

Table of Contents

Introduction.....	5
About this Manual	5
Typeface Conventions.....	5
Additional Assistance.....	5
On-Line Manuals	5
Contact Details	5
Safety Instructions	6
Safety Symbols.....	6
Chapter 1: General Information	7
User Manual Content.....	7
Overview	7
Pulse Transmitter Modules.....	9
Transmitter Control Chassis	11
Tx Power Supply Distribution Unit	11
High Voltage Power Supply Unit.....	12
Options and Accessories	12
Transmit/Receive Switch.....	12
High-Power Splitter Combiner.....	13
RF Drive Splitter	13
Transmitter Control Interface	13
Chapter 2: Specifications.....	14
Chapter 3: Installation.....	15
General.....	15
Unpacking.....	15
Fitting the Castors.....	16
Completing the Unpacking.....	16
Fitting Transmit/Receive Switches and High-Power Splitter Combiners	17
Preparation for Use.....	18
Initial Inspection	18

Location and Cooling.....	18
AC Source Requirements.....	18
AC Input Power Connection.....	18
Turn-On Check Procedure.....	19
Connecting the Load.....	19
Repacking for Shipment.....	19
Chapter 4: Indicators, Controls and Connectors.....	20
Pulse Transmitter Module.....	20
Transmitter Control Chassis.....	21
Transmitter Power Supply Distribution Unit.....	21
HV Power Supply Unit.....	21
Transmitter Control Interface.....	21
Chapter 5: Signal Descriptions.....	24
Tx Control Signals.....	24
RS 485.....	24
Pulse Memory Address A0, A1.....	25
Trigger.....	25
Phase Switch.....	25
RF Drive.....	25
Chapter 6: Configuration and Programming.....	26
Communication Overview.....	26
Factory Default Settings.....	27
Initialisation.....	27
Configuration.....	28
Status Monitoring.....	28
High Voltage Power Supply Unit Communication.....	29
Glossary.....	30
Appendix A: PKT-1 Packet Format.....	31
PK-1 Packet Format.....	31
Standard MD Commands.....	32
GTS MD Commands.....	36
GTC MD Commands.....	47
Appendix B: Transmitter System Examples.....	55

Table of Contents

4 x PTM, 4 x TR Switch, 2 x High Power Splitter Combiner	55
--	----

Introduction

About this Manual

This manual provides a reference for the use and maintenance of Genesis Software's PTS series Pulse Transmitter System.

Typeface Conventions

The following typeface conventions are used in this manual

- ***Bold-italics*** are used for the names of executable programs
- *Italics* are used for internet addresses, URLs and names, or for program states
- *Italics* within double quotes ("*Italics*") are used for on-screen computer menu entries, buttons and other forms of information entry
- Normal text within single quotes ('Normal text') is used for extracts from other text, such as computer commands or command output
- Courier font is used for file names and directory names, computer output and command line syntax examples.
- <Substitute text> indicates an item whose actual text content may vary, depending either on the user's choice, or on the content of a computer response
- <ABBR>- indicates the use of a keyboard modifier, (such as <ALT>- or <CTRL>-) to be used in conjunction with another key or keys

Additional Assistance

On-Line Manuals

PDF versions of the radar system manuals (including this manual) are available on the radar host computer. These manuals may be accessed by navigating the Start Menu, or by directly invoking **acroread** and locating files in the /local0/Documents directory.

Contact Details

Software problems, bugs, anomalies or inconsistencies, or requests for technical assistance should be reported via electronic mail or fax. Support information is also available on the web site shown below.

Contact	Details
Email	support@gsoft.com.au
Phone	+61 8 8267 3493
Fax	+61 8 8267 3039
Web	www.gsoft.com.au
Address	Genesis Software 10 Marian St North Adelaide SA 5006 Australia

Safety Instructions

Safety Symbols

The following safety symbols are used in this manual and on the equipment.



CAUTION Risk of Electrical Shock.



User manual symbol. The equipment will be marked with this symbol when it is necessary for the user to refer to the user manual.



Indicates hazardous voltage.



Indicates ground terminal



Protective Ground Conductor Terminal. Must be connected to Earth Ground.



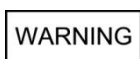
Off (mains supply, power supply, enable)



On (mains supply, power supply, enable)



On / Off (mains supply, power supply, enable)



The WARNING sign denotes a hazard. An attention to a procedure is required. Not following a procedure correctly could result in personal injury. A WARNING sign should not be skipped and all indicated conditions should be fully understood and met.



The CAUTION sign denotes a hazard. An attention to a procedure is required. Not following a procedure correctly could result in damage to the equipment. Do not proceed beyond a CAUTION sign until all indicated conditions are fully understood and met.

Chapter 1: General Information

User Manual Content

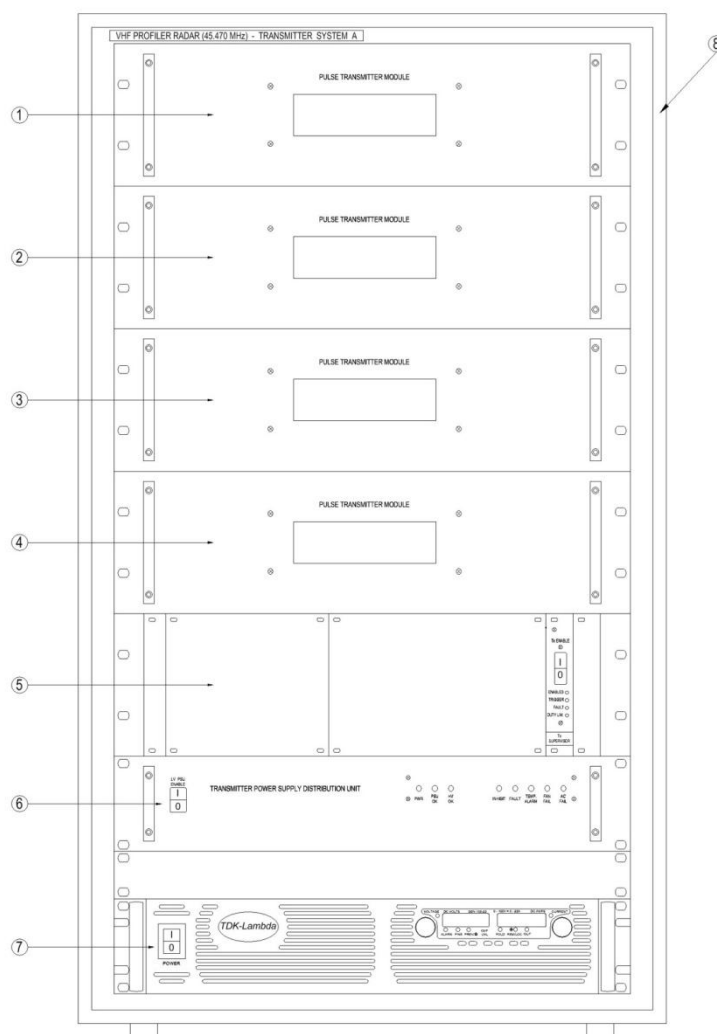
This user manual provides specifications, installation instructions and operating instructions for Genesis Software's PTS series Pulse Transmitter System.

Overview

The PTS series pulse transmitter system is a modular system comprised of one or more pulse transmitter modules (PTMs). The output power of a PTM is typically specified at a maximum of 7.5 kW, although this may vary depending on other specifications of the transmitter such as maximum duty cycle limit.

Each PTM has a single output port which may be used to directly drive an antenna or antenna group. Alternatively, optional multi-port power combiners may be used to combine the outputs of multiple PTMs to provide a reduced number of higher power output ports.

A Pulse Transmitter System comprised of four PTM's is shown in the following diagram.



Pulse Transmitter System Comprised of Four Pulse Transmitter Modules

The components of the PTS series Pulse Transmitter System are shown in the following table.

Number	Item	Description
1-4	Pulse Transmitter Module	4 x Pulse transmitter module each contributing ¼ of the total transmitter power
5	Tx Control Chassis	Transmitter control chassis
6	TxPSDU	Transmitter power supply distribution unit
7	HV PSU	High voltage power supply unit
8	Cabinet	19" equipment cabinet

The physical appearance of components may vary from what is shown above depending on the specifications of the transmitter. For example, transmitters with two PTM's may use a lower maximum output power HV PSU housed in a 1RU form factor.



Pulse Transmitter System Comprised of Four Pulse Transmitter Modules

Pulse Transmitter Modules

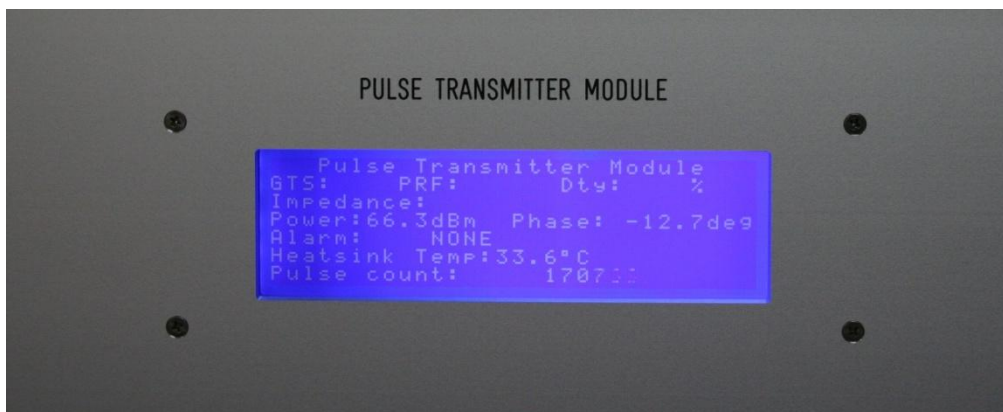
The top chassis in the cabinet are the pulse transmitter modules. These are identically specified in terms of power, but may differ in output port configuration and out port power monitoring.



Genesis Software Pulse Transmitter Module

A Genesis Software pulse transmitter module (PTM) is shown in the above image. The PTM incorporates sophisticated inbuilt monitoring and diagnostics and error reporting, and measurements are both displayed on the front panel LCD and routinely recorded to a log file during operation. Examples of parameters that are measured included output power, output phase and the complex impedance of the load (antenna) during operation under full power.

The front panel display format is shown in the following image.



Pulse Transmitter Module Display Format

The Pulse Transmitter Module is comprised of four power amplifiers. These are controlled and driven by a microcontroller-based transmitter control module, which incorporates sophisticated monitoring of the operational characteristics of each power amplifier. The outputs of the four power amplifiers are combined to provide a single 7.5 kW output port.

The modular design of the transmitter facilitates ease of maintenance and troubleshooting, and in event of a failure, modules may be readily replaced to make restitution.

The internal arrangement of a PTM is shown in the following image.



Internal View of Genesis Software Pulse Transmitter Module

The PTM includes a directional coupler that provides the means to measure the forward and reflected power during transmission. This allows the complex impedance characteristics of the antenna groups to be measured under full power, useful both for monitoring purposes during normal operation and for automatic transmitter shutdown in the event of a load fault. The phase of the transmitted output is also measured enabling the system to automatically check this critical calibration.

Transmitter Control Chassis

Below the PTM's is the Transmitter Control Chassis (TXCC). The TXCC includes a transmitter supervisor module (GTS) and distributes control signals to the PTM's and monitors PTM status. The GTS has an RS-485 interface over which the transmitter may be configured and status reported.

Tx Power Supply Distribution Unit

Located below the Transmitter Control Chassis is the Tx Power Supply Distribution Unit (TXPSDU). The TXPSDU distributes the low and high voltage power rails to the PTM's. The high voltage rail comes from an external high voltage power supply unit and the low voltage power supply rails are generated by an low voltage power supply unit internal to the TXPSDU.

High Voltage Power Supply Unit

The high voltage power supply unit (HV PSU) is located at the bottom of the transmitter cabinet. The HV PSU has an RS-232 interface over which the supply may be programmed and status reported. The HV PSU also has an RS-485 port to expand the interface to additional pulse transmitter systems.

Options and Accessories

A range of options and accessories is available to address specific user-requirements. These items include:

- Transmit/receive switches
- High-power splitter / combiners
- RF drive splitters
- Transmitter control interfaces
- Custom-designed items

Transmit/Receive Switch

The transmit / receive switch (TR switch) allows both transmission and reception on the same antenna or antenna group. In a typical arrangement, a PTM feeds a TR switch and the output of the TR switch feeds a single antenna or a section of an antenna array. The receive port of the TR switch feeds a receiver, either directly, or combined with the receive port signals of further TR switches.

The TR switch has three ports:

- RF In port

This port is fed by a transmitter RF Out port

- RF Out port

This port feeds an antenna or antenna group

- Rx Out port

This port provides receive feed for the receiver system

During transmission in the presence of output power from the transmitter, transmitter power is directed to the antenna and there is high isolation to the receive port. When there is no transmission, the receive port is connected to the antenna and signals received on the antenna are fed to the receiver system.

The TR switch is a passive type and it switches automatically between transmit and receive modes in the presence or absence of transmitter output signal.

High-Power Splitter Combiner

The high power splitter / combiner combines the outputs of two or four PTM's to a single higher power output port.

RF Drive Splitter

The RF drive splitter takes user-supplied RF drive signal and splits and amplifies it to provide RF drive to each PTM. It also provides band pass filtering on the input signal.

Transmitter Control Interface

The transmitter control interface module (TXCI) provides a convenient interface between user-supplied control equipment and the transmitter. It translates transmitter differential logic signals to single-end logic signals. It also provides the RF Gate signal as a BNC output which is for gating user-provided RF drive on for the period required by the transmitter. The TXCI module is described in a following section.

Chapter 2: Specifications

RF	
Frequency range	Fixed frequency, e.g., 50 MHz
Peak envelope RMS power per PTM	7.5 kW / 5% max. duty cycle 6 kW / 7.5% max. duty cycle 5 kW / 10% max. duty cycle
Harmonics	< 60 dBc
Spurious	< 60 dBc
Duty Cycle	5% for 7.5 kW PTM 7.5% for 6 kW PTM 10% for 5 kW PTM
Efficiency	> 60%
Maximum pulse length	400 μ s
Minimum pulse length	1 μ s
Occupied bandwidth	200 kHz (typical). Modulation dependent
RF drive level	10 dBm CW or gated
Modulation shape	Square, shaped, triangular
Maximum VSWR	< 1.4
Protection	Active load monitoring pulse-to-pulse
Status Readouts	
Pulse count	
Output power	dBm
Output phase	Degrees
PA temperature	C
Alarm conditions	VSWR, fan failure, etc.
Controls	
Modulation voltage	2V (differential)
Trigger	CMOS (differential)
Communication	RS485
Power	
Mains supply	110V to 240V
Mains power	Depends on number of PTM's and duty cycle. 3.7kW typical max. for 4 PTM transmitter
Mechanical	
Control connector	D25 (twisted pairs)
RF out	N-type
Drive input	BNC
Sample output	BNC
Housing	19" equipment cabinet, 600mm deep

Chapter 3: Installation

General

This chapter provides instructions for the initial inspection, preparation for use and re-packing for shipment. Interfacing to the transmitter is described in *Chapter 5: Signal Descriptions* and programming the transmitter is described in *Chapter 6: Configuration and Programming*.

Unpacking

The transmitter system is shipped in a wooden packing case and its accessories are generally shipped in one or more cardboard cartons. The transmitter system is heavy and the packed weight may typically be around 140 kg depending on the actual transmitter configuration. The case is fitted with bearers so that it may be readily moved with a forklift or hand pallet truck and the case is lined with a film to provide moisture protection for the contents during transit. The lid and a front side of the case are secured with screws so that the transmitter can be unpacked without damaging the case. If the transmitter is reshipped in the future, it should be repacked in the original packing case.

The transmitter is wrapped in clear protective film for shipment and foam packing frames are fitted to the top and bottom of the cabinet. It is shipped lying on the rear of its cabinet.

Before starting to unpack, inspect the packing case for any signs of damage that may have occurred in transit. If there are any signs of damage evident, take photographs to document and contact the manufacturer.

As the transmitter is heavy and awkward to manoeuvre, ensure that the transmitter is unpacked in an area with ample clear space and that sufficient able-bodied personnel are available to assist in handling. Three to four people are recommended.

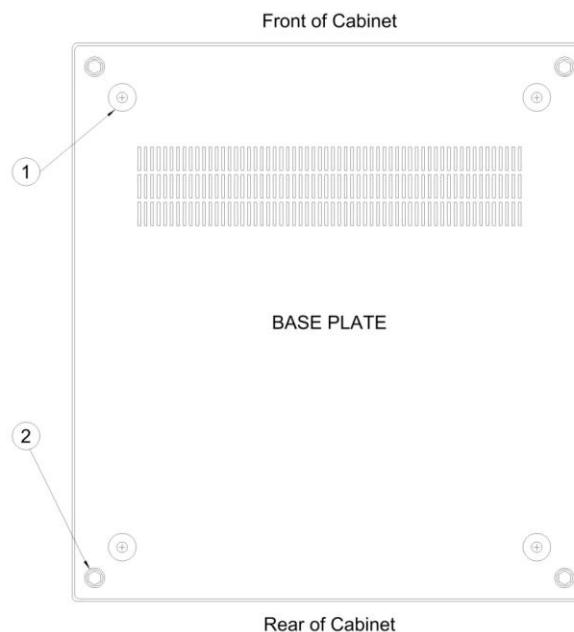
Identify the front side of the packing case with the screw fasteners. This is the side that the transmitter will be removed from. Undo all screws to remove the lid and the front side of the case. Place protective material on the floor to rest the transmitter on when it is removed from the packing case. The transmitter can then be readily slid part-way out of the side of the case. Slide the transmitter out evenly about 2/3 of the way. Allow the leading edge to tilt down onto the floor. Note that cabinet itself does not touch the floor due to the presence of the foam packing frames. Two people can then support the topmost edge of the transmitter cabinet and 'roll' the cabinet a little on the edge resting on the floor so the transmitter cabinet is then clear of the floor of the packing case. While two people support the transmitter in this position, a third person can slide the packing case out from under the transmitter. The transmitter cabinet can then carefully be lowered to rest on its rear on the floor.

As shipped, the base of the transmitter is fitted with aluminium feet. If desired, the set of supplied castors may be fitted for ease of moving the transmitter. The castors are most appropriate if the transmitter is to be used at floor level rather than on a bench top. If the castors are to be fitted, this is a good time to do so.

Fitting the Castors

Lift the bottom end of the cabinet and place a support underneath so that the bottom foam packing frame is clear of the floor. Remove the foam packing frame from the base of the cabinet. Note that the packing frame has a plastic filler strip between the rear bottom edge of the cabinet and the packing frame. Retain the packing frame set for repacking the transmitter if it needs to be reshipped in the future. Pull back any clear film on the base of the cabinet.

The following diagram shows where the castors are fitted.



The cabinet is shipped with aluminium feet fitted (4 x item ①). Remove these and replace with four M6 x 12mm screws (supplied). Remove the hex bolts at the corners of the frame (4 x item ②) with a hex socket. There are two different castors – the plain castors are to the rear positions, the castors with locking tabs are to the front positions. Fit the shake proof washer over the hex socket bolt and pass through the castor. Slide the spacer over the bolt and screw the assembly to the frame.

Completing the Unpacking

If not already done to fit the castors, lift the bottom end of the cabinet and place a support underneath so that the bottom foam packing frame is clear of the floor. Remove the foam packing frame from the base of the cabinet. Note that the packing frame has a plastic filler strip between the rear bottom edge of the cabinet and the packing frame. Retain the packing frame set for repacking the transmitter if it needs to be reshipped in the future. Pull back any clear film on the base of the cabinet.

Place protective padding on the floor under the bottom edge of the cabinet. Lift the bottom of the cabinet to remove the support and lower the bottom rear edge of the cabinet onto the protective padding on the floor. Lift the top-rear of the cabinet to stand it upright. Take care if the castors are fitted – two extra people should assist to lift the bottom rear of the cabinet to

ensure that the castors do not dig into the floor or that the cabinet does not roll out from under on the castors as the cabinet is being stood up.

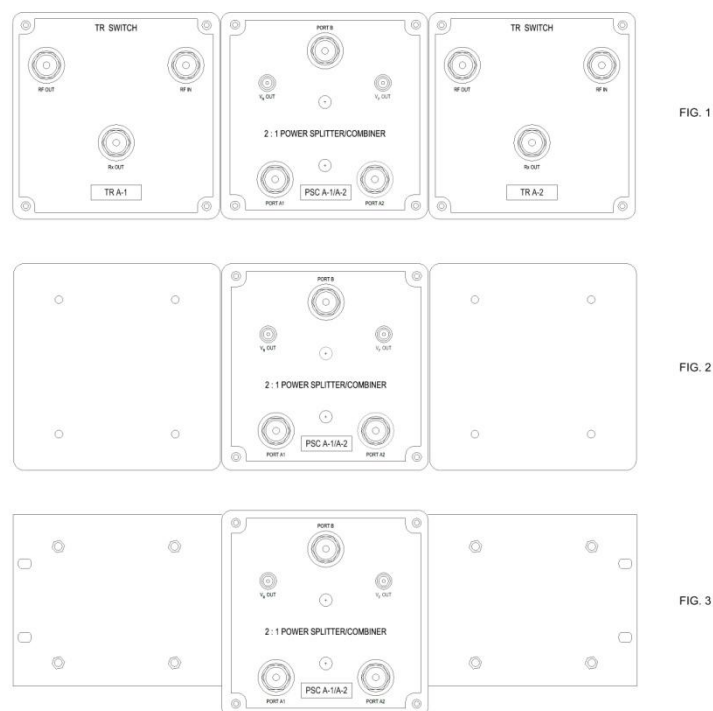
Remove the foam packing frame from the top of the cabinet. Note that the packing frame has a plastic filler strip between the rear top edge of the cabinet and the packing frame. Remove the clear film from the cabinet. Remove the protective film from the front panel LCD displays of the pulse transmitter modules. Carefully inspect the transmitter system for any signs of damage that may have occurred in transit. If there are any signs of damage evident, take photographs to document and contact the manufacturer.

Fitting Transmit/Receive Switches and High-Power Splitter Combiners

This section describes how to fit optional transmit/receive switches (TR switches) and high-power splitter combiners (PSC's) to the rear of the transmitter system cabinet.

There are a number of ways in which these modules may be mounted to the rear of the transmitter system cabinet. In a typical arrangement the modules will be mounted on a 19" panel and this mounting panel is attached with screws to the rear of the transmitter cabinet as shown in a [transmitter system example](#) in Appendix B.

When shipped, the modules and mounting panel are removed from the rear of the transmitter system cabinet and packed as a separate item.



TR Switches and 2:1 PSC Mounting

Fig 1 of the above diagram shows the modules and mounting panel assembly. Remove the lids of the two outer diecast enclosures as shown in Fig 2. This provides access to the screws securing the enclosures to the mounting panel. Remove the two outer enclosures. This

provides access to the screw holes that secure the mounting panel to the rear of the cabinet as shown in Fig 3. Secure the mounting panel to the rear of the cabinet using the supplied screws. Replace the two outer enclosures and lids.

Preparation for Use

In order to be operational the transmitter must be connected to an appropriate AC source. The AC source must meet the AC source requirements and must be connected in an approved manner. The AC source requirements and the AC input power connection are described in following sections in this chapter.

Initial Inspection

Before shipment the transmitter was inspected and tested and found to be free of mechanical or electrical defects. Upon unpacking and before attempting to operate the transmitter, it should be inspected for any damage that may have occurred in transit.

Location and Cooling

The transmitter may generate a large amount of heat during normal operation. The amount of heat generated is dependent on the maximum output power and the duty cycle. For example, if the transmitter is 30kW and operated at 5% duty cycle, the average output power will be $30\text{kW} \times 5\% = 1500\text{W}$. Working on an overall efficiency of around 50%, 1500W of heat will be generated during operation, Heat will be expelled from vents on the rear of the transmitter (PTM's, transmitter power supply distribution unit and high voltage power supply unit) and radiated or expelled from optional transmit/receive switches and power splitter combiners.).

The transmitter must be located where air may flow freely and the user must ensure that adequate cooling or venting systems are provided to ensure the transmitter does not shut down due to over-temperature conditions.

AC Source Requirements

AC power is required for the transmitter power supply distribution unit (TxPSDU) and the high voltage power supply unit (HV PSU).

AC Input Power Connection

The transmitter power supply distribution TxPSDU has an IEC C14 AC mains inlet connector.

CAUTION

Connection of the high voltage power supply unit to an AC power source should be made by an electrician or other qualified personnel

The type of AC input power connection for the high voltage power supply unit (HV PSU) depends on the power rating of the HV PSU. HV PSU's with 750W capacity have an IEC C14 AC mains inlet connector. Higher power capacity units have a 3 or 4-terminal wire clamp connector. Refer to the HV PSU User Manual supplied with the transmitter for information on connecting the HV PSU to the AC power source.

Turn-On Check Procedure

Details to be provided...

Connecting the Load

Details to be provided...

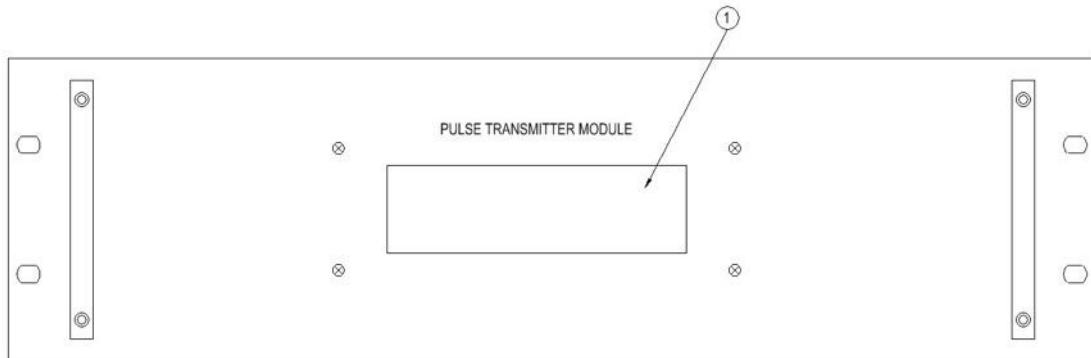
Repacking for Shipment

The original packing case should be retained in the event that the transmitter needs to be re-shipped. Refer to the Unpacking procedure above as a guide to repacking the transmitter for shipment.

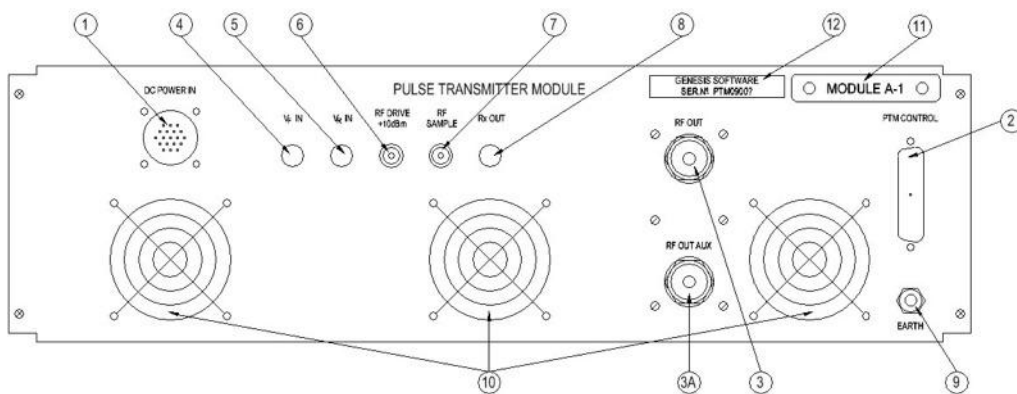
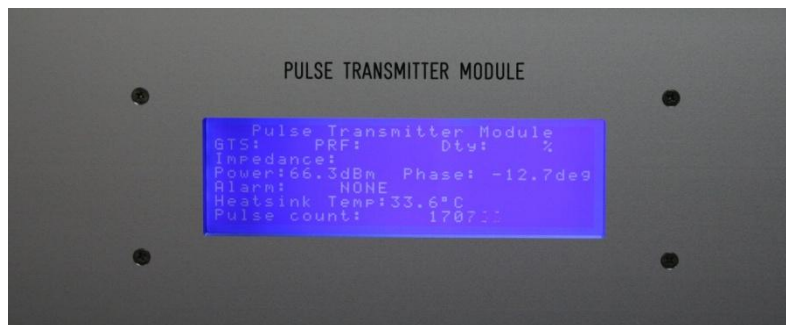
Chapter 4: Indicators, Controls and Connectors

Pulse Transmitter Module

The front panel of the Pulse Transmitter Module is shown below. An LCD display ① shows PTM status information during operation.



The LCD display shows seven lines of information.



Transmitter Control Chassis

Details to be provided...

Transmitter Power Supply Distribution Unit

Details to be provided...

HV Power Supply Unit

Details to be provided...

Transmitter Control Interface

The transmitter control interface module (TXCI) provides an interface between the device controlling the transmitter and the transmitter itself. A single-port version of the TXCI provides an interface to a single transmitter cabinet; a two-port version provides interfaces to two transmitter cabinets. The device controlling the transmitter may be a Genesis Software Radar Data Acquisition System, or it may be user-supplied hardware.

In the case of user-supplied hardware, the TXCI takes user-provided control signals and an RS485 communications port and provides the standard 25-way D-subminiature connector interface to the transmitter. The control signals provided by the user are single-ended and these are converted by the TXCI to differential signals to drive a shielded twisted pair connecting cable.

The integration of the TXCI module into the user-supplied hardware is the responsibility of the user. Suitable mounting hardware for the TXCI can be provided in liaison with the user. An example of a TXCI mounted on a 19" panel which may be attached to the rear of a user's 19" equipment cabinet is shown in the following diagram.



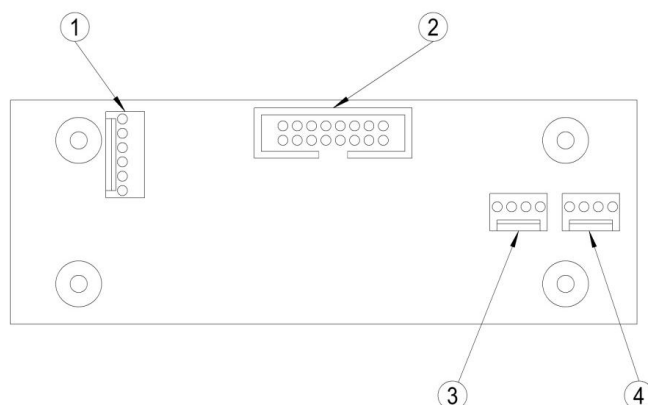
Tx Control Interface Mounted on 19" Panel – Single-Port Version

The connectors of the Tx Control Interface are shown in the following table.

Number	Item	Description
1	RF GATE	RF Gate on BNC jack. Output signal to gate user-supplied RF drive on
2	TX CONTROL	Tx Control interface to transmitter on 25 way D-subminiature plug

Tx Control Interface Connectors (Front Side) – Single-Port Version

The PCB connections for the user-supplied signals are on the rear side of the panel and are shown in the following diagram.



Tx Control Interface Connections for User-Supplied Signals (Rear Side) – Single-Port Version

The rear side connectors of the Tx Control Interface are shown in the following table.

Number	Item	Description
1	J6 POWER	DC power 6-way header Molex KK 22-27-2061 or equivalent
2	J3 TCMC	Transmitter control 16-way box header 0.1" pitch
3	J1 RS 485 IN	RS 485 in 4-way header Molex KK 22-27-2041 or equivalent
4	J4 RS 485 OUT	RS 485 out 4-way header Molex KK 22-27-2041 or equivalent

Tx Control Interface Connections for User-Supplied Signals (Rear Side) – Single-Port Version

The pin allocations of the connectors are shown in the following tables.

Pin Number	Signal Name	Type	Description
1	Pulse A0+/-	Power	+5V
2	RF Gate+/-	Power	Ground
3	Unused		
4	Unused		
5	Unused		
6	Unused		

J6 Power

Pin Number	Signal Name	Type	Description
1	Pulse A0+	Input	Pulse memory address A0
2	Pulse A0-	Unused	
3	Pulse A1+	Input	Pulse memory address A1

4	Pulse A1-	Unused	
5	Tx Trigger+	Input	Transmitter trigger
6	Tx Trigger-	Unused	
7	Tx Sense+	Output	Tx present sense
8	Tx Sense-	Output	
9	Phase Switch+	Input	RF drive phase control 0°/180°
10	Phase Switch-	Unused	
11	Tx Reset+	Input	Transmitter reset
12	Tx Reset	Unused	
13	Tx Enabled+	Input	Enable transmitter to transmit
14	Tx Enabled-	Unused	
15	Ground	Ground	Ground
16	Unused	Unused	

J3 Transmitter Control (TCMC)

Pin Number	Signal Name	Type	Description
1	RS485-	Input/Output	TxD-/RxD-
2	RS485+	Input/Output	TxD+/RxD+
3	-		
4	Ground	Ground	

J1 RS 485 In, J4 RS 485 Out

Chapter 5: Signal Descriptions

The signals required for transmitter communication and control are described in the following sections.

Tx Control Signals

The Tx control signals are available on a D25 connector on the rear of the Transmitter Control Chassis. These are provided as differential signals and in a usual equipment arrangement, there will be a 2.5m shielded twisted pair D25 cable connecting between the device controlling the transmitter and the transmitter itself.

The signals are summarised in the following table.

Pin Number	Signal Name	Type	Description
1 / 14	Pulse A0+/-	Tx input	Pulse memory address A0
2 / 15	Pulse A1+/-	Tx input	Pulse memory address A1
3 / 16	Trigger+/-	Tx input	Transmitter trigger
4 / 17	Tx Reset+/-	Tx input	Transmitter reset
5 / 18	Phase Switch+/-	Tx input	RF drive phase control 0°/180°
6 / 19	Tx Sense+/-	Tx output	Tx present sense
7 / 20	Tx Enabled+/-	Tx input	Enable transmitter to transmit
8 / 21	RS 485+/-	Bidirectional	Tx communication RS 485
9 / 22	RF Drive+/-	Tx input	Unused
10 / 23	RF Gate+/-	Tx output	Gate RF drive on
11 / 24	Unused		Reserved
12	Unused		Reserved
13	Ground		Ground
25	Ground		Ground

A Tx Control Interface (TXCI) module is available that translates transmitter differential logic signals to single-end logic signals. The TXCI also provides the RF Gate signal as a BNC output which is for gating user-provided RF drive on for the period required by the transmitter. The TXCI module is described in a following section.

RS 485

The RS 485 signals provide the communication between the device controlling the transmitter and the transmitter. This is used for programming the transmitter configuration and for reading back transmitter status information.

The RS 485 communications would typically be provided by a PC plug-in card. The RS 485 communication operates in a multi-drop mode and therefore a serial byte may be either an address byte or a data byte. Ideally, the PC RS 485 card should have 9-bit word length capability where the ninth bit set to 0 identifies a data byte, the ninth bit set to 1 indicates an address byte. If the PC RS 485 card does not have 9-bit word length capability, then data/address words can be distinguished by using the parity bit – a data byte is identified by the parity bit set to 0; an address byte is identified by the parity bit set to 1.

RS 485 Communications Settings

The baud rate must be set to 9600. If 8-bit word length is used, then force parity should be selected. If 9-bit word length is used, then no parity should be selected.

Pulse Memory Address A0, A1

The transmitter contains either two or four pulse memories and these may be addressed on a pulse-to-pulse basis. The standard configuration has two pulse memories fitted to support complementary coding. In the absence of A0 and A1 signals, pulse memory 0 will be selected by default. The pulse memory address bits should be set up by the time the trigger is applied and must remain stable for the duration of the transmitter pulse.

Trigger

The trigger is a positive-going pulse. Recommended minimum pulse width is 1 μ s.

Phase Switch

The phase switch signal provides 0°/180° phase control of the transmitted pulse on a pulse-to-pulse basis. The pulse memory address bits should be set up by the time the trigger is applied and must remain stable for the duration of the transmitter pulse.

RF Drive

RF Drive is a user-provided sinusoidal signal at the frequency of operation. The required level is +10 dBm. The transmitter provides an RF Gate signal which the user should use to gate RF drive on for the period of time required by the transmitter.

The RF drive is subsequently split and amplified by an RF Driver Splitter module to provide a +10 dBm RF drive signal for each of the Pulse Transmitter Modules of a Pulse Transmitter System.

Chapter 6: Configuration and Programming

This chapter describes the transmitter configuration and the programming procedure. The transmitter is configured via a combination of hardware control signals and software programming.

Information about the transmitter status is read back by software. There is also a Tx Sense hardware status signal which is a simple indication that the transmitter is powered and not held in internal reset. The user may sense this signal to determine that the transmitter is present and powered.

Communication Overview

Communication with the transmitter takes place via the transmitter supervisor (GTS) module. This is a *multi-drop* module which communicates over the RS 485 bus. There are also a number of hardware control lines going direct to the GTS module. These control transmitter functionality during transmission and include functions such as enabling the transmitter to transmit, pulse address selection and RF drive 0°/180° phase control.

The transmitter software programming and status read back takes place over the RS-485 bus using a multi-drop protocol called PKT-1. PKT-1 involves sending and receiving packets of data. The PKT-1 packet format is discussed in detail in Appendix A.

Briefly, each packet consists of a header, optional data and trailing checksum. The header contains a source and destination address; class, member and sequence number; and packet length. Address 15 is reserved as a broadcast address to which all multi-drop modules recognise.

Each multi-drop module is assigned its own class number. In addition class 0 is reserved for general commands used by all modules. The transmitter embodies two different multi-drop modules:

- Transmitter supervisor module (GTS)

There is one GTS in each transmitter system. If there are multiple transmitter systems, then each transmitter system will have its own GTS with a unique address. Transmitters are generally designated 'Tx A', 'Tx B', etc. Tx A GTS will have multi-drop address 0x40, Tx B GTS will have multi-drop address 0x41, etc.

- Transmitter controller module (GTC)

There is one GTC for every pulse transmitter module in a transmitter system. Each GTC in a transmitter system will have a unique address. GTC's reside on an internal multi-drop bus mastered by the GTS. As the bus master on the internal multi-drop bus, the GTS takes multi-drop address 0x00. GTC multi-drop addresses are assigned as follows:

PTM A-1: 0x01

PTM A-2: 0x02

etc.

The sequence number is a unique number identifying the packet. In normal practice the sequence number would start from zero and increment by one for each packet exchange. Multi-drop commands that expect a response to a command should check that the sequence number in the response is the same as the sequence number in the command. If not, the process that sent the command should log a warning and dump the erroneous response packet.

The transmitter host process normally needs to communicate with only the GTS and there are various GTS commands available which collate status from all transmitter GTC's. However, should the user wish to communicate directly with a GTC, there is a GTS_MDFEED command that allows the host process to feed multi-drop commands through the GTS directly to GTC modules. Responses to MDFEED commands are fed back through the GTS to the host process.

Factory Default Settings

The transmitter has factory default settings that govern its behaviour on power up and so on. These defaults are stored in non-volatile memory and are not normally configurable by the user. If the user wishes to make changes, they should consult Genesis Software for advice.

Initialisation

On power up, the transmitter will load a default pulse configuration from non-volatile memory. The user may readily overwrite the factory default pulse configuration with a pulse configuration that suits their needs.

The factory default setting is for the transmitter to be 'armed on power up'. This means that the transmitter is ready to transmit on receipt of triggers, provided the Tx Enabled control input is set. This behaviour suits situations wherein the control system is on a UPS and the transmitter is run directly off the mains power. If there is a power failure to the transmitter, the transmitter will be ready to transmit on return of power and transmission can resume without any initialisation from the control system. However, the user must take care to ensure that the power-up default pulse configuration has been set appropriately. This factory default power up behaviour can be changed by the user if required.

The first command sent to the transmitter after power up should be a reset packet following by a 1 second wait so that the GTS can become ready and perform various internal self tests. Note that no module replies to a reset packet (sent to the broadcast address or otherwise). After the reset has been performed it is recommended to send an identity command to check that the GTS is talking as expected.

Once it has been established that the module is talking properly the following commands should be sent

- GTS_STATUS with 1 byte of value 1

This clears any stale status in the GTS and allows the user program to store information that can be later used for range checking user input. The user program should also check that the FIFO status is OK

- GTS_PASTATIC with no data

This reports on the number and settings of each GTC module connected to the GTS. Important information here is the internal/scalar VSWR alarm enable. Note that all this information is static except for operating hours

- GTS_MDFEED to each GTC with class 1 (GTC) member 24 (GTC_GETCAL) and no data

This fetches the calibration data in each GTC for later use in calculating impedance

- GTS_GNAME with a data byte from 0 to n where n is the number of shapes reported in the status

This fetches the name and number of elements for a given shape index. The indexes are used later for pulse configuration

Configuration

The pulse characteristics are determined by the GTS_SETPULSE command. Each FIFO bank can hold a different pulse type and the transmitter can change which one it uses on a pulse to pulse basis by changing the pulse address input. The GTS_STATUS command reports the number of FIFO banks that were found at power on

The GTS_SETPULSE command causes the microcontroller to generate the pulse waveform and put it into a FIFO bank, consequently it takes a variable amount of time to complete - the longer the pulse (and pulse code) the longer the command will take to complete (up to 3.5 seconds)

Status Monitoring

During transmission the GTS and GTC's monitor various status elements. If a serious problem is detected then the transmitter will be disabled and a class 0 ALARM packet will be sent.

After each transmission the transmitter status should be queried by using the GTS_STATUS command (with 1 data byte of value 1). Parameters of interest are

- Duty cycle limit
- Combined Tx enable
- Tx pulse count
- Detected RF gate length
- Detected duty cycle
- Detected PRF

Further status is available by using the GTS_PADYNAMIC command. This will read the status from each GTC module including any alarms (notably excess V_R and VSWR faults) as well as heat

sink temperature. Finally, the analogue status from each GTC is returned which can be used to calculate the impedance of the connected load.

High Voltage Power Supply Unit Communication

Information on the high voltage power supply unit (HV PSU) can be found in the manual supplied with the transmitter system or on-line at the following links:

Genesys 750W, 1.5kW:

http://www.us.tdk-lambda.com/hp/pdfs/Product_manuals/83507013.pdf

Genesys 3.3kW:

http://www.us.tdk-lambda.com/hp/pdfs/Product_manuals/83503001.pdf

Chapter 7 details how to communicate with the HV power supply over the serial port. For most transmitter applications, reading the complete power supply status by issuing the STT? command should be sufficient.

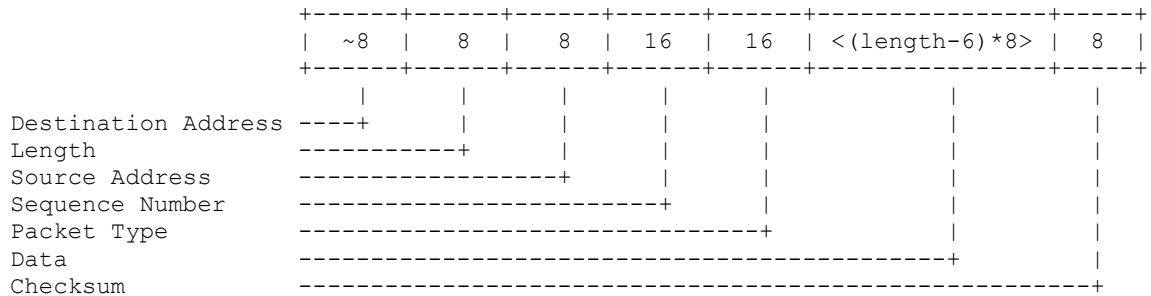
Glossary

Term	Description
Transmitter host process (<i>or</i> host process)	The user-supplied software program controlling the transmitter
Multi-drop protocol	An RS-485 bus communications protocol for transmitter programming and status read back

Appendix A: PKT-1 Packet Format

PK-1 Packet Format

Packet format (size in bits, ~ means bit 9 is set (mark))



Destination Address

The ID of the station the packet is addressed to. 0 is reserved for the master, and 255 is reserved for the broadcast address. Note that a module must never reply to a packet sent to the broadcast address for any reason.

Length

The number of bytes following in the packet. For a packet comprising a total of N bytes, length is N-2. (and there are N-6 bytes of data in the packet).

Source Address

The ID of the station the packet is from. Acknowledgement of the packet will be sent to this address.

Sequence Number

A unique number identifying this packet. Acknowledgement of this packet will refer to this sequence number. (two bytes, MSB then LSB)

Packet Type

Two bytes describing the packet type. The first byte defines the class, the second the specific member within the class. Class 0 is reserved for bus control messages. As a general rule, odd numbered members should be responses to the preceding even-numbered member.

Data

0 or more bytes of data. Note that some devices may have limited receive buffers - the maximum buffer size of a module is returned from a class 0 IDENTITY command (receive buffer length).

Checksum

An 8-bit additive checksum of the entire packet excluding only the Destination Address.

Standard MD Commands

Get Identity

```
IDENTITY      Class: 0      Member: 0      Data: 0      Timeout: 50ms
IDENTITY_R    Class: 0      Member: 1      Data: 8+
```

Requests the addressed module to provide identifying details via an IDENTITY message. Response to this command must begin within 50ms of its reception. This command cannot be broadcast.

The Response to an IDENTITY command identifies the module. Note that later revisions of the protocol may add extra bytes to the end of this response. The following table defines the bytes in the response.

Byte #	Description
0	Module class. (See table in header.txt)
1	Major revision number.
2	Minor revision number.
3	Protocol level supported : this is level 1.
4	Unit identifier. (If more than one of this module type, each must have a unique identifier, otherwise 0.)
5	Unit serial number, high byte
6	Unit serial number, low byte
7	Receive buffer length limit. (0 if not applicable)
8...	Null terminated module identification string (if supported)

Note that the module can receive a packet with RXBLEN - 8 bytes of data.

Reset

```
RESET          Class: 0      Member: 2      Data: 0      Timeout: seconds
```

A module receiving this command should perform as comprehensive an internal reset as is possible. No response must be sent. The reset is allowed to take up to 1 second (the recorder will wait at least this long before trying to talk to a module on the bus).

Command Error

```
ERROR          Class: 0      Member: 3      Data: 1+      Timeout: none
```

A module returns this in response to a command that it has rejected. The sequence number of the ERROR message should match the sequence number of the command. The first byte of data gives the reason for rejection, following bytes are module dependant and may describe the rejection in more detail. The meaning of the first bytes is decoded as per the following table.

value:	meaning :
0	Unknown command.
1	Bad checksum.
2	Timeout receiving command. (optional)
3	Address mark received while receiving command. (optional)
4	Transient error, retry the command.
5	Packet format error


```
6..8 | other possible mdrop bus errors
9    | ID Bus checksum error
10   | ID Bus Unknown device error
11   | Rx buffer overflow
12   | Data value out of range error
13   | Internal comms. error
14   | Deprecated command
15..31 |
32..+ | Johnson module errors
```

Note, it is possible that message corruption may occur in the source address byte. Hence, technically, bad checksum errors and the like in the initial packet should be returned to the master address, i.e. 0. The broadcast address is reserved for Reset commands (or similar) that require the attention of all modules.

Further note that conformance to this specification is very poor, if you want to be sure what the error actually is, check the firmware for the module in question.

Request Status

```
STATUS      Class: 0      Member: 4      Data: 0      Timeout: 100ms
STATUS_R    Class: 0      Member: 5      Data: 1+
```

The status command requests the module to supply its current state. The initial response byte describes the current status of the unit as per the following table. Subsequent bytes are module specific.

```
value: | meaning:
-----+-----
0      | OK.
1      | Becoming ready; not ready for commands, but will at some
      | stage.
      | Second byte should be an estimate in seconds before the
      | unit will be ready, or 0 if the time is unknown.
2      | Unit has encountered a transient error during operation.
      | Data following should identify the error in an implementation
      | specific fashion.
      | (Transient errors should be clearable by a device reset.)
3      | Unit is faulty (error cannot be cleared by device reset). Data
      | following should identify the error in a module specific way.
```

Program Serial Number

```
SERIAL      Class:0      Member: 6      Data: 2      Timeout: 100ms
SERIAL_R    Class:0      Member: 7      Data: 2
```

Program the Serial number of the module with the two hex digits in the data. The data returned is the programmed serial number. This command programs the serial number of the module. The response is the serial number.

Program Multidrop Address

```
MDADDR      Class:0      Member:8      Data: 1      Timeout: 100ms
MDADDR_R    Class:0      Member:9      Data: 1
```

Set the multidrop address of the module to the address supplied in the data. The data returned is the new multidrop address.

This command programs the multidrop address of the card. Obviously, the target module must be programmed with a default address before this command may be used. This command is primarily intended to allow factory setting of module address where multiple copies of the module are fitted to the same system. E.g., the VHF power block controller.

This command is not necessarily available on all modules.

Dump Memory Bytes

```
-----  
DUMP          Class:0      Member: 10    Data: 3      Timeout: 100ms  
DUMP_R        Class:0      Member: 11    Data: 1+
```

The dump memory command returns the contents of memory starting at the specified address (Bytes 0 and 1 - MSB, LSB) and containing the number of bytes specified in byte 2. Note that the maximum number of locations to dump is 249.

This command is not necessarily available on all modules.

Program module identification string

```
-----  
ID            Class:0      Member: 12    Data: 2+     Timeout: 1000 ms  
ID_R          Class:0      Member: 13    Data: 1
```

This command allows the user to program an identifying string into the module's EEPROM memory. The number of characters available for the ID string is module specific, but at least 20 characters should be supported by all modules.

The response to this command is a single byte which is zero if the command completed successfully, and non-zero if it failed:

```
value: | meaning:  
-----+-----  
0      | Command completed successfully  
1      | String too long for memory  
2      | Error in command length
```

This command is not necessarily available on all modules.

Signal beginning of acquisition

```
-----  
ACQSTART      Class: 0      Member: 14    Data: 1+     Timeout: none
```

The ACQSTART command indicates to all modules that an acquisition is about to begin. This is intended to allow modules to reset counters, go to sleep if possible (to reduce RFI) and any other action which is required for such an event.

This command used to be called 'SLEEP' and for older modules it has the same meaning, it also supersedes the gain control sleep command.

Modules that sleep are "woken up" by any multidrop traffic.

Modern modules are expected to be smart enough to decide for themselves whether they should sleep or not. The following applies to older modules which consider ACQSTART a SLEEP command. The data byte(s) for the sleep command specify the multidrop address(es) of the modules which should go to sleep. This allows the class 0 sleep command to be broadcast to all multidrop modules (using the 0xff "broadcast" address) and yet still allow the host to specify a list of modules

which should actually go to sleep. Note that the module address "0xff" in the data byte list should be interpreted as "all module addresses" and result in every module going to sleep. I.e., the simplest form of the SLEEP command will be broadcast to all modules using the 0xff module address, and will contain a single data byte with the value 0xff instructing all modules to go to sleep.

Example:

Suppose that two BSC modules at addresses 0x80 and 0x81 are to be commanded to sleep, but the gain control module at address 0x10 is not to be slept. The two data bytes for the class zero broadcast SLEEP command should take the values 0x80 and 0x81.

There is no response to the class zero ACQSTART command. Modules which do not support it should quietly ignore this command.

Modules that do sleep should be engineered to "wake" in the event of any multidrop traffic. The standard technique for waking up a slept multidrop module will be to issue an ACQEND command to the module at the broadcast address.

It is guaranteed that the recorder will wait at least 100 msec before triggering after this command has been sent.

Send alarm code

ALARM Class: 0 Member: 16 Data: 2 Timeout: none

This command is generated by a multidrop module which has encountered an "alarm" condition. It is received by the host computer and appropriate action taken. The first data byte in this command contains the initiating module's command member number. E.g., a TCMC would send an "8" in this position. The second data byte is an encoded alarm severity value. In general, the higher the number, the more urgent/critical the problem. The severity byte is encoded as follows:

value	meaning of second byte
0	Debug
10	Notice
20	Inform
30	Advise
40	Caution
50	Warning
60	Abort
70	Critical
80	Catastrophic

The acquisition software takes action based on the severity of the alarm. In general, severities "Abort" and above cause the acquisition code to abort, send email and either retry or halt.

There is no response to the alarm code command.

Program EEPROM locations

EEPROM Class: 0 Member: 18 Data: 3+ Timeout: variable
EEPROM_R Class: 0 Member: 19 Data: 1

This command allows the recorder to program arbitrary EEPROM locations with new data. The first two bytes are treated as the first address to be programmed (network byte order). The following bytes are then programmed from this start address.

Not all modules support this command.

The response byte is a status byte encoded thus:

value:	meaning:
0	Ok
1	Address not in EEPROM memory
2	Could not program memory

Note that the timeout for this command depends on the number of bytes to be programmed and the implementation-specific nature of the micro in question. As a rule of thumb, allow 250 ms per byte of memory.

GTS MD Commands

Get control card status

GTS_STATUS	Class: 11	Member: 0	Data: 1	Timeout: 100 ms
GTSR_STATUS	Class: 11	Member: 1	Data: 81	Versions to 1.2
GTSR_STATUS	Class: 11	Member: 1	Data: 82	Version 1.3
GTSR_STATUS	Class: 11	Member: 1	Data: 83	Version 1.4
GTSR_STATUS	Class: 11	Member: 1	Data: 84	Version 1.5+

The STATUS command reports GTS card-related status information as defined below in the GTSR_STATUS command. The data byte provided is used to optionally clear the accumulated status the GTS provides (e.g. pulse count, enable status, duty limit violation, etc) after read out if it is non-zero.

The STATUS response bytes are defined thus:

Versions to 1.2:

Byte #	Description						
0	Feature byte [*]						
1	Enabled on power on/reset [*]						
2	Predistortion flag (1 = on, 0 = off) [*]						
3	MOD offset value (0..255) [*]						
4 - 7	Delay counts in 1/20 MHz units (PREGATE, POSTGATE, PASENSE, RFPHASE) [*]						
8	System gain factor for MOD pulse (255 = no attenuation) [*]						
9 - 10	DC slew rate counts (up/down) in 1/20 MHz units (50 ns). [*]						
11	Secret work around byte for PAs #1						
12 - 13	Pulse length limit in units of 500 ns (16 bits) [*]						
14	Duty cycle limit in units of 1/10th of a percent For example, 10% duty cycle limit is expressed as 100. [*]						
15	Secret work around byte for PAs #2						
16 - 19	Operating hours (32 bits) [*]						
20 - 21	RF drive control unit step size in picoseconds (16 bits) [*]						
22 - 23	Reserved						
24 - 31	RF drive control unit calibration phases (8 bytes) [*]						
32	PA present bitmask. A set bit indicates that the corresponding PA is fitted to the transmitter.						
33	No. of working FIFOs (0..4)						
34 - 37	FIFO status bytes (4 off), possible values indicate: <table border="1" style="margin-left: 20px;"> <tbody> <tr> <td>0</td> <td>FIFO past POST successfully</td> </tr> <tr> <td>1</td> <td>FIFO failed to empty on reset</td> </tr> <tr> <td>2</td> <td>FIFO is full after reset</td> </tr> </tbody> </table>	0	FIFO past POST successfully	1	FIFO failed to empty on reset	2	FIFO is full after reset
0	FIFO past POST successfully						
1	FIFO failed to empty on reset						
2	FIFO is full after reset						

```

|           3           FIFO still empty after write
|           4           FIFO full flag never set
|           5           FIFO size not multiple of 256 words
38 - 41 | FIFO sizes in 256 word blocks (4 off)
42      | Number of pulse shape tables available (1..)
43      | Number of COP resets since last reset or power on
44 - 47 | Operating seconds (32 bits)
48      | Soft Enable status
49      | Temperature in degrees C (obtained after last GTEMP command)
50      | Temperature in 1/255 of degrees C
51      | Duty cycle limit since last clear (1 = SDCLV, 2 = LDCLV,
|       255 = state machine error)
52      | Combined Tx Enable status since last clear
|       (1 = on sometime, 0 = never on)
53      | Current "Tx Enabled" status
54      | Current "Operator Enable" status
55      | Current "External Enable" status
56 - 59 | Tx pulse count since last clear (32 bits)
60 - 61 | Detected RF gate length in units of 500 ns
62 - 63 | Detected "gated" duty cycle in units of 1/10 percent
64 - 65 | Detected PRF in Hz
66      | RF drive control unit readback status (0 = ok, nonzero TBD)
67      | RF drive control unit channels (0 to 8)
68 - 75 | RF drive control unit phases (volatile, relative) (8 bytes)
76 - 80 | Antenna control selections and timing (see ANTCTRL command)

```

Version 1.3 adds:

```

81      | GTC hardware issue number (aka PA type)

```

Version 1.4 adds:

```

82      | TR Switch counter value (non-volatile).

```

Version 1.5+ adds/changes:

```

51      | Duty cycle limit since last clear
|       (1 = SDCLV, 2 = MDCLV, 3 = LDCLV)
83      | Coded-pulse bit-separation count (50 ns steps, non-volatile).

```

Get power amplifier static status

```

GTS_PASTATIC   Class: 11   Member: 2   Data: 0   Timeout: 100 ms
GTSR_PASTATIC  Class: 11   Member: 3   Data: 2+

```

The PASTATIC command reports collated PA status information which does not update as a result of active transmission. (E.g., VSWR-related information.) This information is termed "static" and is therefore only retrieved by the host computer when the acquisition program starts up.

The PASTATIC response bytes are defined thus:

```

Byte #      Description
-----+-----
0           | Number of PA STATIC subresponses following
1           | Length in bytes of each PA STATIC record following
|       (Length = 30)
-----

```

Each PA's STATIC record is defined in the relevant GTC command specification document. Response length may vary depending on the version of the GTC attached.

Repeated for each fitted PA

Note: the length of the PASTATIC response may vary from 2 bytes (no PAs fitted) to 242 bytes (8 PAs fitted).

Get power amplifier dynamic status

GTS_PADYNAMIC Class: 11 Member: 4 Data: 2 Timeout: 100 ms
GTSR_PADYNAMIC Class: 11 Member: 5 Data: 2+

The PADYNAMIC command reports collated PA status information which updates as a result of active transmission. (E.g., VSWR-related information.) This information is termed "dynamic" and is therefore retrieved by the host computer each time an acquisition finishes.

The two data bytes provided with the PADYNAMIC command are used to optionally clear/reset the status information after it has been sent. The first byte, if nonzero, causes all counters, averaging buffers, etc., to be cleared after read out. The second byte, if non-zero, causes any PA ALARM conditions to be reset after read out.

The PADYNAMIC response bytes are defined thus:

Byte #	Description
0	Number of PA DYNAMIC subresponses following
1	Length in bytes of each PA DYNAMIC record following (Length = 30)

Each PA's DYNAMIC record is defined in the relevant GTC command specification document. Response length may vary depending on the version of the GTC attached.

Repeated for each fitted PA

Note: the length of the PADYNAMIC response may vary from 2 bytes (no PAs fitted) to 242 bytes (8 PAs fitted).

Multidrop feedthrough command

GTS_MDFEED Class: 11 Member: 6 Data: 8 Timeout: TBD
GTSR_MDFEED Class: 11 Member: 7 Data: 8+

The MDFEED command allows the host to pass arbitrary multidrop commands on the transmitter's internal multidrop bus. The command packet for the internal bus is essentially encapsulated by the MDFEED command. There is no additional encapsulation parameters required apart from the normal multidrop header bytes which are stripped off by the GTS module. Responses to the command are likewise minimally encapsulated by the GTS before being placed on the external multidrop bus addressed to the host.

Restore power on default pulse specifications

GTS_RESPULSE Class: 11 Member: 8 Data: 0 Timeout: 3500 ms
GTSR_RESPULSE Class: 11 Member: 9 Data: 1

The RESPULSE command restores the pulse specifications defined in non-volatile memory which are employed as power-on defaults to the currently active set of pulse specifications. Up to four pulses may be defined. The RESPULSE response byte reports the number of pulse specifications defined in non-volatile memory. Possible values range from one to four.

Note that as the RESPULSE command is dependent on the SETPULSE command, the timeout for this command is relatively long.

Save pulse specifications to non-volatile memory

```
-----
GTS_SAVPULSE      Class: 11   Member: 10   Data: 0     Timeout: 100 ms
GTSR_SAVPULSE     Class: 11   Member: 11   Data: 1
```

The SAVPULSE command saves the currently-active pulse specifications in non-volatile memory which are employed as power-on defaults. The SAVPULSE response byte reports the number of pulse specifications defined in non-volatile memory. Possible values range from one to four.

Set Pulse Specification

```
-----
GTS_SETPULSE      Class: 11   Member: 12   Data: 6+    Timeout: 3500 ms
GTSR_SETPULSE     Class: 11   Member: 13   Data: 1
```

The SETPULSE command defines one of the four currently-active pulse specifications. For uncoded pulses, exactly six bytes of data must be provided, while for coded pulses, up to 14 data bytes may be present. The data format is defined thus:

Byte #	Description
0	Pulse address (0 to 3)
1, 2	Pulse length in 500 ns steps (MSB, LSB)
3	Pulse shape index (0 = Square, 1 = Gaussian)
4	Pulse Amplitude (0 to 255)
5	Number of code bits (0 = no code, 64 bits max) Note that if 0 code bits selected, no code data may be supplied in set pulse command.
6	First 8 bits of code (if required) MSB Tx'd first
7	Next 8 bits of code (if required)
....	
13	Last 8 bits of code (if required)

The SETPULSE response contains a single data byte which is encoded in the following manner:

Value	Description
0	Pulse defined correctly
1	Data length error
2	No such pulse shape
3	Illegal pulse address
4	Zero pulse length
5	Pulse too long for available memory
6	Pulse address corresponds to bad FIFO
7	Pulse code bit length too short for code gap setting

Note that the timeout for this command depends of the FIFO size fitted. For 64 k FIFOs, the setpulse command should complete in under 3500 ms.

Get Pulse Specification

GTS_GETPULSE Class: 11 Member: 14 Data: 1 Timeout: 100 ms
GTSR_GETPULSE Class: 11 Member: 15 Data: 52

Return the current volatile (data byte = 0) or non-volatile (data byte = 1) pulse specification.

0-12		Pulse definition 0 (13 bytes) (see SETPULSE command defn.)
13-25		Pulse definition 1 (13 bytes)
26-38		Pulse definition 2 (13 bytes)
39-51		Pulse definition 3 (13 bytes)

Perform temperature measurement

GTS_TEMP Class: 11 Member: 16 Data: 0 Timeout: 600 ms
GTSR_TEMP Class: 11 Member: 17 Data: 3 Revisions to 1.5
GTSR_TEMP Class: 11 Member: 17 Data: 5 Revision 1.6+

The TEMP command instructs the on-board temperature sensor(s) to perform a temperature measurement. This may take up to 750 ms. After the measurement is completed, the response to the command returns 5 data bytes defined thus:

Byte	Description
0	One-wire bus status: 0 = OK 1 = No ROMs on bus 2 = No Temp. sensor on bus 3 = Checksum error 4 = Bus still low after reset complete 5 = NVM Temp ID data missing or incorrect (Revision 1.6+)
1	GTS Temperature in degrees C (signed)
2	Fractional GTS temp in 1/256 degrees C (unsigned). Note that if temperature is negative, the fractional part is to be interpreted as negative also.

Version 1.6 adds:

3	TR Temperature in degrees C (signed)
4	Fractional TR temp in 1/256 degrees C (unsigned). Note that if temperature is negative, the fractional part is to be interpreted as negative also.

Enable/disable predistortion mapping

GTS_DISTORT Class: 11 Member: 18 Data: 1 Timeout: 3500 ms
GTSR_DISTORT Class: 11 Member: 19 Data: 0

Enable (data = 1) or disable (data = 0) the predistortion mapping. This setting is non-volatile. There is no data in the response to this command.

Note that as the DISTORT command is dependent on the SETPULSE command, the timeout for this command is relatively long.

Set DC offset for modulation pulse

GTS_OFFSET Class: 11 Member: 20 Data: 1 Timeout: 3500 ms
GTSR_OFFSET Class: 11 Member: 21 Data: 0

The OFFSET command sets the DC offset required for the MOD pulse to the transmitter PAs. Valid range is from 0 (no DC offset) to 255, although higher values leave little or no room for meaningful pulse shapes to be produced. This setting is non-volatile. There is no data in the response to this command.

Note that as the OFFSET command is dependent on the SETPULSE command, the timeout for this command is relatively long.

Set system gain trim value

GTS_GAIN Class: 11 Member: 22 Data: 1 Timeout: 3500 ms
GTSR_GAIN Class: 11 Member: 23 Data: 0

The GAIN command sets the system gain trim required due to transmitter gain variations at differing frequencies of operation. Valid range is from 255 (full gain) to 0 (no gain). These values are used to scale the modulation pulse shape after the predistortion mapping has been performed. This setting is non-volatile. There is no data in the response to this command.

Note that as the GAIN command is dependent on the SETPULSE command, the timeout for this command is relatively long.

Set Delay Counters

GTS_DELAYS Class: 11 Member: 24 Data: 4 Timeout: 3500 ms
GTSR_DELAYS Class: 11 Member: 25 Data: 0

The DELAYS command sets the current values of the four gate delay counters. These are, in order, pregate, postgate, PA sense, and RF phase. The counter values specified are in units of 20 MHz clock periods. These values are non-volatile. The current delay settings may be obtained from the data returned by the STATUS command. The DELAYS response contains no data.

Note that as the DELAYS command is dependent on the SETPULSE command, the timeout for this command is relatively long.

Get pulse name

GTS_GNAME Class: 11 Member: 26 Data: 1 Timeout: 100 ms
GTSR_GNAME Class: 11 Member: 27 Data: 3+

The GNAME command searches the on-chip shape table linked list for a shape index number matching the number specified by the command data byte and returns the number of elements used in the shape table (MSB, LSB) and the text string describing the pulse shape (null terminated). (Note that versions prior to 1.3 only return the shape name.) If the shape index cannot be found, the "UNKNOWN" string is returned. Shape index zero corresponds to the "SQUARE" pulse.

Define pulse shape

GTS_SHAPE Class: 11 Member: 28 Data: 5+ Timeout: 100 ms
GTSR_SHAPE Class: 11 Member: 29 Data: 1

The SHAPE command allows the host to download new pulse definitions to the control card. Due to command length limitations in the pkt1 protocol, multiple SHAPE commands may be required to fully define a new shape definition - each command contains shape data which is known as a "shape segment". The most shape bytes that can be sent in a segment is 200. The shape is downloaded segment by segment until complete.

The format of each of the SHAPE segment commands is defined thus:

Byte	Description
0, 1	Total number of elements in definition (MSB/LSB)
2, 3	Element offset of this segment (MSB/LSB)
4..N+3	Shape name (terminated by \0) (N characters incl. null) The length of the name must not exceed 15 characters.
N+4...	Shape data (up to 200 bytes)

Note that the number of elements available in a single segment command can be calculated from the command packet length minus the extra bytes required to define the shape name, length and offset. Note also that the shape segments must be sent in order - i.e., the first segment definition issued contains data corresponding to the beginning of the pulse, while the following segments' element offsets are monotonically increasing. Further, the element offset data contained in each segment definition must be consistent with the number of shape definition bytes issued to that point. That is, the first segment command must have an element offset of 0x0000.

The GTSR_SHAPE response is a single byte indicating the success or otherwise of each of the segment definition commands. The values of the data byte returned are defined as:

Value	Description
0	Segment definition programmed ok and definition complete
1	Segment definition programmed ok and ready for next
2	Shape too long for available memory
3	No programming voltage present
4	Target memory failed to program correctly
5	Pulse name already in use
6	Command format error/illegal value
7	Pulse name length error (null or > 15 characters)
8	Stale or corrupt pulse in list error

In the event of a failed attempt to program a new pulse specification, the control card "scratches" the pulse so that a new attempt may be made with the same pulse name. The memory required by the pulse is lost, but the pulse data structure quietly avoids the abortive pulse.

Dump pulse shape

```
-----
GTS_GSHAPE   Class: 11   Member: 30   Data: 4     Timeout: 100 ms
GTSR_GSHAPE  Class: 11   Member: 31   Data: 1+
```

The GSHAPE command allows the host to request the GTS to dump the numerical shape values which make up the shape index requested. The four bytes in the GSHAPE command are defined thus:

Byte	Description
0	The index number of the shape required
1	The number of elements to dump

2, 3 | The offset in bytes of the segment data to dump

The GTSR_GSHAPE response is either a single byte indicating that an error has occurred, or a sequence of bytes representing the data requested. The status byte is encoded thus:

Value	Description
0	Command ok and data following reaches to end of shape definition.
1	Command ok and data following does not complete the shape definition.
2	No such shape index
3	Requested offset too large for pulse

If no error has occurred, the first byte specifies whether the data supplied extends all the way to the end of the shape table. In the event that more data are requested than are available within the requested pulse (and offset), the response will be truncated to a sequence of valid data bytes. I.e., it is not an error to request more data than is available, provided that the offset requested is not beyond the end of the shape table.

Return free memory available

```
-----
GTS_GMEM      Class: 11      Member: 32      Data: 0          Timeout: 100 ms
GTSR_GMEM     Class: 11      Member: 33      Data: 2
```

The GMEM command allows the host to request the GTS to count how many bytes of FLASH memory is available for pulse definitions.

The GTSR_GMEM response is a two byte message containing the MSB and LSB of the available memory count.

Load Predistortion table into EEPROM

```
-----
GTS_LDIST     Class: 11      Member: 34      Data: 130        Timeout: 400 ms
GTSR_LDIST    Class: 11      Member: 35      Data: 1
```

The LDIST command allows the host to download a section of predistortion table to the control card. Exactly 128 bytes of distortion table are sent during each iteration - this corresponds to one-half of the table. Two extra bytes precede the table data. Byte zero indicated whether the data following should be loaded into table one or table two (forward or reverse predistortion table) while byte one indicates whether the data are the first half or second half of the table selected. Both bytes may take values of either zero, or one. (Actually, zero or non-zero.) Note that issuing this command does not reload the currently active pulse shapes into FIFOs.

The LDIST response is a single byte which always takes the value of zero. This is provided simply for ease of future enhancement.

Dump Predistortion table

```
-----
GTS_GDIST     Class: 11      Member: 36      Data: 2          Timeout: 100 ms
GTSR_GDIST    Class: 11      Member: 37      Data: 128
```

The GDIST command allows the host to dump a section of predistortion table from the control card. The two data bytes indicate which table, and which half of that table to dump - see the LDIST command for more information.

The GDIST response is simply 128 bytes of the selected table.

Configure antenna control outputs

```
GTS_ANTCTRL      Class: 11  Member: 38  Data: 5      Timeout: 500 ms
GTSR_ANTCTRL     Class: 11  Member: 39  Data: 0
```

The ANTCTRL command allows the user to set the state of the antenna control lines from all PAs in parallel. The first data byte determines the state of the antenna control line during even integration periods (0, 2, 4, etc) while the second byte determines the state for the odd integration periods (1, 3, 5, etc). The GTS will alternate the antenna control line between even and odd integration periods. The third and fourth bytes are interpreted as a 16-bit unsigned integer which must match the number of pulses in an integration period if the mode control is required to match the integration period. If this word is set to zero, then no alternation of mode is performed. The final byte is a timing byte [TBD].

On power-on, the antenna control line is set to zero (low).

Enable transmitter

```
GTS_ENABLE      Class: 11  Member: 40  Data: 1      Timeout: 100 ms
GTSR_ENABLE     Class: 11  Member: 41  Data: 0
```

The ENABLE command is used to enable/disable the transmitter. This can be used in a multiple-transmitter environment to allow use of one or more of the independent transmitters. It is also used to enable a transmitter which is not enabled by default after power-on or reset. (This feature is a non-volatile factory setting which replaces the TCMC "comms lockout" functionality.)

Configure RF phases

```
GTS_RFPHASE     Class: 11  Member: 42  Data: 9      Timeout: 100 ms
GTSR_RFPHASE    Class: 11  Member: 43  Data: 1
```

Set the RF drive control unit phases. The first byte determines if the phases should be written into volatile (data[0] = 0) or non-volatile (data[0] = 1) memory. The following 8 bytes in this command are then stored in the selected memory as either calibration values (non-volatile) or as volatile phase settings. The calibration values are copied to the non-volatile settings and then asserted to the RFDCU on power-on/reset. Only the volatile settings are ever written to the RFDCU phase delay units.

The response byte indicates success or failure and is encoded thus:

```
0      success
1      read back error
```

Set persistent shutdown

```
GTS_PSDOWN     Class: 11  Member: 44  Data: 1      Timeout: 100 ms
```

GTSR_PSDOWN Class: 11 Member: 45 Data: 0

Configure the persistent shutdown state of the 8 PAs. Bits set in the command's data byte bitmask cause the corresponding PA to be persistently shut off. (I.e., this is a non-volatile setting for the PAs.). Bits set to zero in the bitmask restore the corresponding PA to normal operation. This command does not take account of PA groupings (if any).

Set shutdown mask

Deprecated version 1.6 onwards

GTS_SETSDOWN Class: 11 Member: 46 Data: 1 Timeout: 100 ms
GTSR_SETSDOWN Class: 11 Member: 47 Data: 0

Set the shutdown mask to the supplied data byte. Generally used to reset the mask so that all PAs are active. This command does not take account of PA groupings (if any).

Get ID bus devices

GTS_IDBUS Class: 11 Member: 48 Data: 0 Timeout: 400 ms
GTSR_IDBUS Class: 11 Member: 49 Data: 0+

Return the contents of the ID bus in the transmitter control chassis excluding the temperature sensor. Currently, the backplane and RFDCU contain the only ID PROM chips in this chassis. Return a total of 16 bytes for each found IDPROM. These 16 bytes are defined:

Byte	Description
0-3	Serial number (32 bits)
4-7	Epoch timestamp of programming (32 bits)
8-13	Name of module. E.g., "RFDCU\0"
14	Issue number of hardware. E.g., "1"
15	Revision number of hardware. E.g., 0 => "A"

Init EEPROM memory

Implemented version 1.2 onwards

GTS_EEINIT Class: 11 Member: 50 Data: 0 Timeout: 4000 ms
GTSR_EEINIT Class: 11 Member: 51 Data: 1

Initialise the EEPROM memory with values stored in FLASH "Shadow" memory. This command is implemented to work around deficiencies in programming tools which are presently (April, 2004) unable to program EEPROM memory on the HCS12.

The response byte indicates success (0) or failure to program memory.

Set TR Switch counter

Implemented version 1.4 onwards

GTS_TRSWITCH Class: 11 Member: 52 Data: 1 Timeout: 3500 ms
GTSR_TRSWITCH Class: 11 Member: 53 Data: 1

The TRSWITCH command sets the extra duration (50 ns steps) required for the TR Switch control signal relative to the end of the Pulse Active period. Valid range is from 0 (TR Switch signal ends with Pulse Active) to 255 (TR Switch signal 12.7 us longer than Pulse Active). Note that there is no "OFF" state for this counter. Since the TR Switch signal is downloaded into the FIFO pulse memory on the GTS, it is possible to configure a pulse shape/length/TR Switch combination which is too large for the available memory. In this case, the returned data byte is non-zero. This setting is non-volatile, and results in the FIFO memories being reloaded. (Hence the large timeout value specified for this command.)

The response byte indicates success (0) or failure to program NVM memory.

Set pulse code gap

Implemented version 1.5 onwards

GTS_CODEGAP	Class: 11	Member: 54	Data: 1	Timeout: 3500 ms
GTSR_CODEGAP	Class: 11	Member: 55	Data: 1	

The CODEGAP command sets the duration between code bits (50 ns steps) during which the modulation envelope voltage is held at the DC offset level. The half the gap is inserted at the start of each code bit and half at the end. (It is advisable to use only even-numbered "codegap" values.) This quenches the output of the transmitter while the transmitted phase is inverted, thus preventing damage to the amplifiers and minimising spurious outputs. Valid range is from 0 (no code gaps) to 255 (12.7 us is removed from between code bits). This setting is non-volatile, and results in the FIFO memories being reloaded. (Hence the large timeout value specified for this command.)

The response byte indicates success (0) or failure to program NVM memory.

Set soft shutdown

GTS_SOFTSDOWN	Class: 11	Member: 56	Data: 1	Timeout: 100 ms
GTSR_SOFTSDOWN	Class: 11	Member: 57	Data: 0	

Configure the soft shutdown state of the 8 PAs. Bits ***not*** set in the command's data byte bitmask cause the corresponding PA to be shut off. Bits set to zero in the bitmask restore the corresponding PA to normal operation. This command does not take account of PA groupings (if any). Useful for things like BLTR operation of an ST radar where alternative antennas are used to transmit and the majority of PTMs are not needed. Note that this bit is the same one used for shutting down failing PAs, hence a GTS_PADYNAMIC command set to clear alarms will cause all of the PAs to be enabled.

Set PTM phases

GTS_PTMPHASE	Class: 11	Member: 58	Data: 2	Timeout: 100 ms
GTSR_PTMPHASE	Class: 11	Member: 59	Data: 0	

Configure the output phase sense of the 8 PTMs. The first data byte is a mask determining which of the 8 PTMs are phase inverted (bit set) or noninverted (bit unset). Bit 0 controls PTM A-1, Bit 1 PTM A-2, etc. The second byte is a boolean which selects whether the setting should be volatile-only (data byte = 0) or volatile and non-volatile (1).

GTC MD Commands

Get static status

```
GTC_PASTATIC      Class: 1    Member: 0    Data: 0    Timeout: 100 ms
GTCR_PASTATIC     Class: 1    Member: 1    Data: 28   Versions to 1.6
GTCR_PASTATIC     Class: 1    Member: 1    Data: 30   Version 1.7
```

Request GTC status. Data bytes returned are defined in the table below:

Byte	Definition
0	PA feature byte (not implemented) [*]
1, 2	Serial Number high byte/low byte (year/sequence) [*]
3, 4	Issue/revision number of firmware [*]
5, 6	Issue/revision number of hardware [*]
7 - 9	day/month/year of manufacture [*]
10 - 13	Operating hours (4 bytes) [*]
14	Persistent shutdown status (1 = shutdown always) [*]
15	No of PAs (0..7) [*]
16	Sense timer setting (not implemented) [*]
17	Average algorithm points (0 or 1 = off) [*]
18	Average algorithm type [*]
19	FAN control AUTO/Manual [*] (1:AUTO;0:MANUAL)
20	FAN lower temperature limit [*]
21	FAN upper temperature limit [*]
22	PA interlock flag
23	PA OK threshold
24	Soft Enable status (0 = off)
25	FAN Period
26	FAN Duty cycle
27	Alarm override flag

Version 1.7 adds:

28	Internal/scalar VSWR alarm state (0 = enabled, 1 = disabled) [*]
29	Output phase invert POD (0 = off, 1 = on) [*]

Note that status fields marked with [*] are non-volatile values.

Get dynamic status

```
GTC_PADYNAMIC     Class: 1    Member: 2    Data: 0    Timeout: 100 ms
GTCR_PADYNAMIC    Class: 1    Member: 3    Data: 30
```

The GTC_PADYNAMIC command reports collated PA status information which updates as a result of active transmission. (E.g., VSWR-related information.) To reset the counters and clear the analogue status provided in this command response, the CLRXTSTAT command (1:14) should be used.

Byte	Definition
0 - 3	Pulse count since last clear (4 bytes, MSB, LSB)
4	COP reset count since last clear
5	Analog Status: S21 magnitude
6	Analog Status: S22 magnitude
7	Analog Status: IP S21 phase
8	Analog Status: QP S21 phase
9	Analog Status: IP S22 phase

10	Analog Status: QP S22 phase
11	Analog Status: Return loss (internal/scalar)
12	Analog Status: Ambient temperature
13	Analog Status: Drain voltage 1
14	Analog Status: Drain voltage 2
15	Analog Status: Drain voltage 3
16	Analog Status: Drain voltage 4
17	Analog Status: Heat sink temperature 1
18	Analog Status: Heat sink temperature 2
19	Analog Status: Heat sink temperature 3
20	Analog Status: Heat sink temperature 4
21	Tx Enable (0 = No enable since last clear)
22-23	Alarm status bit mask (0 = ok, 1 = fail) latched (see below)
24 - 27	Time since last reset/power-on in seconds (4 bytes)
28	Fan status bit mask (see below)
29	No of PAs(*)

The 16 bit alarm status bit mask is defined:

Bit	Definition
15	Over temperature 4
14	Over temperature 3
13	Over temperature 2
12	Over temperature 1
11	Excess drain Voltage 4
10	Excess drain Voltage 3
9	Excess drain Voltage 2
8	Excess drain Voltage 1
7	Reserved
6	No RF output 4
5	No RF output 3
4	No RF output 2
3	No RF output 1
2	No RF drive in
1	External VSWR fault (vector)
0	Internal VSWR/return loss fault (scalar)

The 8-bit fan status bit mask is defined below. A set bit indicates that the fan is ok, while an unset bit indicates a failure.

Bit	Definition
7	PA fan 4
6	PA fan 3
5	PA fan 2
4	PA fan 1
3	Case fan 2
2	Case fan 1
1	Reserved
0	Reserved

Persistent shutdown select

GTC_PSDOWN	Class: 1	Member: 4	Data: 1	Timeout: 100 ms
GTC_PSDOWN	Class: 1	Member: 5	Data: 1	

Select the non-volatile state of the transmitter's persistent shutdown facility. The single data byte enables (1) persistent shutdown or disables (0) it. Persistent shutdown prevents the VHF power amplifier from transmitting even when all other transmission inhibitors are deasserted. This facility is designed to be

used is situations where a load has become permanently faulty and the associated PA should never be allowed to transmit.

The response byte to this command indicates success (0) or failure (1) in the execution of the command. The persistent shutdown status is stored in non-volatile memory and may therefore encounter write errors when changed.

Alarm over ride -----

```
GTC_ALARMVRT      Class: 1      Member: 6      Data: 0      Timeout: 100 ms
GTCR_ALARMVRT     Class: 1      Member: 7      Data: 0
```

This command overrides any alarm condition generated by the analog status comparator circuitry. Useful to disable alarms during VNA calibration run to avoid VSWR mismatch. "Clear alarm" should be executed to switch back the hardware alarms to standby.

Set alarm threshold -----

```
GTC_SETTHRESHOLD  Class: 1      Member: 8      Data: 4      Timeout: 100 ms
GTCR_SETTHRESHOLD Class: 1      Member: 9      Data: 1
```

This command sets the non-volatile threshold for Drain voltage, Temperature, VSWR external and VSWR internal/return loss.

VSWR external represents vector impedance measurement circuitry in GTC.

Return Loss represents scalar detection circuitry which protects PTM if its vector impedance detection circuitry is wired to external combiner.

For VSWR required threshold level can be calculated using following equation:

$$\text{threshold} = (s22+31)/0.3267$$

E.g.:

$$s22 = -10\text{dB} \rightarrow \text{Threshold} = 64 \rightarrow 0x40$$

Get alarm threshold -----

```
GTC_GETTHRESHOLD  Class: 1      Member: 10     Data: 0      Timeout: 100 ms
GTCR_GETTHRESHOLD Class: 1      Member: 11     Data: 4
```

This command gets the non-volatile threshold for Drain voltage, Temperature, VSWR external and VSWR internal/return loss.

VSWR external represents vector impedance measurement circuitry in GTC.

Return Loss represents scalar detection circuitry which protects PTM if its vector impedance detection circuitry is wired to external Combiner.

Soft enable -----

```
GTC_ENABLE        Class: 1      Member: 12     Data: 1      Timeout: 100 ms
GTCR_ENABLE       Class: 1      Member: 13     Data: 1
```

Enable or disable the power amplifier. This is a volatile setting and power amplifiers are enabled by default on power-on, after a soft "init", and out of reset. The persistent shutdown command should be used if a non-volatile shutdown is required. The data byte controls the enable status: a zero implies that the power amplifier is disabled, while a one implies that it is enabled.

The response to this command indicates success (0) or failure (1). If the persistent shutdown command has been issued to the power amplifier and the enable command is sent with a data byte with a non-zero value, then an error response is generated.

Clear Tx status

```
GTC_CLRTXSTAT   Class: 1   Member: 14   Data: 0   Timeout: 100 ms
GTCR_CLRTXSTAT  Class: 1   Member: 15   Data: 0
```

This command clears the internal volatile Tx status. It does not affect the non-volatile VNA calibration values. In addition, the analog status averaging buffer is cleared.

Clear alarms

```
GTC_CLRALARM    Class: 1   Member: 16   Data: 0   Timeout: 100 ms
GTCR_CLRALARM   Class: 1   Member: 17   Data: 0
```

This command clears any alarm condition generated by the analog status comparator circuitry. An alarm condition is immediately latched once it occurs and prevents further transmission by the power amplifier. Such condition can only be cleared by this command, an "init" command, a power cycle, or a hardware-generated reset. Also soft enables PAs.

Set VNA calibration constants

```
GTC_SETCAL     Class: 1   Member: 18   Data: 9   Timeout: 100 ms
GTCR_SETCAL    Class: 1   Member: 19   Data: 1
```

This command provides the VNA calibration constants to the power amplifier to be stored in non-volatile memory. These are the VNA calibration constants provided as part of the GTC_GETCAL command response. The 9 bytes are:

Byte	Description
0	Reflection, Low-impedance load, magnitude
1	Reflection, Low-impedance load, phase
2	Reflection, Mid-impedance load, magnitude
3	Reflection, Mid-impedance load, phase
4	Reflection, High-impedance load, magnitude
5	Reflection, High-impedance load, phase
6	Transmission, magnitude
7	Transmission, phase
8	Phase lead/lag bit mask

All magnitudes are 8-bit representations of V_f/V_r ratios which are expressed as linear-in-dB quantities. All phases are 180 degree scaled to 8 bits. Lead/lag information of all the phasors are stored in the 8th byte.

The phase lead/lag bit mask is defined below. A set bit indicates that the phase leads while an unset bit indicates that it lags.

Bit	Definition
7 - 4	Reserved
3	Transmission
2	Reflection High-impedance
1	Reflection Mid-impedance
0	Reflection Low-impedance

Configure averaging algorithm

```

GTC_SETAVG      Class: 1    Member: 20   Data: 2     Timeout: 100 ms
GTCR_SETAVG    Class: 1    Member: 21   Data: 1
  
```

This command specifies the number of data points and the type of averaging algorithm to be used when averaging the analog status obtained during live transmission. The first data byte specifies the algorithm type. Presently, this byte is ignored as the only algorithm employed is a running mean with unity weighting. The first data byte specifies the number of points to be included in the average. A value of zero or one indicates that no averaging should be performed. The maximum allowable number of data points in the average is implementation-specific. If this value is exceeded an error response is generated (non-zero data byte in command response). The second data byte specifies the algorithm type. Presently, this byte is ignored as the only algorithm employed is a running mean with unity weighting.

Note that configuring the averaging algorithm clears the current averaging buffer, as does a soft-init, hard reset, or power on.

Configure sense timing

```

GTC_SETSENSE   Class: 1    Member: 22   Data: 1     Timeout: 100 ms
GTCR_SETSENSE  Class: 1    Member: 23   Data: 0
  
```

This command specifies the delay (in microseconds) between the sense input rising edge and the ADC control timing edge.

Get VNA calibration constants

```

GTC_GETCAL     Class: 1    Member: 24   Data: 0     Timeout: 100 ms
GTCR_GETCAL    Class: 1    Member: 25   Data: 9
  
```

This command extracts the VNA calibration constants from the power amplifier as stored in non-volatile memory. These are the VNA calibration constants as defined in the GTC_SETCAL command above.

Set fan speed

```

GTC_FAN        Class: 1    Member: 26   Data: 5     Timeout: 100 ms
GTCR_FAN       Class: 1    Member: 27   Data: 1
  
```

This command configures the FAN control.

Byte	Description
0	Auto/Manual speed control (1:AUTO;0:MANUAL)

```
1      | Lower temperature threshold to start spinning FAN slowly (deg).
2      | Upper temperature threshold to turn flat on (deg).
3,4    | If manual, period and duty cycle scale for fan speed.
        | Default: Period scale $FF; duty cycle scale:0
```

```
Output Period = 8e06/(2*256*period_scale) Hz
Duty Cycle = (duty_cycle_scale/256)*100%
```

NOTE: Maximum duty cycle value is FE not FF due to unknown bug in HC12.

The response to this command indicates success (0) or failure (1).

LCD dump

```
GTC_LCDDUMP      Class: 1      Member: 28      Data: 3+      Timeout: 100 ms
GTCR_LCDDUMP     Class: 1      Member: 29      Data: 1
```

This command dumps graphic data to lcd. First two bytes are address pointer. First byte is upper byte. Third byte is number of data bytes following. Then data bytes.

The response to this command indicates success (0) or failure (1).

LCD get

```
GTC_LCDGET      Class: 1      Member: 30      Data: 3      Timeout: 100 ms
GTCR_LCDGET     Class: 1      Member: 31      Data: 0+
```

This command gets the data from lcd. First two byte is address pointer. First byte is upper byte. Third byte is number of data bytes following.

LCD table

```
GTC_LCDTABLE    Class: 1      Member: 32      Data: 180     Timeout: 100 ms
GTCR_LCDTABLE   Class: 1      Member: 33      Data: 1
```

This command writes default table to lcd which shows up in start up. The response to this command indicates success (0) or failure (1).

LCD mode

```
GTC_LCDMODE     Class: 1      Member: 34      Data: 1      Timeout: 100 ms
GTCR_LCDMODE    Class: 1      Member: 35      Data: 1
```

This command sets the LCD mode.

```
0: Text mode
1: Graphic mode
```

The response to this command indicates success (0) or failure (1).

Program EEPROM address

```
GTC_EEPROG     Class: 1      Member: 36      Data: 3      Timeout: 100 ms
```

Appendix A: PKT-1 Packet Format

GTCR_EEPROM Class: 1 Member: 37 Data: 1

This command, programs a byte in EEPROM or RAM at given address. First 2 bytes are 16 bit address and the third byte is value. First byte is MSB in address.

The response to this command indicates success (0) or failure (1).

Send multidrop alarm packet

GTC_ALARM Class: 1 Member: 38 Data: 0 Timeout: 100 ms

This command is generated when GTC encountered alarm condition. Data byte would have alarm code.

00	No alarm
01	Temperature1
02	Temperature2
03	Temperature3
04	Temperature4
05	Drain Voltage1
06	Drain Voltage2
07	Drain Voltage3
08	Drain Voltage4
09	VSWR internal
10	VSWR external
11	Drive fail

Configure interlock

GTC_INTERLOCK Class: 1 Member: 40 Data: 1 Timeout: 100 ms
GTCR_INTERLOCK Class: 1 Member: 41 Data: 1

This command sets if all the PAs should be disabled or not in the event of failure in one PA. PAs are interlocked if data is (1), else not locked.

The response to this command indicates success (0) or failure (1).

Read memory location

GTC_MEMORY_DUMP Class: 1 Member: 42 Data: 2 Timeout: 100 ms
GTCR_MEMORY_DUMP Class: 1 Member: 43 Data: 1

This command reads memory location of given address. The data is the address in memory to read (MSB first).

Upload VSWR lookup table

Implemented version 1.3 onwards

GTC_VSWRLOOKUP_TABLE Class: 1 Member: 44 Data: 92 Timeout: 100 ms
GTCR_VSWRLOOKUP_TABLE Class: 1 Member: 45 Data: 1

This command uploads 92 byte of VSWR lookup table to EEPROM.

Upload phase lookup table

Implemented version 1.3 onwards

GTC_PHASELOOKUP_TABLE Class: 1 Member: 46 Data: 4+ Timeout: 100 ms
GTCR_PHASELOOKUP_TABLE Class: 1 Member: 47 Data: 1

This command is used to upload 508 byte of phase lookup table in number of passes.

Byte	Description
0	Start index in table byte 0
1	Start index byte 1
2	No of data following
4...	Table data

Set servo phase delay

Implemented version 1.4 onwards

GTC_SETPHASE Class: 1 Member: 48 Data: 1 Timeout: 100 ms
GTCR_SETPHASE Class: 1 Member: 49 Data: 1

This command sets the phase servo phase steps for GTC hardware version GTC04A. Use this command during testing to make sure phase servo is working as expected. Data values should be between 0 to 15.

The response to this command indicates success (0) or failure (1).

Set output phase inversion

Implemented version 1.7 onwards

GTC_PHASEINV Class: 1 Member: 50 Data: 2 Timeout: 100 ms
GTCR_PHASEINV Class: 1 Member: 51 Data: 1

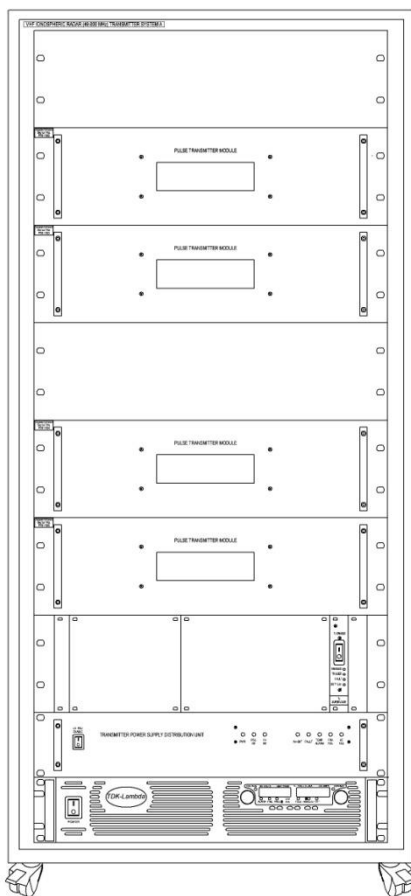
Configure the output phase of the PTM. The first data byte specifies whether to invert the output phase (1) or not (0). The second data byte indicates whether the change should be volatile-only (0), or for both volatile and non-volatile settings (1).

The data byte in the response to this command indicates success (0) or failure (1).

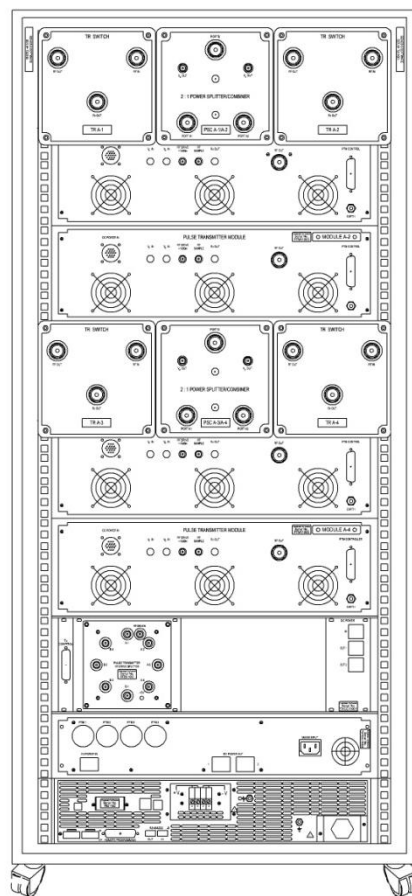
Appendix B: Transmitter System Examples

The PTS series pulse transmitter system is a module design with various options available. Most systems are configured to meet specific customer requirements and this means that the physical arrangement of the pulse transmitter system equipment will vary from system to system. This appendix provides some examples of transmitter system physical arrangements.

4 x PTM, 4 x TR Switch, 2 x High Power Splitter Combiner



Front View



Rear View

30 kW, 5% Maximum Duty Cycle, TR Switches and Power Splitter Combiners

The transmitter has four pulse transmitter modules (PTM's) each with a single 7.5 kW RF OUT port. There are four transmit receive switches (TR switches) and two 2:1 power splitter combiners (2:1 PSC's).

The transmitter may be configured in a number of different ways. For example:

- Each PTM may directly drive an antenna or antenna sub-group
- Each PTM may drive an antenna or antenna sub-group through an in-line transmit receive switch

In this arrangement returning signals from the antennas / antenna sub-groups are available on the receive port of each TR switch

- Pairs of PTM's may be combined by the 2:1 PSC's to provide two 15 kW ports. TR switches may also be used before the 2:1 PSC's to provide access returning signals on the antennas / antenna sub-groups