth:	30 kHz	300 kHz

4.5 MHz Transponder

6 dB Bandwidth Measurement



Customer:	Union Switch & Signal, Inc.
Test Sample:	PTS, Transponder(4.5 MHz Transmitter/27 MHz Receiver)
Model No.:	L34000 0001ED.6
Test Method:	6 dB Bandwidth Measurement
Notes:	6 dB Bandwidth= 53 kHz

Date: December 7, 1998 Tech: T. Schneider Sheet 1 of 1

Retlif Testing Laboratories

Report No. R-7864-2

Installation Instruction
Minitransponder
L34000 0000

PREPARATION

COMPANY	NAME	DATE
AT Signal System	S-O Heed	97-11-12

APPROVALS

COMPANY	NAME	SIGNATURE	DATE
AT Signal System/P	J-Å. Forsell		
AT Signal System/T	B. Sjöbergh		
AT Signal System/Q	A. Maiste		

MODIFICATION HISTORY / ÄNDRINGSFÖRTECKNING:

EDITION: CHANGES / ÄNDRINGAR:

Ed2 Text.
Ed3 Tools , tolerances
Ed4 drawing L34000 0000R changed to Ed3

Note:

This equipment has been tested and found to comply with the limits for an intentional radiator pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, as can radiate radio frequency energy and if not installed and used in accordance with the instructions may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

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CONTENTS / INNEHÅLL:

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1. Introduction.

When installed the transponders can appear in two different modes - either fixed coding, or controlled by a distant encoder .
This document contains installation requirements of the ATP- minitransponder unit and if applicable the connection to encoder unit.
An installation parts list exist and is available as appendix.
Positions indicated in drawings is referred to in the parts list.
This document shall be considered as recommendations and limitations, customer related modifications are possible but shall be made only after consultation with ATSS .

2. General information.

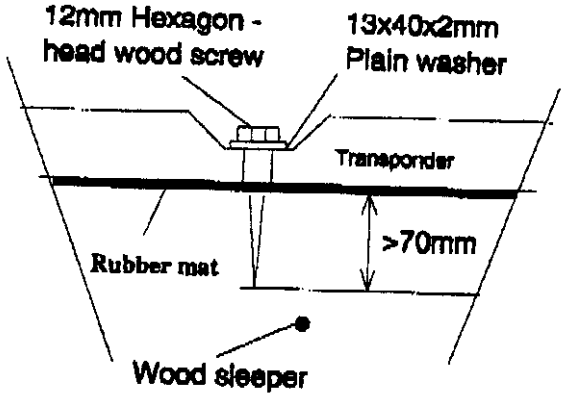
Depending of what system of ATP will be used (" 12 bit " or " 180bit ") up to 5 transponders can be installed at one location .
In general the transponder can be mounted in 2 ways , either transversal or longitudinal in the track. A small reduction in contact volume will result when the transponder is mounted transversal compared to longitudinal mounting, but this reduction is within the specification .
A transversal mounting in a wide or standard gauge track will make the transponder less exposed to damage due to works on the track side. On narrow gauge tracks the longitudinal mounting is recommended , in order to reduce the risk of coupling effects between the rails and the transponder that might result in multiple readings of transponder telegrams. The same recommendation is valid when protection rails are present.
The transponder can be mounted on either wooden sleepers or reinforced concrete sleepers.
A rubber mat shall always be used between transponder and sleeper in order to even out irregularities on the sleeper surface.
Closed electrical loops must be avoided in the immediate vicinity of the transponder, this also includes cables crossing the tracks and thereby making a loop track - cable - track .
If the transponder is controlled, the cable shall be appropriately fixed and a protection sleeve shall be used to protect the cable from damage. A special tool to tighten the coding cable connector is available, as it is important that the connector is firmly but not too tightened. This also applies to the connector protecting cover used when the transponder is a fixed telegram transponder.
The transponder does not need to be dismounted for reprogramming or change of controlling cable.

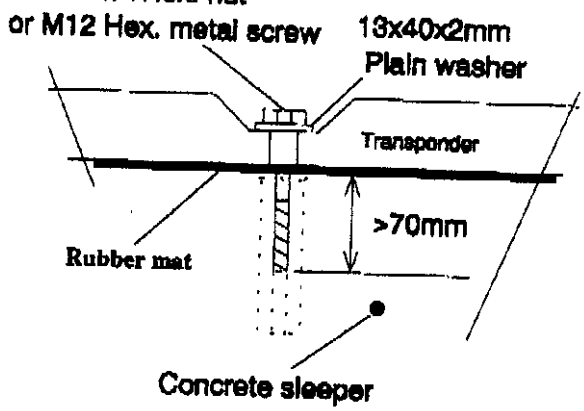
3. Mounting.

The transponder is designed to be mounted flat on a sleeper by two bolts. M10 bolts will have strength enought to keep the transponder in place, but M12 bolts are recommended in order to get a larger pressure surface at the fastening point. If M10 bolts are used, it is recommended to use a tube to fill up the hole in order to secure that the transponder will stay in its position. To even out the mounting surface a rubber mat shall be placed between transponder and sleeper. Due to the need of tolerances, the mounting holes in the transponder plate have a large diameter:
A plain washer must be used. The washer shall fill up the fastening cavity (40mm).

If for some reason the transponder bolts can not be fastened into the sleeper, a mounting bracket can be used, still a rubber mat must be used together with the plain washer.
When tightening the fastening bolts, the force shall be such that beginning of compression of the rubber mat can be noted. Note ! The compression shall just begin .

The figures below illustrates the fastening method .



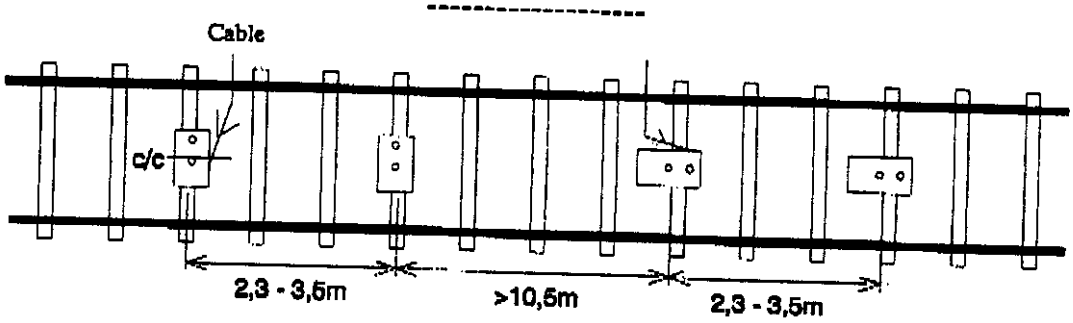


The rubber mat is described in the appendix under par.6.4
The hole pattern of the transponder is described in the appendix, see par.6.5
The active part of the screw shall always penetrate the sleeper by > 70mm, this must not be forgotten if a thicker rubber mat or other distance or spacer is used.

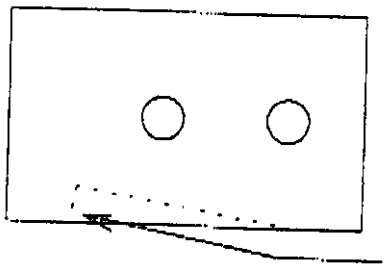
The transponder can be placed in two ways in the track. Transversal or longitudinal. Longitudinal gives a little longer contact area , i.e. higher maximum speed. The main method is to mount the transponder transversal. When mounting the transponder transversal to the track, note that the mounting holes are not symmetrically placed in the plate. See the drawing of hole pattern, par. 6.5.
The way the transponder is mounted in respect to which side the cable enter is of no importance, it is just a question of what the location demands .

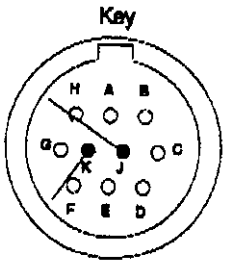
Care shall be taken to mount the transponder in the centre of the track , this tolerance is ±10mm .

To avoid " Transponder failure " the area close to the transponder shall be free of attenuating objects like metal loops, crossing cables, metal-rods , metal-plates etc., except for reinforcing iron in the sleeper .
If a cable crosses the track near a transponder location, it is recommended to have a distance of >200mm between crossing cable and rail. This will reduce the coupling between cable and rail, minimizing risk of getting multitransponder readings caused by transponder effects in the tracks. This does of course not mean the controlling cable to the transponder.
See 6.2.2

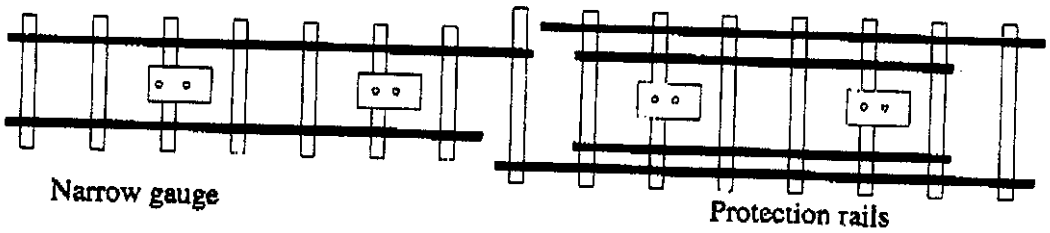


Internally in a transponder group the distance shall be 2.3 to 3.5 m .
The distance between groups of transponders shall have a minimum of 10.5m .
Se appendix 6.2.1



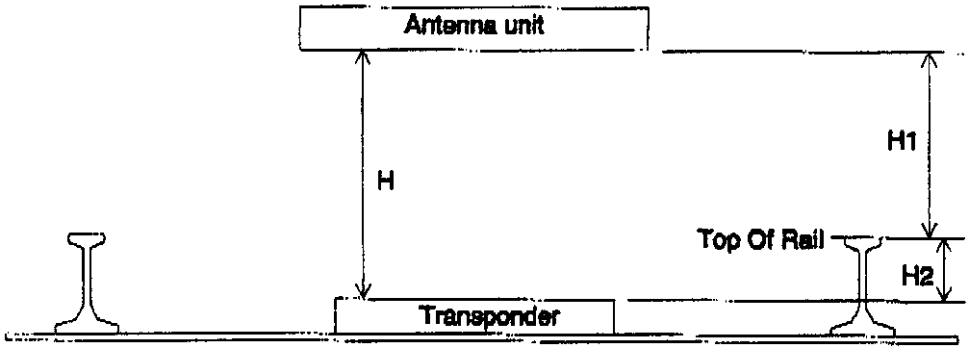


The above figure illustrate how the coding cable enters the transponder , seen from above the connector is covered .
To loosen and tighten the cable, a tool is designed (ATSS L34000 9510, see appendix . 6.6), the connector shall be connected / disconnect with such a tool, just let the hex-nut reach the bottom, do not tighten with more force than what can be done by hand with the recomended tool.
In the connector is a sealing which will give the feeling of some friction, when tightening, this is normal.
Before inserting the connector, it is good practice to apply a thin layer of Vaseline on the edge of the male connector, this this will make the untightening easier nex time.
Note ! The large orientation key in the connector is oriented towards the centre of the transponder. Se figure above.



In the situation of narrow gauge track, or if protection rails are present, it is recommended to mount the transponder longitudinal, to avoid too much coupling of the field from the transponder into the rails and thereby increase the risk of " transponder failure " indications.

The distance between top of transponder and top of rail is of importance and must be considered together with the specification of the Antenna installations on board the vehicles in use.



Primarily the figure act as guide-line to the installation of antennas on board the vehicles . " H " is the overall distance, which incorporates all tolerances and movements by the vehicle . As " H2 " have small differences the main part of movements and tolerances will be transferred to the distance " H1 " , expressed in a formula .

$$H \pm tol. = (H2 \pm 5) + (H1 \pm (tol.-5)) \text{ mm}$$

The tolerance at the mounting of the transponder is set to ± 5mm (H2 ± 5).
The factor " tol. " incorporates mounting tolerance (± 10mm) and deviation of " H " from variations in load of vehicle , wheel diameter , etc..

" H " are stated in the specification of the different antenna units in use , See appendix 6.2.3 .

In some sleepers the centre of the sleeper is lower than the level of the bottom of the rail, if the distance " H2 " reaches a too great part of " H " (>150mm) it can be necessary to implement a non metallic spacer between transponder and sleeper, the length of fastening bolts must in such a case be that much longer that they penetrate the stated 70mm into the sleeper.

4. Connection to encoder.

Specification and tools, see appendix 6.3.

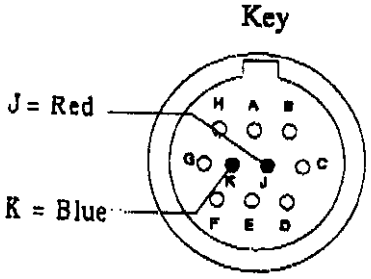
The fixed transponder shall have a special cover nut placed on the connector, ATSS part no. 86A00065. After programming firmly tighten the nut with the assigned mounting tool. Do not seal the nut, as it must be possible to re-program or check the transponder in the future.

To a controlled transponder installation, an ATSS transponder cable (ATSS part nr. 24A00052 and 24A00060) is available, this cable has a reinforced protective screen and extra thick outer sleeve in order to make it resistant to damage. Still it is recommended to have an extra protecting tube and fasten this well along the sleeper until the cable leaves the track bed.

An extra length of cable than what is the absolute minimum needed, coiled up somewhere near the track is a good practice in case the connector has to be replaced in the future, due to damage etc. .

A female transponder connector is designed to match the ATSS cable. ATSS part nr 86A00067.

Note ! The larger orientation key in the connector is oriented towards the centre of the transponder .



Encoder connection is pin J and K.

Other pins are used at programming and are not connected in the way side installation .

Connector 10 pin male at transponder , cable connector ATSS 86A 0067. Isolation pins shall be inserted in not used cavities .

The Green and Black wires are not used , avialable as spare wires.

Mounting instruction for ATSS transponder connector, see appendix 6.3.

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5. Programming.

At the installation the transponder is programmed. This programmed telegram can either be the main telegram in case the transponder acts as a fixed telegram transponder, or in case it is a controlled transponder, this programmed telegram is a default telegram which will be activated if the encoder or the encoder input fails .

In the event of replacement of a transponder or if for some reason the telegram has to be changed, a transponder test unit is available by which the transponder can be programmed and checked. The test unit can also be used to check if the coded telegram is correctly (re-)transmitted. At the tests the condition of the transponder will also be tested.
ATSS transponder test unit L34100 0000 or equivalent shall be used.
For programming instruction see the transponder test unit instruction.

An ATP equipped loco with a recording unit installed can (as option) be used to validate the telegram.

6. Appendices.

1. Part revue
2. Measures on the track side
3. Mounting instruction of cable connector
4. Rubber mat
5. Hole pattern and measures — Drawing L34000 9510R
6. Connector mounting tool — Drawing L34000 0000R
7. Connector holding up tool — Drawing L34000 9560R
   Drawing L34000 9561R

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6.1 Part revue

This list is not a purchasing parts-list, it shall be seen as an overview of parts to be used at and in the installation.
The length of the bolt - hole in the transponder is 22mm, to be addad to the >70mm recommended.

6.1.1 Transponder :

6.1.1.1 Mounting on wood sleeper.

1	Transponder	L34000 0000	delivered with a cover nut.
1	Rubber mat	L34000 9510	or suitable spacer
2	12mm Hex.head wood screw		length depends on mounting distance to sleeper (add 22mm for transponder hole)
2	Plain washer 13x40x2mm		

6.1.1.2 Mounting on concrete sleeper :

1	Transponder	L34000 0000	delivered with a cover nut.
1	Rubber mat	L34000 9510	or suitable spacer
2	Plain washer	13x40x2mm	
2	M12 Hex. metal screw (M10)		can be substituted by M12 bolt + M12 Hex.nut length depends on the mounting distance to the sleeper

6.1.2 Cable , connector

1	Cable ATSS part nr.	24A00052	Tropical environment; Brass shield
	ATSS part nr.	24A00060	Standard; Copper shield .
1	Connector	86A00067	House
2	Sockets	46A00030	
8	Insulator pins	46A00032	to seal non-used contact cavities
1	Protecting sleve		to protect cable from ballast
	Silicone	09A00022	Water protection for connector house
1	Cover nut	86A00065	If no cable is connected . Normally delivered with the transponder.

Tools

0	Crimp tool	M22520/1-01	
0	Turret head	M22520/1-02	
0	Insertion tool	MS24256A-20	
0	Removal tool	MS24256R-20	
0	Tool ATSS part nr.	L34000 9560	Connector mounting tool .
0	Tool ATSS part nr.	L34000 9561	Connector holding up tool .

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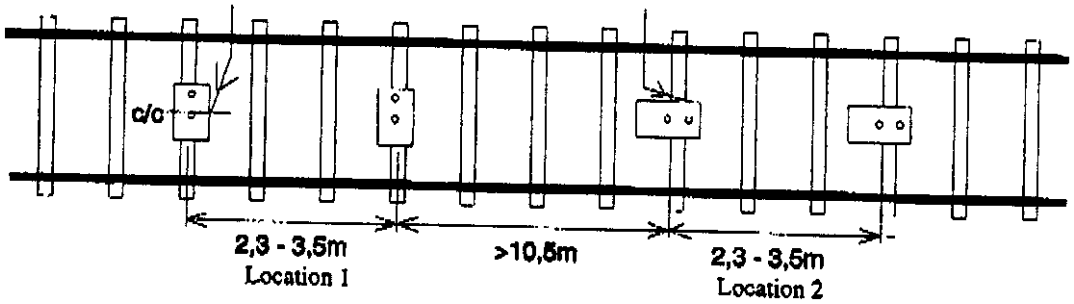
6.2 Measures on the track side.

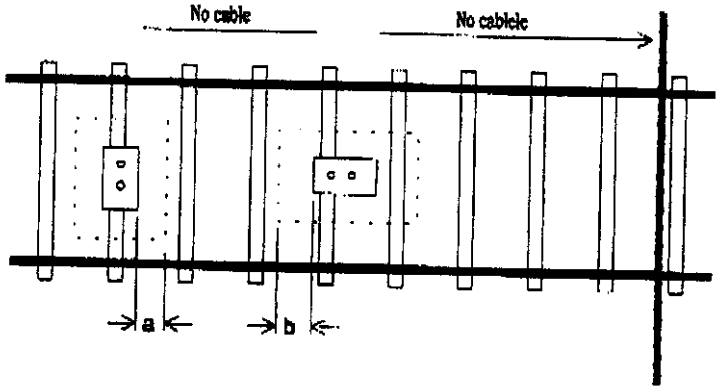
6.2.1 Distances between transponders.



Transponder center	" C/C "	Rail - Transponder - Rail	c/c ±10 mm
Information location		Transponder - Transponder	2.3 - 3.5 m
"		Location - Location	>10.5 m

The distances are measured at the centre of the transponder.
A transponder location can, depending of the system, consist of up to 5 transponders .

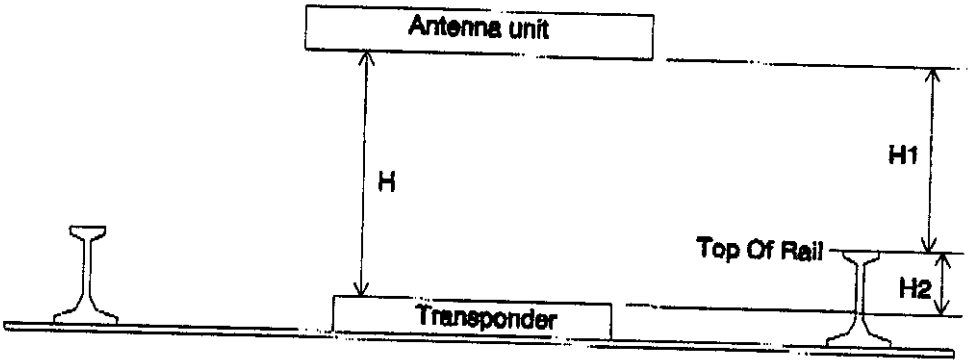
6.2.2 Free area.



Free area " a ", " b " + under the transponder >200 mm
The definition free area; no metal plates, loops or other metal objects except reinforcement of the sleeper.
If cables cross the track between transponders in a location and closer than 1,5m from a location, a distance of 200mm to the crossing rail is recommended.

6.2.3 Mounting heights.

The ATSS ATP-system incorporates two types of antenna units, with some differences. The differences connected to the transponder point of view is the distance " H "



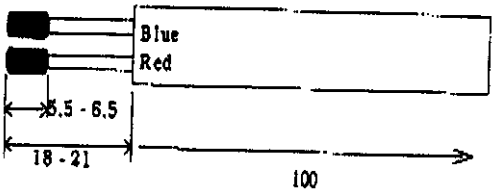
"H2" can be calculated from the formula $H \pm tol. = (H2 \pm 5) + (H1 \pm (tol.-5))$ mm

Distance " H " at	L32043 0010 (Large antenna)	307mm	±90mm	ref. L32043 9500R
"	L32044 0000 (Reduced antenna)	325mm	±90mm	ref. L32044 1150R
	A usable average is	320mm.		at the same tolerance

If " H2 " tends to be over 150mm it is recommended to insert a spacer between transponder and sleeper.

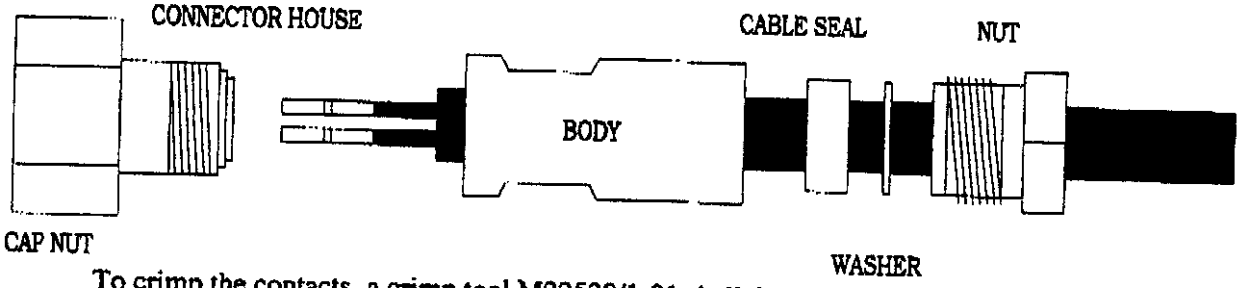
6.3 Mounting instruction of cable connector.

Cut the cable to appropiate length, it is a god practice to leave extra length in case of future need of reparations.



Before the cable is stripped, slide on the protecting sleves and house clamps.
The cable is dismantled as the figure indicates.**Make sure the outer insulation is not scratched or damaged,** at least 100mm from the stripping, this is of importance in order to get a watertight connection.
The outer insulation cover and shields are removed 18 to 21 mm, make sure no wires from the shielding is left. Cut the two remaining (green and black) wires wich will not be used.
Remove the insulation of the red and blue wire 5,5 to 6,5 mm from its ends.

Slide on the connector parts as the picture below shows. To ensure water tightness, apply a small amount of silicone around the cable and cable seal before sliding the cable seal in position.



To crimp the contacts a crimp tool M22520/1-01 shall be used together with the turret head M22520/1-02.
Rotate the turret head to the correct contact size position, se the color code .
To achieve the correct crimp pressure, the cable size is adjusted on the cable size knob at the handle of the tool.
The by ATSS recomended cable have the wire size AWG 20 , corresponding to selection nr. " 4 " on the wire size knob.
The size of the contacts is 20, the turret colur corresponding to this is RED.

A table of these combinations can be found on the turret head.

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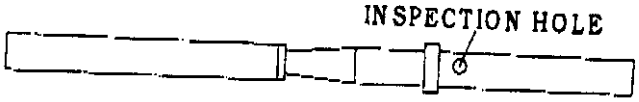
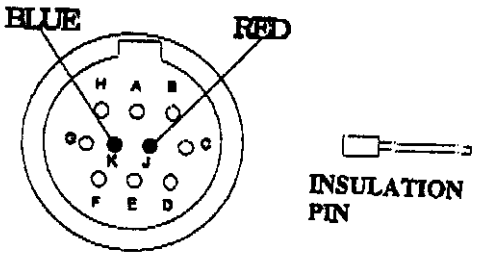
Insert the stripped wire into the contact element and make sure the wire can be seen trough the inspection hole in the contact element, the golden end is the cable side and the stainless end the connector side.



Release the handles of the crimp-tool and insert the contact element into the contact pocket of the tool, the contact element shall stay even with the surface in the tool. Close the handles in a full stroke, after a full stroke the handles are released and the crimp process is completed.

Insert the crimped contact elements in the connector house. Use insertion tool MS24256A-20 . Start by inserting the contact element in proper position by hand (Blue wire in "K " and red wire in " J) in the connector house, place the wire in the groove of the insertion tool and locate the contact properly in the tool, keep the contact in line with the axis of the cavity, smoothly push the contact element into the cavity until it is fully seated in its position. Withdraw the insertion tool from the grommet.

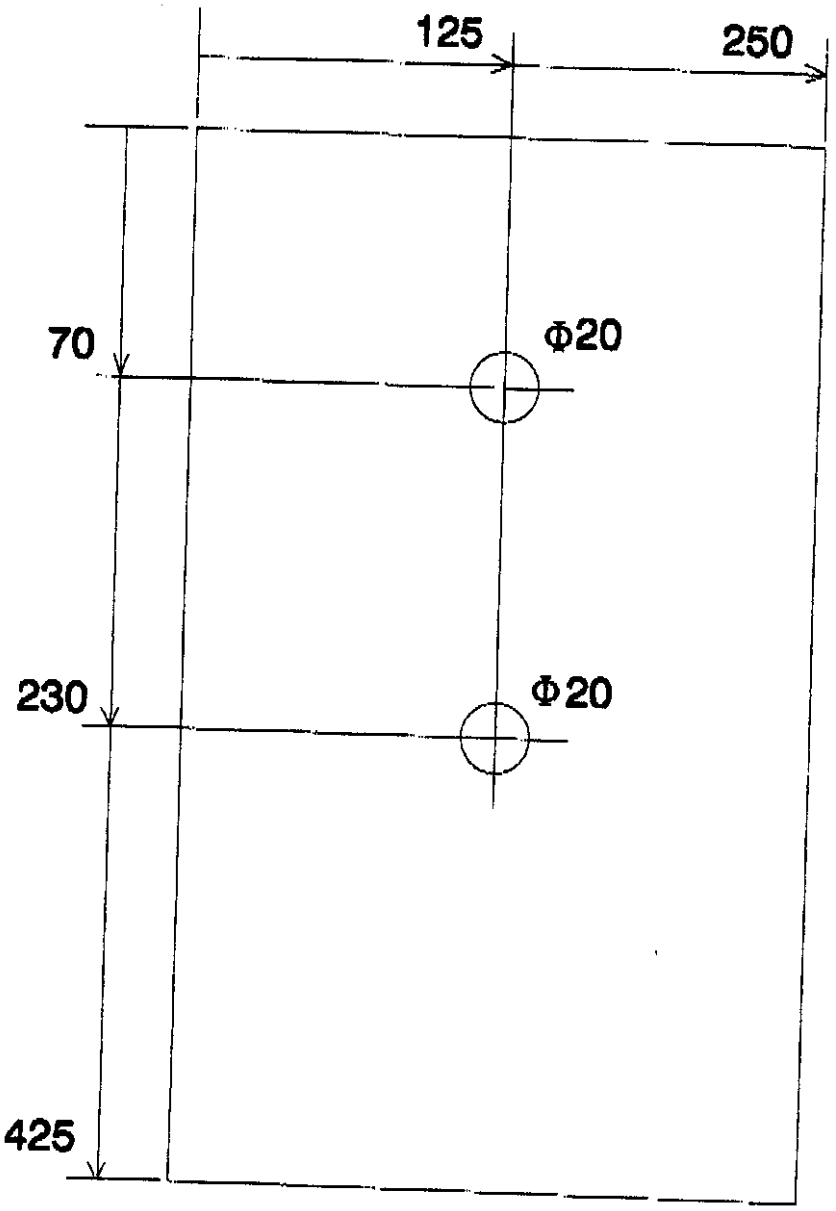


If for some reason the contact needs to be removed use contact removal tool MS24256R-20.

The remaining 8 contact cavities shall be sealed with the insulation pins, as illustrated. Start with the narrow end of the pin, the whole pin shall be pushed into the grommet.

Slide and screw the contact body onto the house. By using the holding-up-tool (L34000 9561), tighten the contact body. Mount the cable seal, apply some silicone on cable and seal, apply the washer and the nut. Tighten with the help of the holding-up-tool. The nut shall go all the way to the bottom.

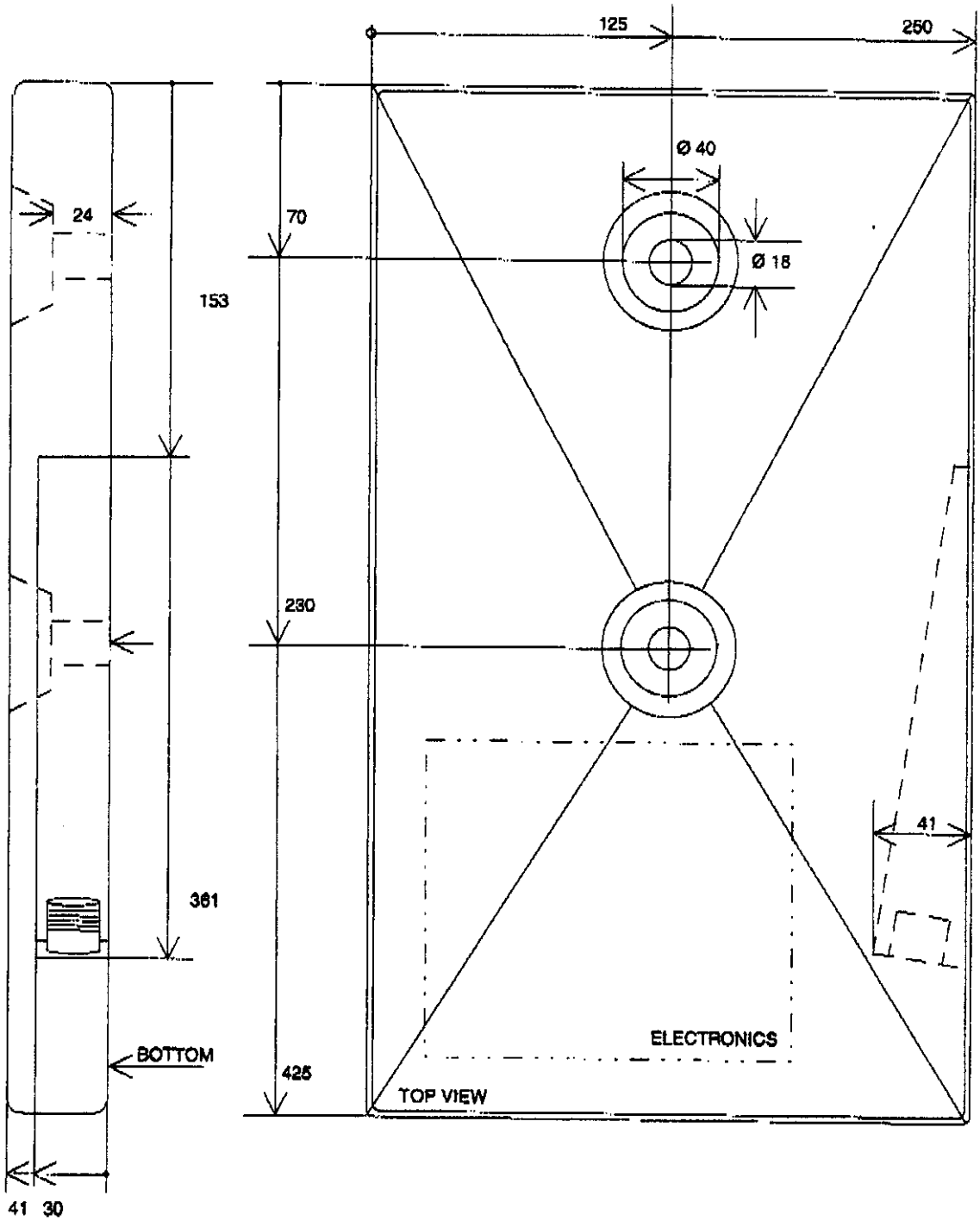
6.4 Rubber mat L34000 9510



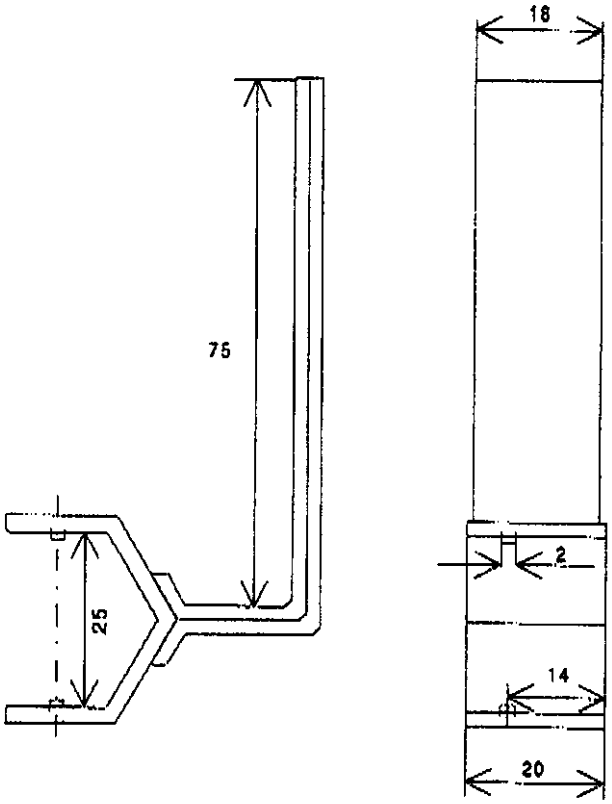
3mm rubber ATSS part nr 14A00013 (CHLOROPRENE , SHORE A60)

General tolerance is ± 1mm

6.5 Hole pattern and measures L34000 0000R



6.6 Connector mounting tool . L34000 9560



The connector mounting tool is designed to be slided over the control cable.
To tighten the connector no more force shall be used, than to fix the locking ring just tight into the bottom. Pliers or wrenches should not be used.

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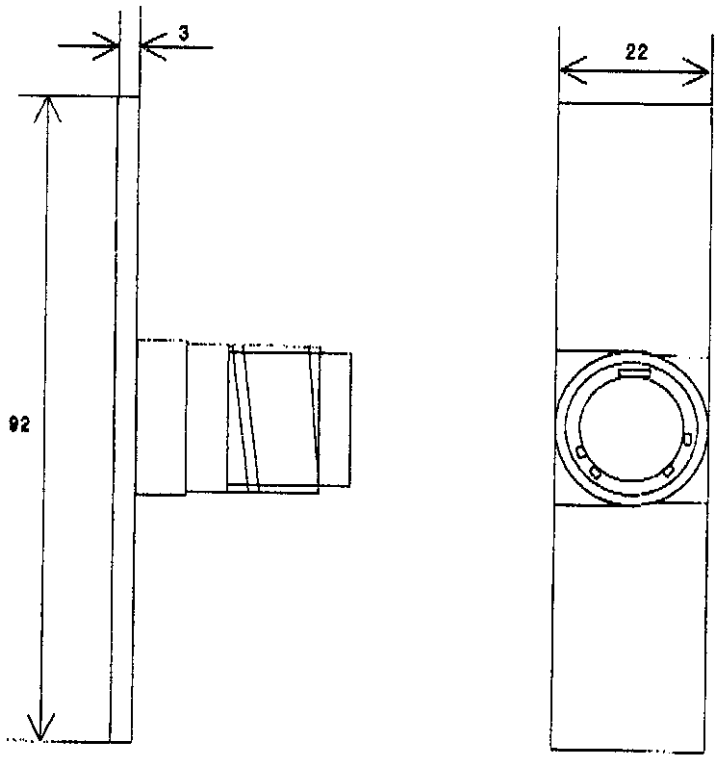
6.7 Connector holding up tool. L34000 9561 .



This tool simulate a chassis connector house. To be used while mounting the cable connector.

Maintenance Instruction
Minitransponder
L34000 0000

PREPARATION

COMPANY	NAME	DATE
AT Signal System	S-O Heed	97-11-12

APPROVALS

COMPANY	NAME	SIGNATURE	DATE
AT Signal System/P	J-Å. Forsell		
AT Signal System/T	B. Sjöbergh		
AT Signal System/Q	A. Maiste		

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MODIFICATION HISTORY / ÄNDRINGSFÖRTECKNING:

EDITION: CHANGES / ÄNDRINGAR:

ED2	Reprogramming	960807
ED3	Reprogramming	961030

CONTENTS / INNEHÅLL:

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1. Introduction.

This document contains maintenance requirements for the ATP- minitransponder unit and if applicable the connection to coding unit.
As a complement, Transponder Test Unit users manual is added as appendix.

If any deviation will arise from the limitations or other recommendations in this document, this shall only be implemented after consultation and written confirmation from ATSS.

2. General information.

In general the transponder is maintenance free (of service) and is not allowed to be repaired , i.e. it shall never be opened. When a fault is noted the unit shall be exchanged and checked, in case of faulty default telegram the unit can be reprogrammed and checked , otherwise the faulty unit shall be taken out of service.

A Service instruction is for this reason not available. For programming see para.5 .

3. Maintenance.

In the ATP - system an electrical fault in the transponder will be detected and indicated as a transponder failure or as a missing transponder. If a failure is detected the transponder shall be tested, and in the case of a coded transponder, the fault can be isolated to failing component (transponder, cables or encoder).
For these tests a transponder test unit is available (L34100 0000).

The transponder is for obvious reasons exposed to severe mechanical stress.
A regular inspection of the unit shall be performed , along with maintenance and regular inspection of other wayside equipment.
At the inspection the following shall be checked:

A visual inspection of the transponder, looking for mechanical damages as cracks etc..
A check of fastening bolts, missing or loose. If the connector is loose or the cover is missing.
If the encoder cable connection needs to be loosened from the transponder, the seal shall be checked and exchanged if needed.
In case of default memory failure, the unit can be reprogrammed and checked.

4. Programming .

At the installation the transponder is programmed. This programmed telegram can either be a main telegram in case the transponder acts as a fixed telegram transponder, or in case it is a coded transponder, the programmed telegram is a default telegram which will be activated if the encoder or encoder input fail.

In the event of replacement of a transponder or if for some reason the telegram has to be changed, a transponder test unit is available by which the transponder can be programmed and checked. The test unit can also be used to check if the transponder coding telegram is correct.
At the test the air gap parameters of the transponder is tested.
This procedure is also valid for reprogramming.

ATSS transponder test unit L34100 0000 or equivalent shall be used.

An ATP equipped loco with a recording unit installed can (as an option) be used to validate the telegram.

5. Appendices.

L34100 1100T Transponder test unit , Users manual.

Comments to Minitransponder L34000.

The Norwegian telecommunication authority (PT) approves the transponder.

Experiences from the tests performed in connection to the approval in Norway.
When tested at the laboratory (in free air) as specified by ETSI 300 330 the transponder will emit some spurious above what is accepted by ETSI 300 330 spec. The environmental situation at a laboratory is far from reality, in field, where the transponder is activated by an installation on a vehicle, The vehicle will act as an absorber/screen to the transponder, why the transponder will emit consequently much less spurious. The level measured according to ETSI will, in a realistic environment, be well below this specification.
This is, it is meaning less, from a practical and realistic point, to test the transponder in laboratory, it must be performed in a true installation situation.

Comments to schematics.
The 27MHz signal is rectified and stabilised to supply the system with power. From the modulation of the 27MHz signal a 50kHz clock signal is detected. The transponder retransmit its information at 4.5MHz, at a clock frequency of 50kHz. The 4.5MHz signal is a damped oscillation pulse.
The clock frequency of the encoder signal (if used) is 50kHz. In the encoder detection circuit are used a 1MHz ceramic resonator to generate an internal clock.

Spec.

Transmitter frequency:	nom. 4,5MHz	(4.4 to 4.6MHz)
Receiver frequency:	nom. 27.115MHz	(26.7 to 27.7MHz)
27MHz modulation:	17uS on , 3uS off.	>50% , 50kHz modulation
The 4.5MHz pulse shall decrease to 50% after 4.5uS		(4 to 5 uS)

AT Signal System AB Stockholm, Sweden Fax no: +46 8 621 14 24 E-mail: atss@atss.se	**ANSALDO** TELEFAX Ref no : SED/2579	Date: 1998-12-03 Pages no. : 1 + 38
TO	Company : Union Switch & Signal To : Joe Schaad Fax no: 009 1 412 688 2398 CC :	
FROM	From : Sven-Åke Edlund Office address : Gunnebogatan 22 Mail address : Box 8142, S-163 08 SPÅNGA, SWEDEN E-mail : sed@atss.se Phone no. : +46 8 621 95 40	
SUBJECT	Transponder documentation	

Joe!

Please find attached the requested transponder documentation.

Best regards

Sven-Åke

This information is intended solely for the person or company given on this covering sheet.
If you have received this telefax by mistake, we would request you to notify the sender immediately!

IF NOT CLEARLY RECEIVED, PLEASE CALL IMMEDIATELY!