

DATA SHEET

CU1216LS MK3 family All Bands DVB-C Receiver Unit

Preliminary specification

Approval by :



Name / Date : Lim Kui Yong / 14.01.2005



All Bands DVB-C Receiver Unit**CU1216LS MK3 family****FEATURES**

- Small size 40mm x 70mm x 13mm in horizontal mounting
- Digitally-controlled (PLL) tuning via I²C-bus
- Minimum power supply : 1.8V, 3.3V and 5V
- Fully compliant with ETS 300 429 specification for DVB-C application, ITU-T J.83 (Annex A, B & C)
- Output of MPEG-2 parallel/serial transport stream
- Digital SAW filter
- Support up to 256QAM
- Wide symbol rate of 0.87 to 6.9Mbaud
- Fulfill Cenelec requirements, EN55013 & EN55020

ORDERING INFORMATION

TYPE	DESCRIPTION	12 NC
CU1216LS/A GI G V-3	DVB-C, MPEG-2 Parallel Transport Stream; F-long connector, IEC connector; active passive loop through, vertical	3139 147 24311
CU1216LS/A GI G H-3	DVB-C, MPEG-2 Parallel Transport Stream; F-long connector, IEC connector; active passive loop through, horizontal	3139 147 24321
CU1216LS/A IG G V-3	DVB-C, MPEG-2 Parallel Transport Stream; IEC connector, F-long connector; active passive loop through, vertical	3139 147 24331

MARKING

The following items of information are printed on a sticker that is on the top cover of the tuner:

- Type number
- Code number
- Origin letter of factory
- Change code
- Year and week code

All Bands DVB-C Receiver Unit**CU1216LS MK3 family****DESCRIPTION**

This internal product specification covers CU1216MK2 & CU1216MK3 family. RF electrical characteristic, mechanical interface are the same for both family beside the channel decoder. In the CU1216MK2, the channel decoder used is TDA10021. While for the CU1216MK3, the channel decoder used is TDA10023. Both channel decoders are supplied from Philips Semiconductor. The TDA10021 only covers DVB-C requirement while for the TDA10023, it covers ITU-T J.83 (Annex A, B & C) with the DVB-C requirement inclusive.

The narrowband 36MHz IF output after SAW filter is being amplified further by a variable IF amplifier. The variable IF amplifier having a 60dB of dynamic range. The 2Vp-p differential amplified IF output is input to a DVB-C Receiver. The pre-filter IF is also available as IF output for analog processing purpose.

The CU1216LS MK2/MK3 also allow a passive loop through possibility beside the active loop through function.

Upon power down, signals is still available at antenna connector out.

DVB-C Receiver includes a QAM demodulator together with RS Forward Error Correction (8 erroneous bytes correction is possible) and 10bits A/D converter. The output could be either a parallel or a serial MPEG transport stream.

INTERMEDIATE FREQUENCIES

SIGNAL	FREQUENCY⁽¹⁾ (MHz)
Center frequency	36.15

Notes

⁽¹⁾ The oscillator frequency is above the input signal frequency.

FREQUENCY COVERAGE

BAND	FREQUENCY RANGE⁽²⁾ (MHz)
Low band	⁽³⁾ 51 to 160.25
Mid band	160.5 to 444.25
High band	444.5 to 858 ⁽⁴⁾

Notes

⁽²⁾ Data refers to the RF channel center frequency

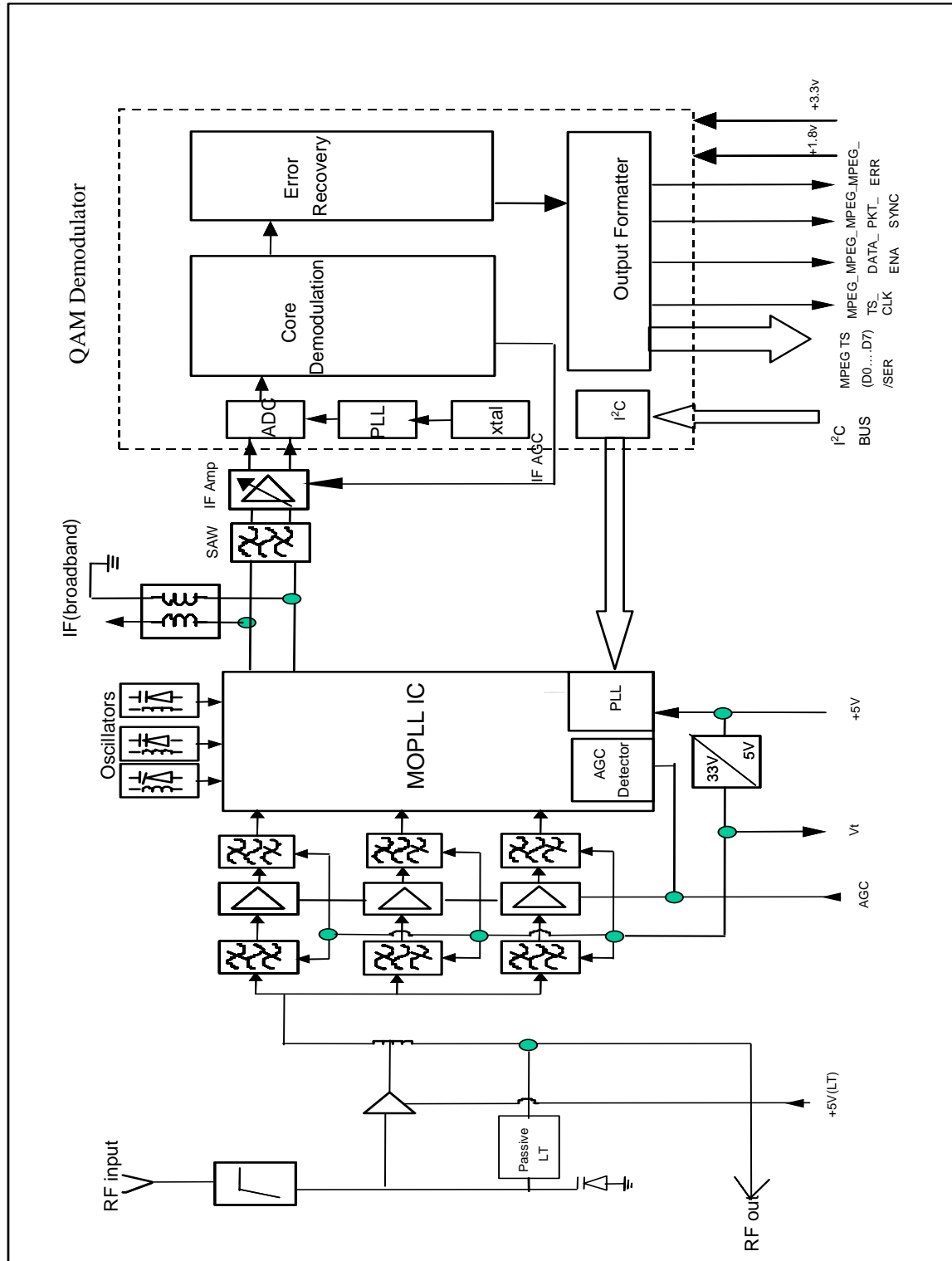
⁽³⁾ Sufficient margin is available to tune down to 47MHz.

⁽⁴⁾ Sufficient margin is available to tune up to 866MHz.

All Bands DVB-C Receiver Unit

CU1216LS MK3 family

BLOCK DIAGRAM



All Bands DVB-C Receiver Unit**CU1216LS MK3 family****Definition of Terminals / Supply Data**

SYMBOL	PIN	DESCRIPTION
N.C	1	Not connected
N.C	2	Not connected
N.C	3	Not connected
5V (LT)	4	Loop Through Supply Voltage +5V
AGC	5	Automatic Gain Control (external) +4V [Do not connect for normal usage with Wideband AGC]
5V	6	Tuner Supply Voltage +5V
AS	7	NIM Address Select
Vt	8	Tuner Tuning Voltage [For monitoring purpose only, do not connect to power supply]
N.C	9	Not connected
GND	10	Ground
1.8V	11	Supply +1.8V
3.3V	12	Supply +3.3V
IF	13	Intermediate Frequency (unfiltered)
GND	14	Ground
MPEG D0/SER	15	Parallel MPEG Transport Output Data Bit 0/Serial Output
MPEG D1	16	Parallel MPEG Transport Output Data Bit 1
MPEG D2	17	Parallel MPEG Transport Output Data Bit 2
MPEG D3	18	Parallel MPEG Transport Output Data Bit 3
MPEG D4	19	Parallel MPEG Transport Output Data Bit 4
MPEG D5	20	Parallel MPEG Transport Output Data Bit 5
MPEG D6	21	Parallel MPEG Transport Output Data Bit 6
MPEG D7	22	Parallel MPEG Transport Output Data Bit 7
MPEG_TS_CLK	23	MPEG Transport Stream Clock
SDA	24	I ² C-Bus Serial Data
SCL	25	I ² C-Bus Serial Clock
RST	26	Reset
MPEG_DATA_VAL	27	MPEG Data Valid
MPEG_PKT_SYNC	28	MPEG Packet Sync
MPEG_ERR	29	MPEG error out
N.C	30	Not connected
N.C	31	Not connected
N.C	32	Not connected
GND	M1,M2, M3,M4	Mounting Tags (Ground)

All Bands DVB-C Receiver Unit**CU1216LS MK3 family****LIMITING VALUES****Environmental conditions**

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Non-operational Conditions					
T _{AMB}	Ambient temperature		-25	+85	°C
RH	Relative humidity		-	95	%
g _B	Bump acceleration	25g	-	245	m/s ²
g _S	Shock acceleration	50g	-	490	m/s ²
	Vibration amplitude	10 to 55 Hz	-	0.35	mm
Operational conditions					
T _{AMB}	Ambient temperature		-10	+60	°C
RH	Relative humidity		-	95	%

Limiting values under operational conditions

The tuner can be guaranteed to function properly under the following conditions.

A)

SYMBOL	PARAMETER	PIN	MIN	TYP.	MAX.	UNIT
5V	Tuner Supply voltage	6	4.75	5.00	5.50	V
V _{S(ripple)}	Peak to peak ripple voltage susceptibility ⁽⁶⁾		5	-	-	mVpp
I _{5V}	Supply current		-	-	150	mA
5V (LT)	Loop Through Supply voltage	4	4.75	5.00	5.25	V
I _{5V(LT)}	Supply current		-	-	60	mA
1.8V	Supply voltage 1.8V	11	1.75	1.8	1.95	V
I _{1.8V}	Supply current		-	-	140	mA
3.3V	Supply voltage 3.3V	12	3.0	3.3	3.6	V
I _{3.3V}	Supply current		-	-	105	mA
V _{AS}	Address select input voltage	7	-	-	5.5	V
V _{SCL}	Serial clock input voltage	25	-0.3	-	5.5	V
V _{SDA}	Serial data input voltage	24	-0.3	-	5.5	V
I _{SDA}	Serial data input current		-1	-	5	mA

NOTE

⁽⁶⁾ Sinusoidal ripple voltage superimposed on the 5V-supply voltage in the frequency range of 20 kHz to 500 kHz. Criteria for TV interference is >57 dB.

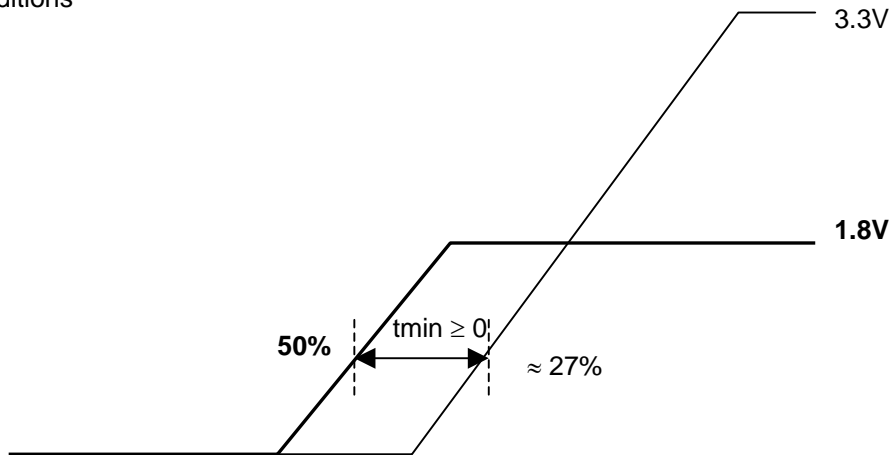
All Bands DVB-C Receiver Unit

CU1216LS MK3 family

B) Power Supply Sequencing Include Reset.

The voltage level of the 5V must always exceed the voltage level of the 3.3V & 1.8V supply during power up in order to guarantee against latch-up.

The voltage level of the 3.3V and 1.8V supplies must always fit to the following conditions to ensure proper power up conditions

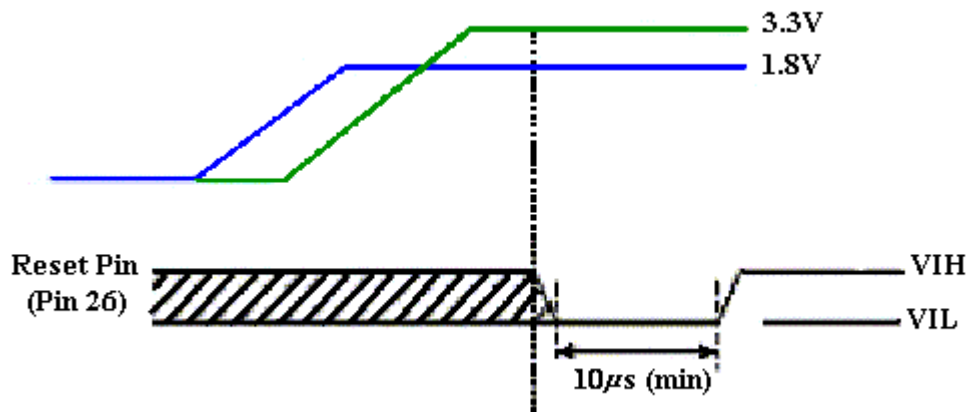


If a period of 't' is needed for 1.8V to turn on, then, 3.3V needs to be turned on after 't' time of 1.8V.

C) RESET REQUIREMENT

After power up sequencing, a software reset has to be implemented as follow :

This form of reset is managed by host processor and the timing conditions as below :-



Level VIH and VIL are TTL compliant

All Bands DVB-C Receiver Unit**CU1216LS MK3 family****ELECTRICAL DATA****Conditional data**

Unless otherwise specified, all electrical values for Chapter "Electrical data" apply at the following conditions and the electrical performance is related to system B,G and H. A proper function is guaranteed within the specified operational conditions but a certain deterioration of performance parameters may occur at the limits of operational conditions.

SYMBOL	PARAMETER	VALUE	UNIT
T _{AMB}	Ambient temperature	25 ± 2	°C
RH	Relative humidity	60 ± 10	%
5V	Tuner Supply Voltage	5 ± 0.1	V
5V(LT)	Loop Through Supply Voltage	5 ± 0.1	V
1.8V	Supply Voltage 1.8V	1.8 ± 0.1	V
3.3V	Supply Voltage 3.3V	3.3 ± 0.1	V
Z _{S(AE)}	Aerial source impedance (unbalanced)	75	Ω

The tuner has to be tuned to an IF-frequency of 36.15 MHz.
RF-out must be terminated with 75 ohm when not used!

TUNER CHARACTERISTIC	Conditions	Min.	Typ.	Max.
Frequency Range				
Low band		51MHz		157MHz
Mid Band		164MHz		442MHz
High Band		450MHz		858MHz
Tuning Margin		3MHz		
Surge Protection		4		kV
Voltage Gain CU1216LS ^(*)		45dB		57dB
Gain Taper			6dB	
Image Rejection	0dB to 10dB GR			
Low Band		66dB		
Mid Band <300MHz		66dB		
Mid Band >300MHz		63dB		
High Band		50dB		
Oscillator Phase Noise	@10kHz			
Low Band		-84dBc		
Mid Band		-84dBc		
High Band		-82dBc		
RF AGC range			45dB	
Low Band		40dB		
Mid Band		35dB		
High Band		30dB		
Noise figure ^(*) ^(*)				11dB
Osc. Voltage at aerial input (75Ω): (f < 1GHz) (f > 1GHz)				< 46dBμV < 46dBμV

All Bands DVB-C Receiver Unit**CU1216LS MK3 family**

TUNER CHARACTERISTIC	Conditions	Min.	Typ.	Max.
Channel tilt (IF center \pm 3.0MHz) for CU1216LS (IF center \pm 4.0MHz) for CU1216LS	0dB GR, $f < 300$ MHz 0dB GR, $f > 300$ MHz			4.0dB 4.5dB

LOOPTHROUGH CHARACTERISTIC ^(*) (RF in to RF out) – CU1216LS	Conditions	Min.	Typ.	Max.
Frequency Range		48MHz		855MHz
Power gain	@75 Ω	-1dB		5dB
Noise Figure				10dB
Passive LT gain ^(*)			-2.5dB	-4dB
2 nd order intermodulation	80dBuV input level	136dBuV		
3 rd order intermodulation	90dBuV input level	121dBuV		
Return Loss @75 Ω	75 Ω termination at RF out - freq \leq 70 MHz - freq $>$ 70 MHz	6dB 8dB		
Osc. Voltage at RF out: ($f < 300$ MHz) ($f > 300$ MHz)				< 20dB μ V < 30dB μ V
DEMODULATOR	Conditions	Min.	Typ.	Max.
Sensitivity 64QAM 256QAM	6.9MS, BER 2×10^{-4}	-66dBm -62dBm		
C/N 64QAM 256QAM	Pin = -45dBm, 6.9MS, BER 2×10^{-4}	26.5 32.5		

(*) : to be measured at broad band IF output

(*) : to be measured \pm 3.0MHz from IF center. RF-out terminated with 75 Ω

(*) : to be measured at max. gain (nom. AGC voltage)

(*) : to be measured Tuner supply and loop through supply off

All Bands DVB-C Receiver Unit**CU1216LS MK3 family****APPLICATION INFORMATION**

A detailed description of the IIC specification, with applications, is given in brochure "The IIC bus And how to use it". Code number : 9398 393 40011.

The CU1216 family contains two I²C transceivers, one in the tuner part, and one in the QAM channel decoder. It is imperative to ensure that both I²C devices are programmed correctly according to their addresses. Please note that to prevent interference to the tuner from the constant activity on the I²C bus to the channel decoder IC, all I²C communications to the MOPLL IC is gated through the decoder IC. In this case, channel decoder's I²C bus should be placed in bypass mode.

A more detailed description of the PLL IC (especially logic diagram) can be found in the device specification of Philips Semiconductor, TDA6509AHN.

For application information about the channel decoder, please refer to the TDA10021/23, single DVB-C Channel Receiver from Philips Singapore. Code number : 9398 393 40011. Address select for the module is defined by the TDA10021/23 IC on pin 7 (AS pin) of the module. If the AS pin (pin 7) of the module is grounded, the module's address is 0 x 18 else if it is tied to 5V, the module address would be 0 x 1A.

I²C Control**I²C settings (For PLL Tuner only)**Logic diagram

Telegram examples:

Start - ADB – DB1 - DB2 - CB - BB - Stop

Start - ADB - CB - BB - DB1 - DB2 - Stop

Start - ADB - DB1 - DB2 - Stop

Start = start condition Stop = stop condition

ADB = address byte

DB1 = divider byte 1 DB2 = divider byte 2

CB = control byte 1 BB = control byte 2

Table 1 **I²C-bus data format, 'WRITE' mode**

NAME	BYTE	BITS								ACK
		7				0				
		MSB				LSB				
Address Byte	ADB	1	1	0	0	0	0	0	R/W=0	A
Prog. Div. Byte 1	DB1	0	N14	N13	N12	N11	N10	N9	N8	A
Prog. Div. Byte 2	DB2	N7	N6	N5	N4	N3	N2	N1	N0	A
Control Byte	CB	1	CP	T2	T1	T0	RSA	RSB	WSB=0	A
Band-switch byte	BB	0	0	0	P4	P3	P2	P1	P0	A

All Bands DVB-C Receiver Unit**CU1216LS MK3 family**PROGRAMMABLE DIVIDER SETTING (BYTES DB1 AND DB2)

Divider ratio: $N = F_{OSC}/F_{SS}$

where $F_{OSC} = (F_{RF} + F_{IF})$ and F_{SS} is the step-size set by RSA and RSB as described below.

$$N = 8192*N13 + 4096*N12 + 2048*N11 + 1024*N10 + 512*N9 + 256*N8 + 128*N7 + 64*N6 + 32*N5 + 16*N4 + 8*N3 + 4*N2 + 2*N1 + N0$$

Note: $F_{IF} = 36.15 \text{ MHz}$

CONTROL BYTE CBCharge Pump Setting:

CP can be set to either 0 (low current) or 1 (high current).

CP = 1, charge pump current = 280uA results in fastest tuning (default mode)

CP = 0, charge pump current = 60uA results in moderate speed tuning with better residual oscillator

PLL Disabling:

OS=0 for normal operation,

OS=1 switches off the PLL tuning amplifier (PLL tuning is disabled)

Weak Signal Booster:

Warning: WSB must be set to 0. Otherwise tuner overload will occur.

Test Mode Setting:

T2	T1	T0	TEST MODES
T2	T1	T0	Test Mode
0	0	0	Normal mode (read and write mode bytes allowed)
0	0	1	Normal mode (read and write mode bytes allowed) (1)
0	1	0	Charge pump is off
0	1	1	Byte BB ignored
1	0	0	Charge pump sinks current
1	0	1	Charge pump sources current
1	1	0	½ f ref output from port P3
1	1	1	½ f ref output from port P3

(1) Default mode at power-on reset.

Reference Divider Ratio Select Bits:

RSA	RSB	Reference Frequency/Step Size	Remarks
0	1	31.25kHz	Slow picture search
1	1	62.5kHz	Normal picture search

BANDSWITCHING BYTE BB

PORTS	P0	P1	P2	P3	P4
LOW BAND	1	0	0	0	0
MID BAND	0	1	0	0	0
HIGH BAND	0	0	1	0	0

All Bands DVB-C Receiver Unit**CU1216LS MK3 family****Tuner Part Programming (Read Mode)**

BIT ALLOCATION (READ MODE R/W = 1)

NAME	MSB	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	LSB	ACK
Address Byte ADB	1	1	0	0	0	MA1	MA0	R/W=1	A
Status Byte SB	POR	FL	1	1	1	A2	A1	A0	A

The following data can be read from the device through the status byte:

POR (power on reset): POR is internally set to 1 in case V_{cc} drops below 3V. The POR bit is reset when an end of data is detected by the PLL-IC.

FL: in lock flag (FL = 1 when the phase lock loop is in lock)

The loop must be phase-locked during at least 8 periods of the internal 7.8125 kHz reference-frequency 1msec before the FL flag is internally set to 1.

A2, A1, A0: Not used.

All Bands DVB-C Receiver Unit**CU1216LS MK3 family**

MECHANICAL DATA

See product drawing 3139 149 0155

AERIAL CONNECTIONS

Standard phono socket female, IEC socket/plug
75Ω or F-connector socket female

SOLDERABILITY

The solderability of pins and mounting tags when tested initially and after 16 hour steam ageing in accordance with "IEC 60068-2-20", test Ta, method 1 (solder bath 235°C for 2s), results in a wetted area of 95%. No de-wetting will occur when soldered at 260°C for 5s.

RESISTANCE TO SOLDERING HEAT

The product will not be damaged when tested in accordance with "IEC 60068-2-20", test Tb, method 1A (solder bath 260°C for 10±1 s).

MASS

Approximately: 41g

ROBUSTNESS OF PINS

The pins will not be damaged when tested in accordance with "IEC 60068-2-21":

- Test Ua1, tensile of 10N in axial direction
- Test Ua2, thrust of 4N in axial direction

PUNCHING PATTERN OF CHASSIS PCB

For optimum mounting of the tuner to a PCB, the punching pattern is recommended (see 3139 149 0155).

The tuner must be mounted without clearance between the tuner supporting surface and the printed circuit board (PCB). When mounted in this way, the tuner must be soldered to the PCB. This can be achieved by pressing the unit vertically onto the PCB during soldering.

All Bands DVB-C Receiver Unit**CU1216LS MK3 family****PACKAGING INFO**

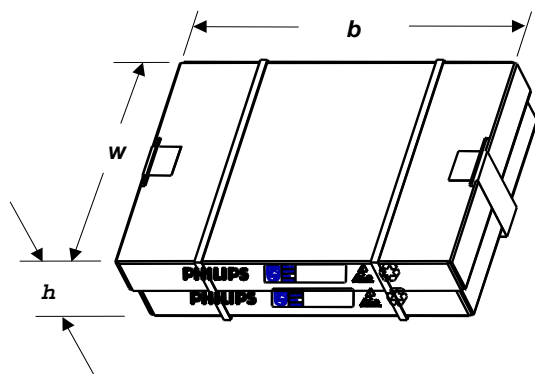
The products are packed in the carton box and transferred to customers by Pallet Transport.

Mounting Type	Dimension b x w x h (cm)		No. of sets	Gross Wt (kg)
	Carton	46 x 34 x 10.1		
Horizontal-mount type	Pallet	120 x 105 x 105	6264	348
	Carton	46 x 34 x 10.1	128	5.8
Vertical-mount type	Pallet	120 x 105 x 105	7424	362

The information in the above table is valid for the following types only:

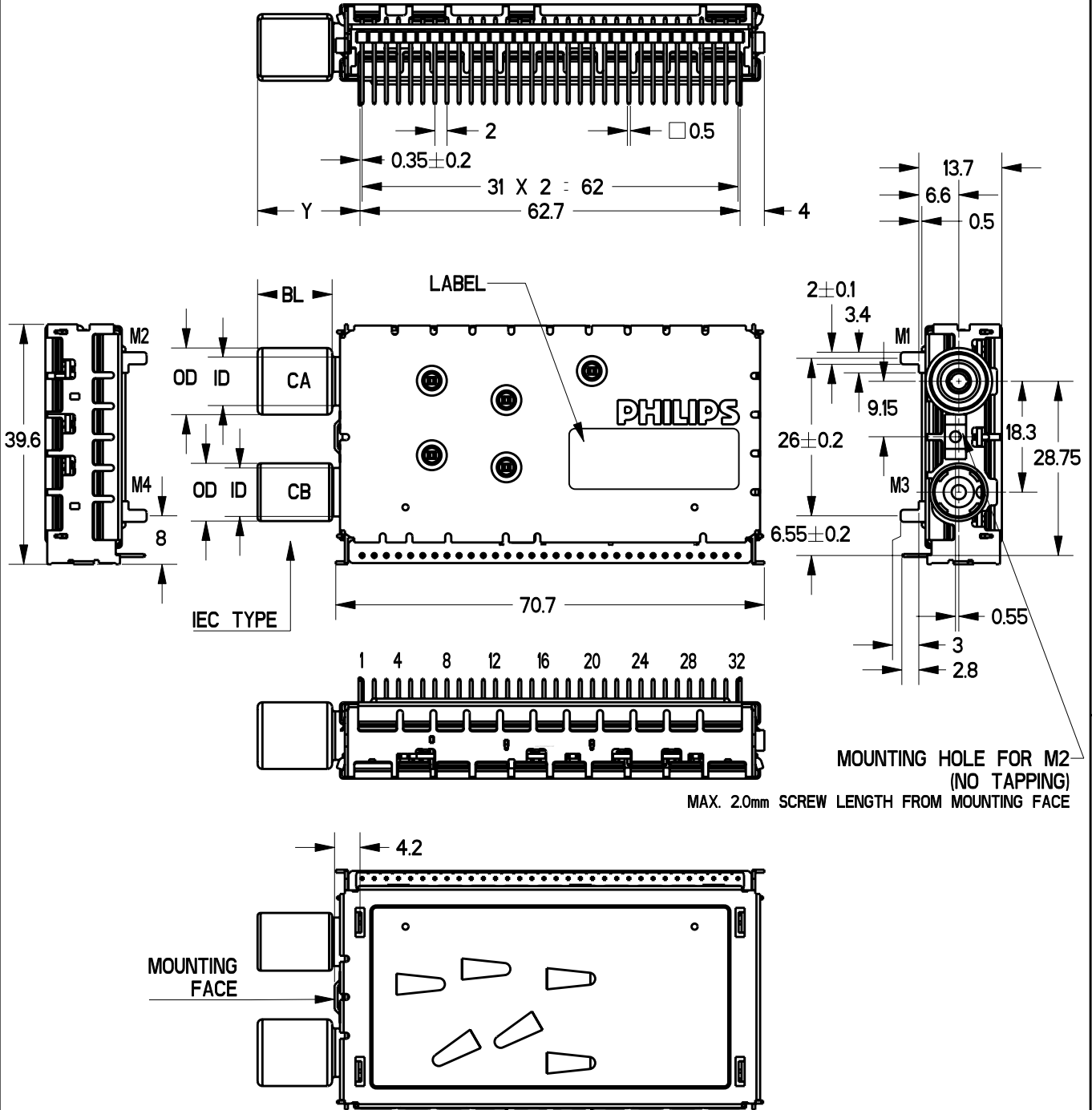
- CU1216LS/A F G V-3,
- CU1216LS/A FI G V-3, and
- CU1216LS/A FI G H-3.

Carton Boxes are made of Corrugated Fibreboard, which are free of environmentally banned substances

Example of Carton Box:

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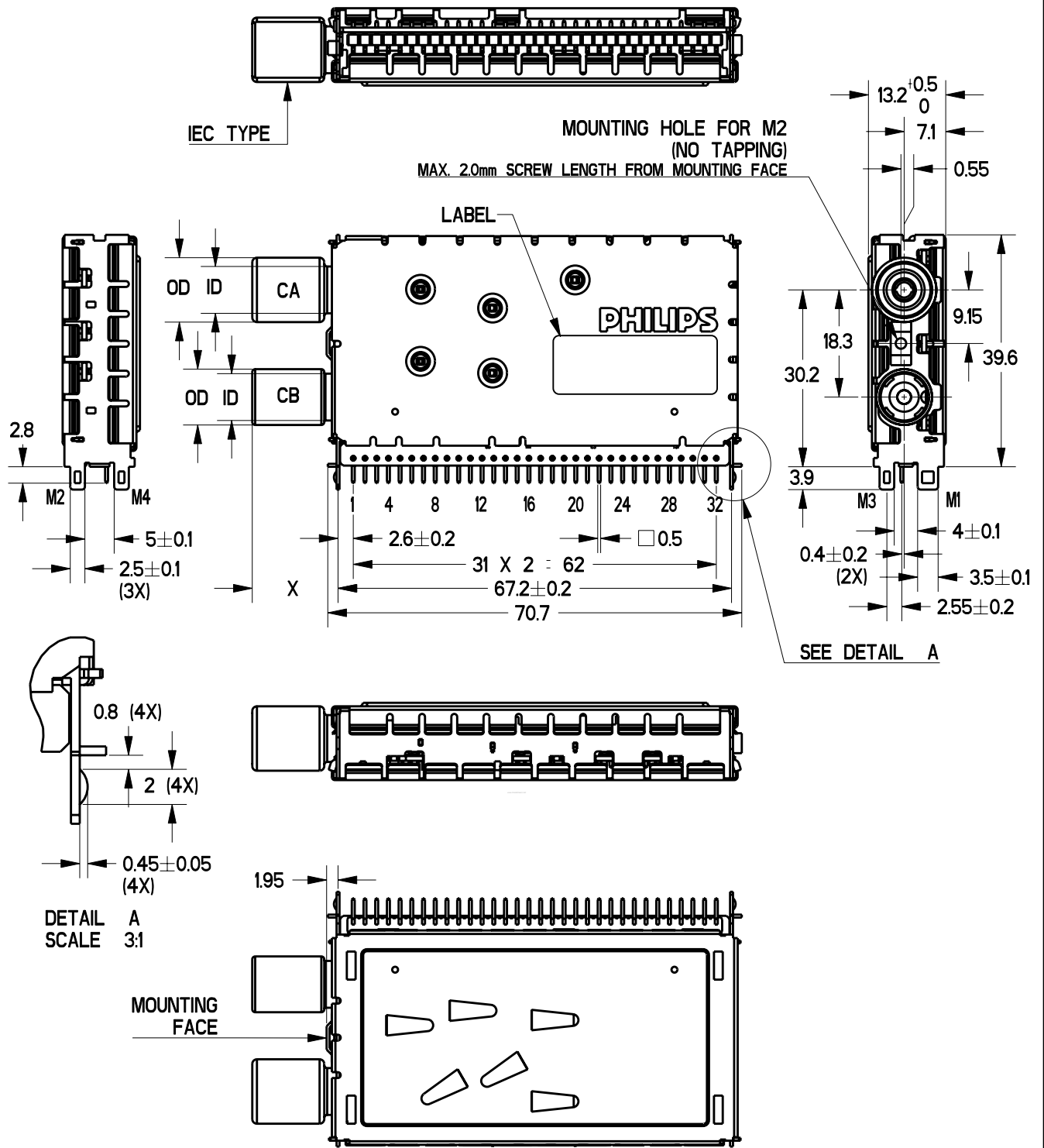
NOTE:

- DRAWING IS FOR HORIZONTAL MOUNTING VERSION
- ALL DIMENSIONS IN MILLIMETER.
- GENERAL TOLERANCE ±0.5mm
- CONNECTOR CB IS VOID FOR SINGLE-CONNECTOR VERSION.
- DRAWING NOT TO SCALE.
- SEE SH110-3 FOR OTHER CONNECTOR TYPES.

CLASS NO. 2SM000	PRODUCT MECHANICS CU/TU1216		3139 149 0155		1	-----
					1	03-03-06
					1	04-03-12
					1	04-08-18
02-08-28						
NAME SOH KL	SUPERS	XXXX XXX XXXX	5	10	110 - 1	A4
SV	CHECK	DATE 02-08-28	© KONINKLIJKE PHILIPS ELECTRONICS N.V.			

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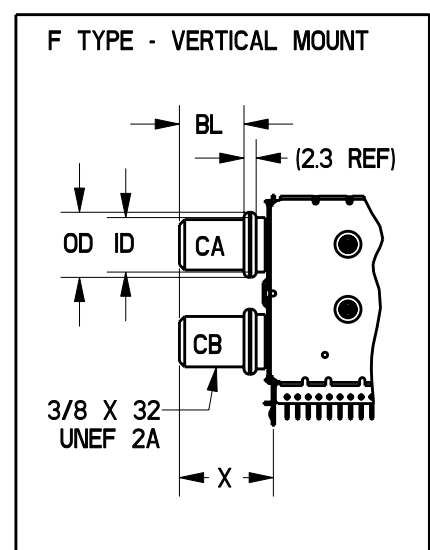
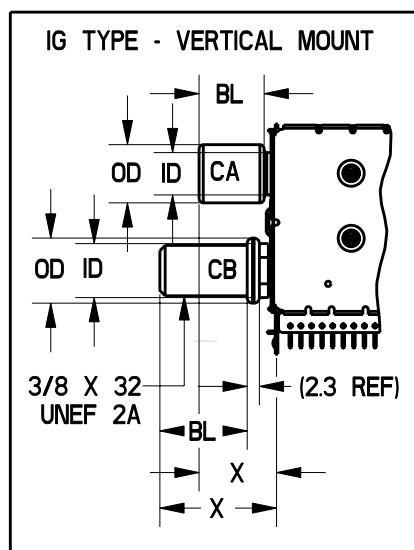
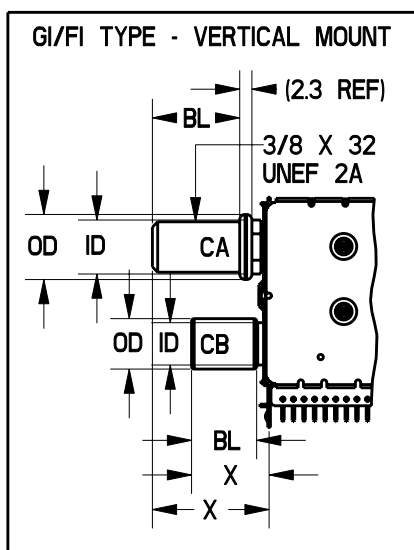
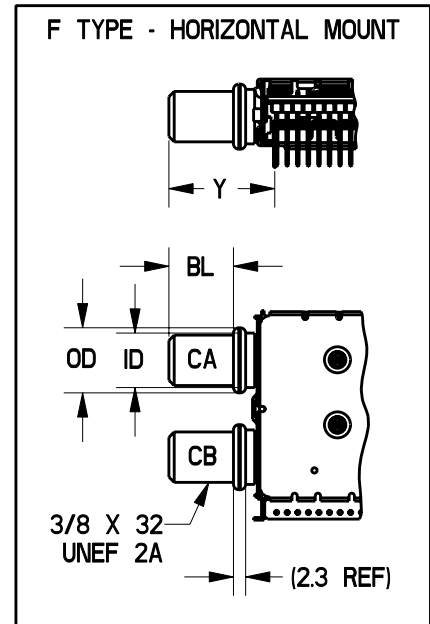
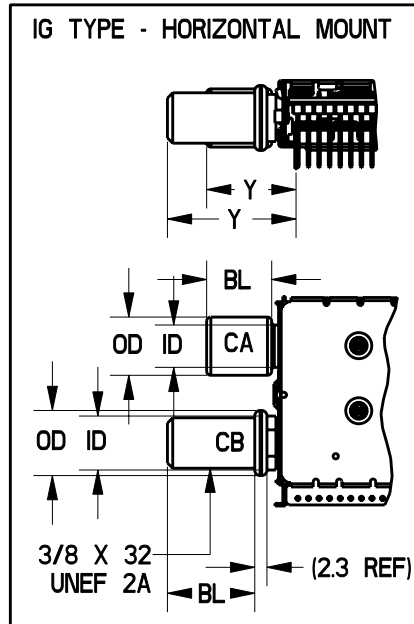
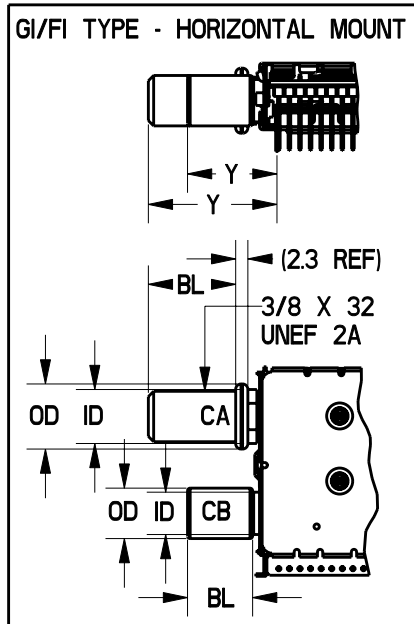


- NOTE:
- DRAWING IS FOR VERTICAL MOUNTING VERSION
 - ALL DIMENSIONS IN MILLIMETER.
 - GENERAL TOLERANCE ±0.5mm
 - CONNECTOR CB IS VOID FOR SINGLE CONNECTOR VERSION.
 - DRAWING NOT TO SCALE.
 - SEE SH110-03 FOR OTHER CONNECTOR TYPES.

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					1	04-03-12
					1	04-08-18
02-08-28						
NAME SOH KL	SUPERS	xxxx xxx xxxxx	5	10	110 - 2	A4
SV	CHECK	DATE 02-08-28	© KONINKLIJKE PHILIPS ELECTRONICS N.V.			

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OTHER CONNECTOR TYPES:



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AERIAL CONNECTOR TYPE			CONNECTOR DISTANCE, Y	CONNECTOR DISTANCE, X	BODY LENGTH, BL	OVERALL DIAMETER, OD	INNER DIAMETER, ID
I	CA	IEC FEMALE	16.9±0.5	14.65±0.5	12.2±0.3	∅11.0±0.1	∅8.0±0.2
	CB	IEC MALE				∅9.53±0.05	
F	CA	F	20.0±0.5	17.75±0.5	12.2±0.3	∅12.3 ^{0/-0.3}	∅9.8±0.2
	CB						
GI	CA	F	24.3±0.5	22.05±0.5	16.5±0.3	∅12.3 ^{0/-0.3}	∅9.8±0.2
	CB	IEC MALE	16.9±0.5	14.65±0.5	12.2±0.3	∅9.53±0.05	∅8.0±0.2
IG	CA	IEC FEMALE	16.9±0.5	14.65±0.5	12.2±0.3	∅11.0±0.1	∅8.0±0.2
	CB	F	24.3±0.5	22.05±0.5	16.5±0.3	∅12.3 ^{0/-0.3}	∅9.8±0.2
FI	CA	F	20.0±0.5	17.75±0.5	12.2±0.3	∅12.3 ^{0/-0.3}	∅9.8±0.2
	CB	IEC MALE	16.9±0.5	14.65±0.5	12.2±0.3	∅9.53±0.05	∅8.0±0.2

CLASS NO.	2SM000
DATE	02-08-28

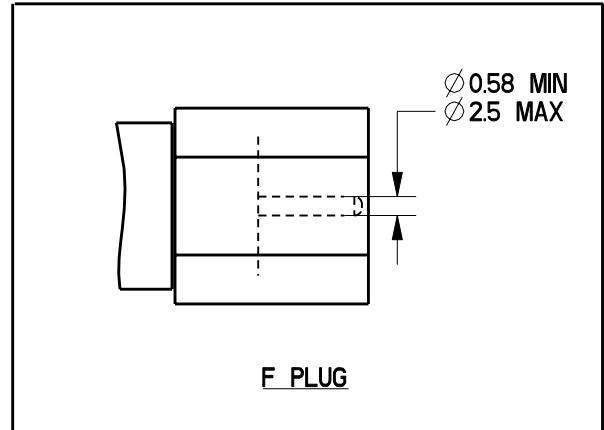
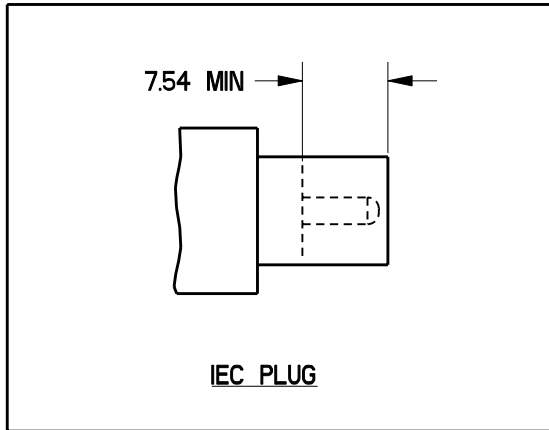
PRODUCT MECHANICS
CU/TU1216

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	1	04-03-12
	1	04-08-18
	.	.

NAME	SOH KL	SUPERS	XXXX XXX XXXX	5	10	110 - 3	A4
SV		CHECK	DATE	02-08-28	© KONINKLIJKE PHILIPS ELECTRONICS N.V.		

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MALE CONNECTOR REQUIREMENTS



For dimensions which are not reflected in the drawing, refer to IEC 600169-2 (for IEC plug) and IEC 600169-24 (for F plug).

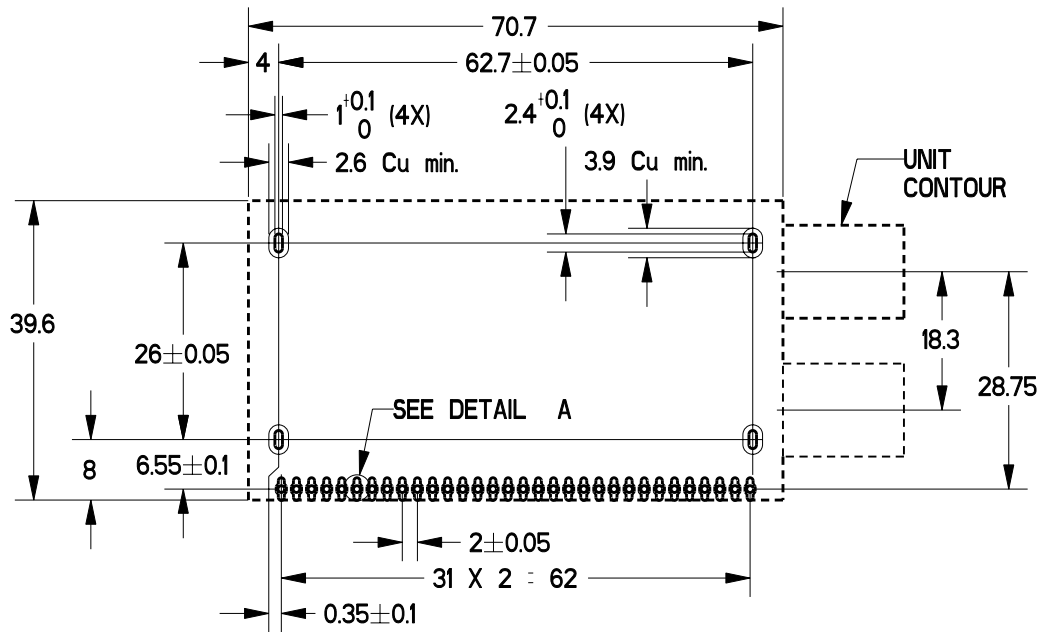


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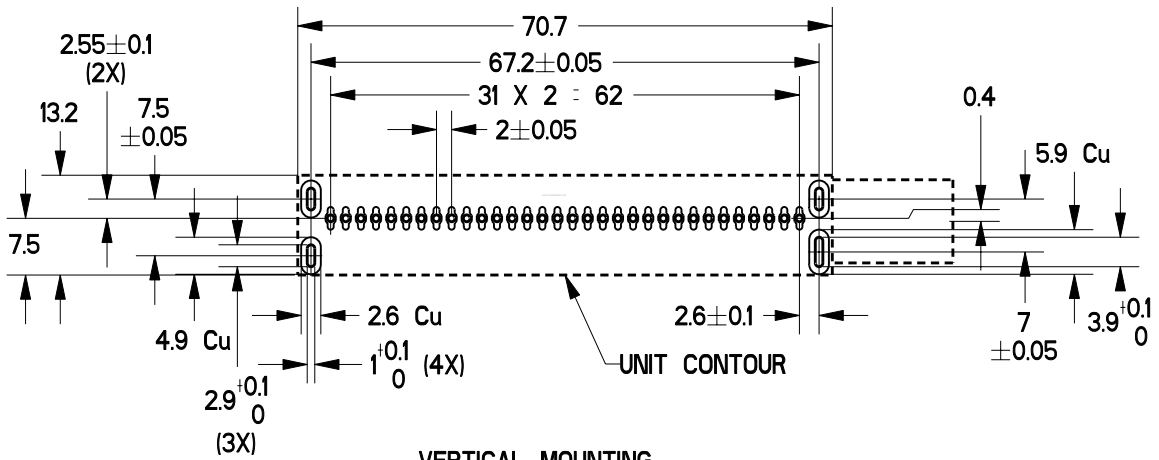
CLASS NO. 2SM000		<p>PRODUCT MECHANICS CU/TU1216</p> <p>3139 149 0155</p>			1	-----
					1	03-03-06
					1	04-03-12
					1	04-08-18
02-08-28					.	.
NAME	SOH KL	SUPERS	XXXX XXX XXXX	5	10	110 - 4
SV		CHECK	DATE	02-08-28	© KONINKLIJKE PHILIPS ELECTRONICS N.V.	

PUNCHING PATTERN OF CHASSIS PCB

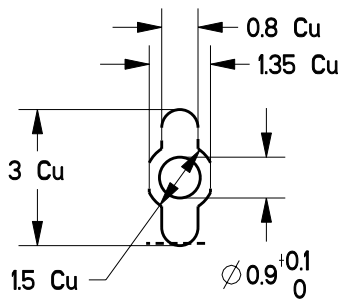
(for free xy- wave soldering direction, seen from solder side)



HORIZONTAL MOUNTING



VERTICAL MOUNTING



DETAIL A

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CLASS NO. 2SM000	PRODUCT MECHANICS CU/TUI216	3139 149 0155		1	-----
				1	03-03-06
			1	04-03-12	
			1	04-08-18	
02-08-28					
NAME SOH KL	SUPERS xxx xx xx xxx	5	10	110 - 5	A4
SV	CHECK	DATE 02-08-28	© KONINKLIJKE PHILIPS ELECTRONICS N.V.		

All Bands DVB-C Receiver Unit**CU1216LS MK3 family****DEFINITIONS**

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specification.
Application Information	
Where application information is given, it is advisory and does not form part of the specification	

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